A 'Mature' Market

Cogeneration plants are finding their sweet spot at New York City homes for the aged.

BY DAVID ENGLE

If a single type of facility for small-scale combined heating, cooling, and power represents the ideal, it might as well be a convalescent or similar residential care center. And if any community in the land is ideally hospitable to distributed energy just now, it might be the boroughs of New York.

As it turns out, the region virtually runs the gamut of good indicators for project viability, and the following elements seem to be aligning with an uncanny harmony:

- A continuously favorable spark-spread (i.e., the difference between what it costs to buy power from the utility versus cogenerating it), especially at peak-rate times
- Several steady heat sinks in the form of demand for a lot of hot water, seasonal heating, and heat-fired cooling
- A mandatory need for power redundancy
- Multiple incentives programs
- Innovative technologies
- Plenty of vendors and contractors who possess the needed skills
- A public policy that is very supportive
- Good, inexpensive equipment that neatly matches the niche parameters

Better still: Even the classic local "nemesis" against onsite power—namely, interconnection tariffs and other barriers raised by utilities—are now occasionally working, contrary to type, and actually opening doors rather than slamming them shut. Call it a perfect storm or an ideal match; whatever is behind this booming market, for half a dozen years now, it has been enriching opportunity for regional cogen developers.

As one of them, Bob Panora of Tecogen LLC, accurately put it: "Right now it's almost like a feeding frenzy." Already, in the first half of 2008 alone, his firm installed three cogen plants for the Jewish Home and Hospital in the Bronx (NY). This was shortly after sending two to the Hebrew Home for the Aged, in Riverdale, NY. On Long Island, a plant for a nursing home was just getting underway, installed early in 2008. And these installations are just in the health-care sector.

One of two 400-ton gas-fired chiller and heating plants at the Jewish Home and Hospital replaces all-electric chillers. By eliminating peak power rates, comparative operating cost are expected to decline by over half.

Tecogen descended upon New York from its base in Waltham, MA, to take advantage of area opportunities, but local firms are doing well on their home turf as well. One—Energy Spectrum, of Brooklyn, NY—has been pursing the health care sector there for about four years now. David Ahrens, a project engineer at Spectrum, notes that New York's market, numbering more than 500 nursing homes, "has been expanding rapidly" thanks to "a good match of technology with this sector."

However, he adds, the nursing home industry's fragmentation means that he and other developers must sell their services to each locale individually, and, to maintain credibility, must continue to prove themselves with every project. Each success then serves as showcase model, boosting the health-care industry's cogen awareness and acceptance.

Sharing in the proceeds of this lucrative market, a close-knit network of cogen developers and contractors seems to keep the business referrals coming. Panora notes that, "A lot of the same guys are engineering these around the area, and they've had great success."

Among notable participants in the market are Energy Concepts, of Rochester, NY; Coast Intelligen Inc. (based in Vista, CA, with offices in Manhattan and Ronkonkoma, NY); Energy Solutions LLC of Fort Lee, NY; UTC Power and its Carrier division in Connecticut; and American DG of Waltham, among others. What's primarily driving the "frenzy" is, of course, economics. On both sides of the transaction, the dollars pencil-out nicely. On their part, cogen developers have discovered a certain repeatability that makes the projects come to fruition faster, along with similarities and consistencies among clientele, which tends to lower the risks of the unknown. All of these factors translate into nicely improved efficiencies in the installation work and job performance. Next Page >

On the other side of the equation, homes, retirement centers, and other such facilities often inhabit similar mix-commercial/residential neighborhood, making zoning and permitting routine. Sites also tend to share comparable loads for electricity and heat utilization, on a per-bed basis. Thus, the skills of engineers and technicians can be leveraged a bit more efficiently as they become adept in this specialized application. And lastly, notes Ahrens, "There are some rules of thumb that a certain piece of equipment might be just the right solution—so we can specify it with confidence."

