

District Heating & Cooling

Volume 76 Number 4

Second Quarter 1991



*Nassau County:
Trigeneration Saves
Money and Energy*

Featuring

DOE Awards Engineering and
Design Grants for Cooling

Iola Powerhouse: County
District Heating System
Optimizes Fuel-Use Strategies

University of North Carolina
at Chapel Hill: Community
Acceptance Key

International Energy Groups
Stress Efficient Energy
Resource Use as Key to
Environment

and more. . .

TRIGENERATION

BRINGS



**COST &
ENERGY
SAVINGS**

to NASSAU COUNTY

IN 1927, CHARLES LINDBERGH began his historic cross-Atlantic flight from Mitchel Field, situated 30 miles east of New York City in Nassau County, Long Island, New York. After many years as an Army air base, the property was turned over to Nassau County. It became the site for expansion of Hofstra University and later, the home of Nassau County Community College and other institutions.

During the mid 1960s, in keeping with the "guns and butter" ideals of American society, Nassau County set out to develop the remainder of Mitchel Field as a large, proposed government and recreational/cultural center. Like many large-tract developers, the County understood the logic of building a central utility plant to provide district heating and cooling (DHC) services to the entire development. They proceeded to build the Central Utility Plant (CUP) in 1971. The County had entered the district energy business.

The first customer for its high-temperature hot water and chilled water, the Nassau Veterans Memorial Coliseum (home to the New York Islanders National

Hockey League team), went on-line in 1972. A portion of the Community College was hooked up in 1978. In 1982, the newly built Marriott Hotel became the third customer. From the outset of operations in 1971, the CUP was staffed and operated on a 24-hour basis, 365 days per year by County employees and a contract labor force under the aegis of the Department of General Services.

**THE SENSIBILITY OF
EXPANDING THE DHC
SERVICES FOR MITCHEL FIELD
BECAME MORE APPARENT AS
RENEWED SPECULATION FOR
GROWTH FOCUSED ON
LARGER PARCELS FOR
DEVELOPMENT.**

The County operated the CUP through April 1987, providing all of the hot- and chilled- water service to its three customers. Other planned developments for Mitchel Field never materialized, thwarted

BY

**Thomas R. Casten, President,
and Claudette Greene
Trigen Energy Corporation**

**with special thanks for the generous assistance
of Thomas F. Darcy, Deputy Commissioner Nassau
County Department of General Services**

by escalating interest rates and environmental regulations. Although Nassau County experienced phenomenal population and economic growth through the 70s and 80s, the growth had no impact on the CUP. Operating and maintenance expense in excess of \$3 million per year were spread over fewer users than had been anticipated, resulting in excessively high costs.

In the early 1980s, cogeneration facilities and DHC systems were gaining technical recognition and acceptance throughout the nation. Nassau County began to re-evaluate its resources, seeking ways to conserve expenses including those related to energy costs. They saw the potential for adding cogeneration capacity. The sensibility of expanding the DHC services for Mitchel Field became more apparent as renewed speculation for growth focused on larger parcels for development.

The Search for Privatization

The Honorable Francis Purcell, who was County Executive at the time, directed his

colleagues to explore cost-reduction methods, including the feasibility of cogeneration and privatizing the CUP. While privatization has more recently gained popularity as a way for governments to reduce their costs and to focus their efforts on the essential services that only governments can provide, this was not the case in the early 1980s. Nassau County's vision represented a trail-blazing approach to privatization.

In March 1984, at the suggestion of Lizardos Engineering Associates, local consulting engineers, the County issued an open Request for Proposals (RFP) "to provide design, construction and financial services" for a prospective contractor to purchase or lease the CUP, replace it if appropriate, add any new equipment including cogeneration systems, and link to other County facilities. The RFP gave respondents maximum latitude to develop creative ways to reduce the County's energy expense burden.