Developers have indeed found a groove, particularly with preferred engines and cooling plants. Coast Intelligen, for one, often specifies a favorite microturbine. American DG and Tecogen—like Energy Spectrum—have settled on compact natural gas-powered reciprocating engines made by Cummins and GM, both of which have been adapted from their primary use in transportation fleets. After undergoing minor modification enabling them to power stationary plants, they are turning out to be ideal in terms of size, power density, scalability, ruggedness, maintainability, and reduced noise. They're also pre-qualified by the air-quality regulators, for compliant emissions. For purposes of heat capture, the engine blocks are equipped with built-in water jackets and recovery systems. Finally, the engine blocks' high production numbers for their primary duty in hundreds of buses greatly lowers unit costs at stationary sites.

Year-Round User Benefit

For the value-proposition afforded to cogen customers (a number of whom talked about their experiences for this story, but preferred not to have their names published), all this boils down to cogen plants emerging as a good fit for typical heat loads. Nursing homes need a lot of hot water or steam. Some use steam for heating; others pipe around hot water, which works out to be optimal. Either or both states will distribute cogen heat in winter, and the steam extends its utility in summer when it drives absorption chillers. This equates to steady utilization, "365 days a

CM-100 CHP plants prepared for delivery to the booming cogen market in New York City residential care facilities.

year, hour by hour," and it means, as one participant noted, "nothing is wasted."

As for the customers' electricity benefit, the modified transportation engines can be throttled up or down and variably rated to match loads ranging from about 65 kW to 120 kW. Thus, a single one of these extraordinarily high-value, low-cost power plants can provide cogen heating, cooling, and electricity for a residence of about 200–250 beds. That range happens to match a scale quite typical of many care centers.

Efficiencies like these can be further optimized, too, if the site manager is willing to be flexible regarding operational changes. For example, one nursing home laundry opted to shift its start-time from 8:00 a.m. to pre-dawn, in order to take better advantage of a night's worth of cogen hot water production. Still better would be the efficiencies in running 24-hours, adds Ahrens. Another strategy he often recommends is to enlarge hot water storage.

As a result of such intelligently applied measures, several of the recently cogen-equipped retirement homes of New York report being able to "retire" their boilers or hot water heaters and relegating them to rare backup roles. This situation has proven to be the case "most of the time," or at least for much of each year, according to Ahrens. The actual volume of heat output at a given site remains just as it was before the cogen plant installation—only, now the same fuel yields electricity and heat, in an energy market with relatively high per-kilowatt rates. This makes the combined heat and power (CHP) quite valuable.

To illustrate, here are results at five representative projects within the past four years, as monitored by a developer:
Park Garden Rehabilitation and Nursing Center (in the Bronx, near Westchester): A plant for peak shaving lops off 155 kW of the costliest power, saving approximately $135,000 annually.

- Regeis Care Center (Bronx): Another peak-load reduction project, along with chilled water/hot use cogen from natural-gas engine chillers, eliminate in excess of 450 kW in demand, worth $175,000 annually.
- Gold Crest Care Center (Bronx) replaced electric water heaters and reduced its peak electrical demand by more than 100 kW. Annual savings: about $70,000
- Fieldston Lodge Care Center (Bronx): A peak-shaving strategy eliminates about 155 kW, saving $111,000 yearly.
- Eastchester Rehabilitation and Health Care Center (Bronx): Peak demand was decreased by 140 kW, saving $110,000 each year.

In these and similar projects, payback time frames usually work out to around five years.

Inverters Trip Into "The Red Zones"

As noted above, Tecogen LLC also entered the market with a power plant based on GM bus engines. But the company's latest version—introduced early in 2008—is fitted with an inverter interconnection that significantly boosts its value and dramatically changes the user's relationship to the grid. For one early adopter of it, the Jewish Home and Hospital (JHH), the inverter technology arrived rather serendipitously, because it enabled a cogen plant to be built which otherwise probably would not have happened.

As Panora recounts the story, back in 2007 at the start of the hospital's quest for cogen, JHH had originally intended to install a several-hundred-kilowatt conventional synchronous generator—but then was keenly disappointed when the request for an interconnection permit, from utility Con Edison (Con Ed), of New York City, was flatly refused. The reason: JHH—along with about 70% of New York City—lies within an area that Con Ed calls a "red zone," signifying a power-constrained grid sector where, as the utility asserts, the addition of synchronous generators to the existing congestion poses an unacceptably high fault-current risk. Thus, essentially, synchronous generators are now banned in most of New York.

When JHH approached the utility for a permit, Con Ed snapped, "No way." But, through the grapevine, JHH's director of physical plant operations and maintenance, Gene Holland

Interior view

learned of Tecogen's emerging technology solution using inverters (the only one of its kind in the size range). Inverters, during a grid fault, seamlessly disconnect and thus eliminate any safety concerns. Con Ed gave its blessing.

Three Tecogen CM-100s now share one point of common coupling to the grid. They interact with each other in fully automated, algorithmically controlled microgrid, notes Holland. Genesys, a major regional cogeneration developer based in Rochester, handled engineering and installation.

When the grid fails and disconnection occurs, the microgrid works in island mode; JHH critical loads—its lighting and ventilation—continue unfazed. Unlike the situation of emergency diesel backups, which are normative for life-critical services, JHH should theoretically enjoy "100% of its services during an outage," says Panora. And of course, hot water keeps flowing in any case.

For Tecogen, this favorable "score" in the New York "red zone" also means that its customers can more readily get money from the New York State Energy Research and Development

Authority (NYSERDA)—and NYSERDA bucks often total in the tens of thousands per project. Under these particular contractual terms, money can be awarded only if a generator will keep running during a utility outage. Since Panora's CM-100 effectively provides the only way that a small generator can be affordably sited in the red-zoned 70% of New York, NYSERDA effectively drives the market to this product.

Panora believes most of his future adopters will be applying for, and probably getting, NYSERA grants. It should be noted, too, that Tecogen competitors who use induction generators, rather than synchronous, will not be as impacted by the "red zone" hurdle. However, such generators are probably at some competitive disadvantage in any case, because they require the grid for synchronization; during a grid power outage, they cannot continue operating.

Cogen Heating ... And Chilling?

Another innovation introduced locally by Tecogen, albeit some years ago, also effectively circumvents the "red-zone" ban and any similar interconnection hurdles; this is the company's unusual "heating and cooling cogen" chiller. Note that the word "power" is missing. Nevertheless, this plant, in purely economic terms, accomplishes the very same goal as CHP, by eliminating most of the electrical load of air conditioners. It is this load that eats up a huge share of any facility's summer operating budget, be it a hospital, nursing home, or other residential or commercial site.

Tecogen's regional sales manager Jeff Glick gives an historical perspective on the product's origins. "In the late 1980s, we had so much push-back from utilities [in the form of interconnection
barriers] when we were trying to make our cogen business go, that we developed a [gas] engine-driven chiller," he says.

This unit thus "achieves much of the same efficiency as a heat-and-power cogeneration machine, in that you take the big, giant electric motor off the chiller, and you replace it with a natural gas engine—and you make all your air conditioning with natural gas," adds Glick. "And, so you don't have an electric bill. You're also not subject to standby charges, and you're not subject to interconnection requirements."

The key here, of course, is that the gas-fired chiller eliminates the most expensive summertime peak electricity—conveniently, too, "when natural gas is at its cheapest," says Glick. "You offset the electricity, just as if you were running cogen."

In fact, gas-powered cogen achieves several times higher efficiency than electrically driven chillers. Operating costs shrink to a small fraction of those for a same-capacity electric unit.

Another benefit is that even though this kind of cogeneration yields no electric power, it qualifies for NYSERDA grants, because, as Panora explains, "you're burning natural gas to make chilled water and getting hot water as a byproduct."

Again, all of this is made possible because nursing homes and hospitals often need lots of summer chilling at the same time that hot water is needed.

Such a plant also faces no utility interconnection barriers or standby charges of any kind. This alone makes it even easier to sell and cost-justify than heat-and-power cogen. As Glick puts it, "The utility doesn't even have to know. You're under their radar."

Tecogen claims it has "sewn-up" the natural-gas-powered chiller market, having shipped more units than all other brands combined. In early 2008, the firm shipped two chiller-heaters to the Highfield Gardens Care Center, of Greatneck, NY; one to Flushing Manor Care Center, in Flushing, NY; and two of its largest 400-ton gas chillers to JHH (on top of the three 100-kW "red zone" generators noted previously). This was in addition to 15 of these unusual systems installed at five other New York

One of three 100-kW Tecogen heating-and-power cogen plants installed at the Jewish Home and Hospital in the Bronx, early in February 2008. This one is tucked into a small, unused alcove.

hospitals. In all sites, besides shouldering the air-conditioning load, all are cogenerating domestic hot water.