For a creative, entrepreneurial enterprise like Trigen, the most appealing aspect of the RFP was that the County offered

ABOUT TRIGEN ENERGY CORPORATION AND PROJECT FINANCING

Trigen Energy Corporation was formed in 1986 to specialize in the development, design, financing, ownership and operation of cogeneration/district heating and cooling (DHC) systems. As part of its initial business organization, Trigen purchased certain assets of Cogeneration Development Corporation (CDC), including its development rights for DHC projects in Nassau County and other locations. The principals and shareholders of CDC are now the senior management and minority stockholders of Trigen. Majority ownership is held by two French companies.

One, Cofreth, S.A., is a leading European district heating developer and operator, currently operating approximately 70 district heating facilities in France. The other owner, Compagnie Parisienne de Chauffage Urbain (CPCU) is the operator of the 175-mile Paris district heating system, one of the world's largest district heating steam systems. A substantial percentage of the shares of both Cofreth and CPCU are held by Societe Lyonnaise des Eaux-Dumez, a French corporation with worldwide operations in cogeneration and district heating, water distribution, water and waste treatment among its interests. This Paris Stock Exchange firm had over \$16 billion in annual sales in 1990.

Since 1987, Trigen has operated the CUP under a Service Agreement with Nassau County, making minimal investment in plant and equipment. This was a logical interim operation to provide immediate savings to the County while allowing Trigen to become familiar, at a detailed operating level.

Project Financing

One of Trigen's corporate shareholders provided a \$45 million interim financing loan to Trigen so that construction could begin immediately and proceed concurrently with obtaining permanent financing. For permanent financing, Trigen Energy Corporation will provide up to \$19.5 million in equity. The Toronto-Dominion Bank has provided \$57 million in term financing; a letter of credit securing \$14.35 million of tax-exempt revenue bonds was issued through the Hempstead Industrial Development Agency. Lazard Freres, a New York investment firm, served as investment advisor and bond underwriter.

Continued on page 7

TRIGEN—THE POWER TO SAVE PUBLIC DOLLARS



TRIGEN is proud to announce the full commercial operation of our new \$85 million trigeneration* plant in Nassau County, NY.

- Generating 400 million kilowatt-hours of electricity per year for Long Island
- Generating 500 million pounds of steam per year to heat the Nassau County Veterans Memorial Coliseum, Community College, Medical Center, Jail Complex and the Marriott Hotel
- Generating 13 million ton-hours of chilled water per year to cool the same facilities we heat
- Saving 17 million gallons of oil (or its equivalent) per year

*Trigeneration—the sequential generation of electricity, heat, and chilled water



TRIGEN ENERGY CORPORATION
1 WATER STREET
WHITE PLAINS, NY 10601
(914) 948-9150

April 30, 1991

The Honorable Thomas S. Gulotta
County Executive
Nassau County
1 West Street
Mineola, NY 11501

Dear Mr. Gulotta:

It is our pleasure to announce that the privatization of your district energy plant is now complete. **Our 57 megawatt trigeneration facility went into commercial operation this month.**

In January of 1989, you agreed to lease two central power plants to us for 25 years, and accepted our plan for an \$85 million trigeneration project. **We are now ready to begin delivering the \$90,000,000 in savings over the 25-year life of the plant, as projected by your consultants, Ernst & Young.**

Thank you for allowing Trigen to be of service.

Thomas R. Casten
President
Trigen Energy Corporation



Your Partner for Responsible Community Development

no preconceptions of what bidders should propose. In simple terms, the RFP described the CUP; its thermal and cooling loads; the adjacent, available land; and the existence, two miles away, of a large medical center and prison complex using nearly 500,000 Mlbs. of steam per year. Prospects were invited to bid on the basis of serving one or the other, or both, or to connect them; to bid on cogeneration if that seemed feasible; or to bid on any other technological approach. It was clear that the successful proposal would offer the greatest overall savings to Nassau County.