One of the latest chiller-heater customers, the 240-bed, six-story Regeis Care Center, sits in the Bronx, like many of these sites. Regeis' Ben Obstfeld, who was recently promoted as director of building services, recalls that, when the nursing home was built in the 1970s as a nearly all-electric facility, each of its rooms were equipped with individual heating-and-cooling systems. Electric bills kept mounting predictably higher every year—but no real viable alternative presented itself.

Eventually though, Regeis discovered this gaseous chiller-heater cogen, in 2004. Two 150-ton plants were installed; peak electric loads then dropped by over 450 kW. Resulting annual savings have been totaling over $175,000. NYSERDA also kicked in a nearly six-figure sum, as a reward for achieving much higher efficiencies, and for contributing to the permanent

reduction of electrical load for this transmission-constrained Bronx neighborhood.

After several years, the overall experience had proven to be such a positive one that, in 2008, Regeis commissioned two more cogen absorption chillers. These now provide year-round seasonal heating, alternating with summer cooling. Obstfeld hasn't yet tallied Regeis' first-year savings on this plant, but he's confident that "it is quite significant—being much more fuel-and-economy friendly."

And easier to run and maintain. The single chiller-heating plant resides in a former boiler room, feeding into a one-loop system, augmented by three Patterson Kelly boilers. Obstfeld observers that centralization "is much better and more convenient." The prior situation of having 200-plus individual room units meant doing "a lot of maintenance, which required calling around for an outside technician," he says.

Now having just the single plant, with fully optimized settings and contractually outsourced maintenance service, has saved money and greatly simplified life.

In the residents' rooms, instead of individually controlled compressors, comfort is maintained by coils and adjustable-speed fans blowing air across them. Hot water arrives in winter, and is chilled in the summer. For backup in case of a failure of the primary, a second chiller stands by. It comes on seamlessly; so far it's been needed just once, and "chiller number two kicked in automatically" as designed, says Obstfeld. In the rare event that both should fail at once, portable units are on contract to be delivered and tapped in, he notes. There's a sense of having some cushion, in the redundancy.

Similar good things have been reported at other cogen and chiller-heater plants. In Jamaica, NY, the 200-bed Margaret Tietz Center for Nursing and Rehability began with a 60-kW cogen plant for peak power shaving, in 2000. Mike Wilson of Energy Solutions, a local energy consultancy, selected the design. This was upgraded in 2006 with three 75-kW cogen plants, after a feasibility audit by Pathfinder Engineers LLP, of Rochester. Cogen-heated water now supplements boilers (which were fabricated onsite by Easco Boiler Corp. of the Bronx). Combined, the four units supply all domestic hot water and steam, space heating in winter, and low-pressure steam to operate a 200-ton Trane absorption chiller.

As for electricity, about 95% of the site's power is now self-generated. Director of engineering, Ben Messa thinks the resulting $113,000 average annual savings are "incredible," considering an initial total payout of much less than $1 million. A decade ago, the 387-bed Jamaica Hospital Medical Center in Queens experienced a heavy electrical load. A local energy firm, EBM Consulting Services, evaluated chilled water needs and advised switching to gas-fired cogen chiller-heaters. Two 400-ton gas-fired chiller and heating plants arrived, and the investment was recouped in less than 3 years, reports director of engineering, Hans Waldvogel.

And bottom-line, head-to-head comparison, as of 2006:

- Powering either a conventional electric chiller or electric absorption
- chiller was costing about $160,000 each.
- An all-gas chiller cost just $57,000.
- A chiller-heater cogen plant lowered the total expense to a mere $23,000—one-seventh the expense of either electric type.

And during grid outages, the gas keeps delivering cooling and heating, because gas-fired loads of course remain uninterrupted; the electronics for control are easily sustained by a small backup generator.

All in all, it is a hot market for heating and electricity-saving upgrades of any kind, and looking ahead, Ahrens thinks the good times should continue. Rumblings on how to control greenhouse gases, and the promise of future incentive programs, bode well. Whenever cap-and-trade or other major funding mechanisms finally do arrive, they will make cogen investments all the more lucrative, all around.

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