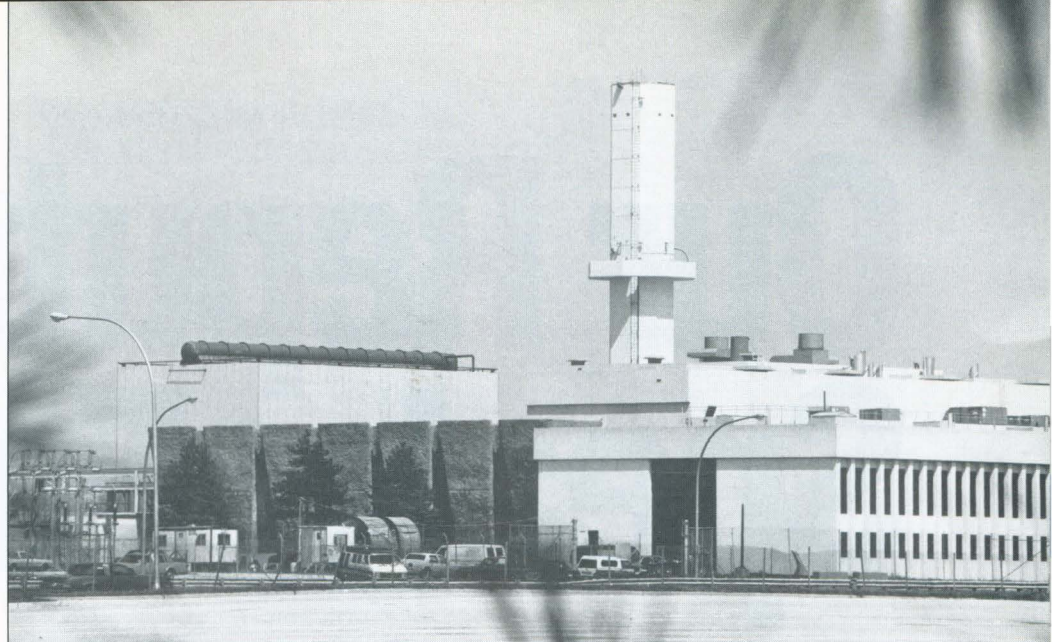
After the RFP was issued, over 80 people participated in a tour of the CUP and an initial briefing. Among the 25 to 30 companies present was the Cogeneration Development Corporation. Subsequently, seven vendors responded to the RFP in June 1984. The proposals were reviewed competitively on the basis of technical, environmental and cost criteria. In 1985, the County awarded the project to Nassau District Energy Corporation (NDEC), a wholly owned subsidiary of Cogeneration Development Corporation — later to become Trigen Energy Corporation.

Trigen's Proposal: Re-powering the CUP

The object of Trigen's proposal was to re-power the CUP with a new combined cycle cogeneration facility to reduce the County's energy costs while providing much needed electrical capacity to the Long Island Lighting Company (LILCO). In accordance with the RFP guidelines, the principle objectives in making this possible were outlined as follows:

1. Increased thermal sales to spread operations and maintenance costs.
2. Addition of cogenerated electrical power, providing usable "waste" heat.
3. Higher utilization of all equipment.

The first objective, increased thermal sales, was to be accomplished by adding thermal users to the system. (The first user



*The Nassau County Center Utility Plant.
Courtesy of Trigen-Nassau. Bob Klein.*

to be added was the Nassau County Medical Center and Prison Complex, representing a significant load with a high ratio of thermal load to peak load.) The second objective, cogeneration, was to be accomplished by installing a 57 megawatt gas turbine combined cycle system, which would generate electrical power and recover enough heat to supply over 90 percent of the thermal load. The third objective, higher equipment utilization, would come as a direct result of improved thermal sales and 'round-the-clock electric production and sales from the cogeneration facility.

Achieving \$1 Million of Early Savings

Under an interim operating agreement, operations by Trigen began in April 1987, allowing Trigen to become fully familiar with the facility. The intriguing question about interim operation of the CUP by Trigen is, "Where did the \$1 million savings come from?" The answers lie in the knowledge and experience that only specialists can provide.

It should be noted that Trigen employed the identical group of competent operators who had been running the plant for the County, and all savings were measured against the CUP's base history. The fol-

Continued on page 9

SAVINGS SUMMARY

Year	Fuel Savings (MMBtu)	Electricity Savings (MWh)	Water Savings (Mgal)
1987 ¹	25,900	1,595	34.5
1988	52,600	2,805	58.0
1989	27,700	2,298	37.5
1990	34,000	2,362	35.4
Total	140,200	9,060	165.4

¹ April to December

lowing summary of changes that were made illustrate how Trigen achieved the savings.

A. Conducted a complete energy and water balance on the plant to identify items inconsistent with experience in other plants.

B. Made changes to the boilers and hot water system:

1. Updated the boiler control system to use oxygen trim controls and other automatic combustion controls.
2. Lowered the steam pressure from 225 to 165 psig during periods when chillers were not in service, lowering stack temperature and waste.
3. Rescheduled equipment to allow units to operate based on external load, rather than always running the largest unit or running in numeric sequence.
4. Reduced the loss of water due to overflow from the de-aeration tank.
5. Improved water treatment to reduce wasted blow-down steam.
6. Installed new feed water pumps to optimize boiler feed water flow.
7. Stepped up the repair and maintenance program of all steam valves, traps and safeties.

C. Improved operations of the chilling system cooling tower:

1. Modified chiller piping to "free cool" with the cooling tower.
2. Optimized schedules for chilled-water distribution pumps, resulting in electricity savings.
3. Improved cooling tower controls to lower condenser water temperature and increase the efficiency of the chillers.
4. Installed a chilled-water expansion tank that allowed for more consistent delivery pressures on the chilled-water system. This also reduced the electric consumption of the air compressors and reduced the cycling of

Continued on page 11

CURRENTLY IN OPERATION SERVING NASSAU COUNTY, NY

EXISTING PLANT (CUP)

EQUIPMENT

3 Steam Boilers:

1 Murray (1970)	90,000 lbs/hr	Gas/Oil 275 psig
1 Murray (1972)	90,000 lbs/hr	Gas/Oil 275 psig
1 Trane (1976)	110,000 lbs/hr	Gas/Oil 275 psig

3 Centrifugal Chillers:

2 York Turbomaster	2,500 tons	Steam Turbine Driven
1 York Turbomaster	3,000 tons	Steam Turbine Driven

DISTRIBUTION SYSTEM

Hot Water Lines: Operating Temperature 265°F

Pipe Size: 10"	0.2 miles (0.3 km)
Pipe Size: 12"	0.4 miles (0.6 km)

Chilled-Water Lines:

Pipe Size: 20"	0.2 miles (0.3 km)
Pipe Size: 24"	0.4 miles (0.6 km)

SALES

Heating Sales:

Total Heating Customers	3
Total Annual Sales	165,000 MMBtu
Peak Heating Sales	85 MMBtu/hr

Cooling Sales:

Total Cooling Customers	3
Total Annual Sales	5,700,000 ton hours
Peak Cooling Sales	3,000 tons

Electricity Sales:

None

CURRENT STAFF

James A. Monk, Jr., President	
Management/Administrative	3 persons
Operations/Maintenance	15 persons

NEW COGENERATION PLANT

EQUIPMENT

1 General Electric Frame 6 Gas Turbine, Dual Fuel	40 MW
1 Condensing Steam Turbine, 250 psig extraction	<u>17 MW</u> 57 MW
1 Heat Recovery Boiler with Supplementary Firing	
H.P. Steam 324,000lb./hr. 1300 psig 955°F/I.P. Steam 26,000lb./hr. 310 psig 500°F	
1 Air Cooled Condenser	
1 Gas Compressor	
1 Demineralizer 2 x 250 gpm	

NEW DISTRIBUTION SYSTEM

Steam Pipe	Pipe Size: 12"	2.7 miles (4.25 km)
Condensate Return Line	Pipe Size: 6"	2.7 miles (4.25 km)

NEW SALES

Electricity:	415,000 MWh/year
Steam:	350,000 Mlb/year

these compressors. This results in improved performance and a reduction in the maintenance cost.

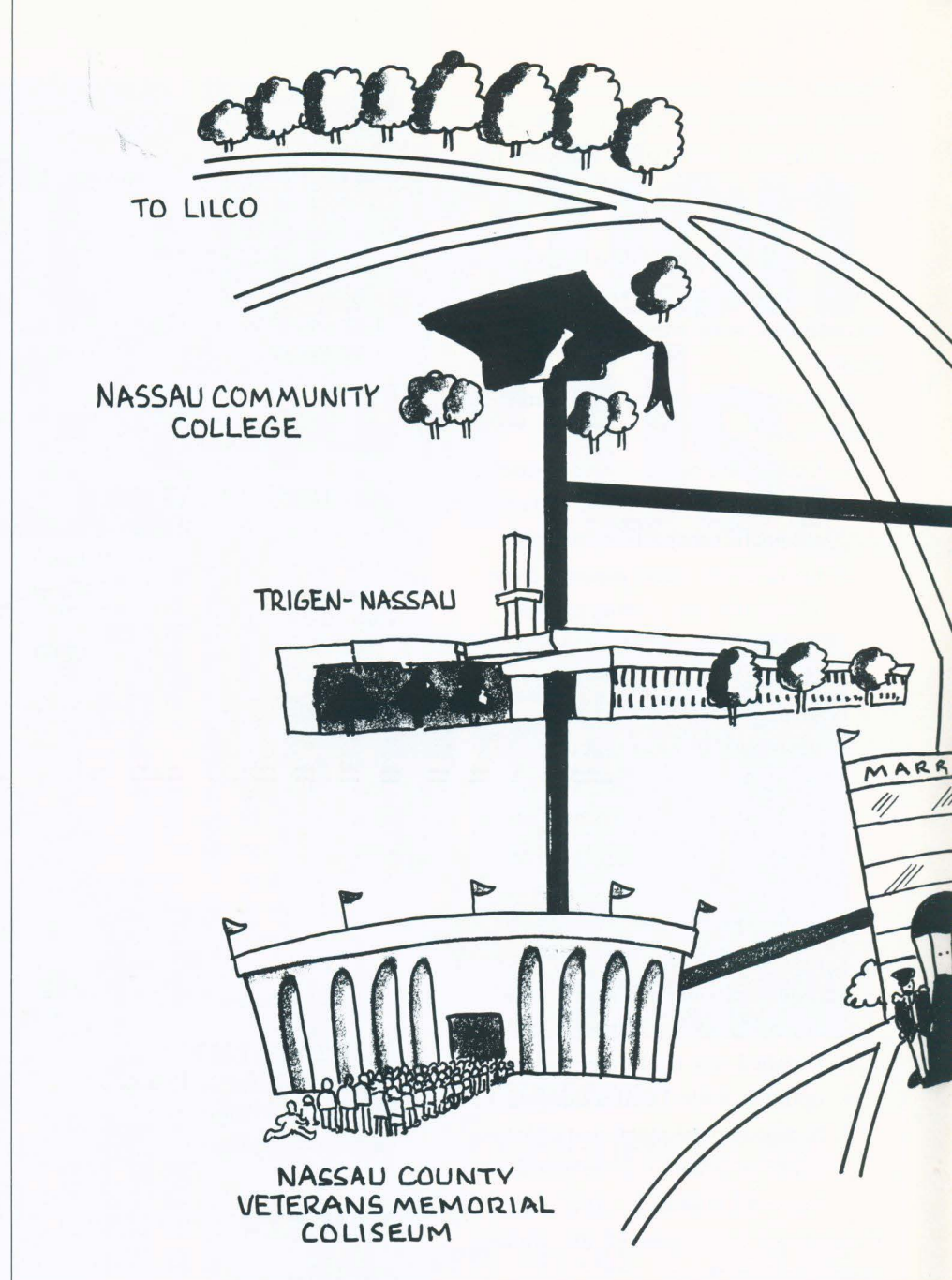
5. Changed the cooling tower operating procedure to match active cell volume and fan operation to load, resulting in additional electrical savings.
6. Converted from vacuum pumps to steam ejectors, to develop a vacuum in the surface condenser, lowering electric cost and utilizing steam that had previously been dumped as waste heat.

D. Modified general plant operating conditions:

1. Upgraded the lighting system to increase productivity of the maintenance staff, while lowering the electric consumption by using high efficiency devices.
2. Constructed a new control room enclosure for central monitoring. Adding air conditioning and reducing the noise levels resulted in improved employee productivity and compliance with OSHA standards.

**Development History
(or Running a Three-Year
Obstacle Course)**

Being a pioneer can be an exhilarating experience, but it generally involves a long journey. The development of Trigen's Nassau County project followed that pattern. For instance, New York State law required that an environmental impact statement be approved and accepted before Nassau County could enter a binding agreement: a one-year process. But what if new elections resulted in a change of County policy in the middle of the environmental study? This well-intentioned law puts developers at extreme political risk, as opposed to the usual, less draconian statute that allows counties or cities to enter into contracts that are subject to a final environmental permit. A softening of this draconian rule was provided by the



*The trigeneration system in Nassau County serves a variety of customers.
Courtesy of Trigen-Nassau. John Nordland.*

New York State Energy Research and Development Authority, which advanced \$200,000 of risk funds (at 25 percent interest) during the development phase.

In addition, LILCO, the local utility, was locked in a life or death struggle with New York Governor Mario Cuomo. LILCO faced bankruptcy unless they could open the Shoreham Nuclear Plant. Governor Cuomo was adamantly opposed to the plant opening. Needless to say, even though Federal law, specifically the Public Utili-

ties Regulatory Policy Act (PURPA) mandated that electric utilities would purchase power from cogenerators at fair rates, the power purchase contract negotiation with Trigen was hardly LILCO's priority. Predictably, they reviewed each step in Trigen's negotiations in light of its impact on the Shoreham outcome.

Corporation of Houston, Texas, and with Brooklyn Union Gas Company which is responsible for gas transportation, storage, and the supply and delivery of No. 2 fuel oil for gas backup.

The rest of the project details were seemingly endless, but everything finally came together in late 1989. On January 22, 1990, the Nassau County Board of Supervisors met under the leadership of County Executive Thomas Gulotta and voted to approve the final 25-year master energy agreement with Trigen. They also agreed to lease the district energy plant to Trigen for the same period.

Contractual Arrangements: Making It Work

Trigen has leased the CUP, including all of its equipment and pipelines, for a period of 25 years and will continue to operate it as part of the cogeneration plant. Shortly after the County's January 1990 acceptance of the 25-year master energy agreement, Trigen's contractor, Ebasco Constructors Inc., broke ground on the 57 megawatt, combined cycle cogeneration plant which now abuts the CUP. Joseph Jingoli & Sons were awarded the task of laying two miles of steam pipe, with condensate return, across the six-lane Meadowbrook Parkway and the Eisenhower Golf Course, making it possible for the steam extracted from the cogeneration plant to completely power the 815-bed Nassau County Medical Center and the Jail Complex — a 500,000 Mlb. annual load.

Thirteen months after breaking ground, Ebasco achieved commercial operation of the plant, meeting the standards of the New York State Power Pool. Pierre Remigereau, director of distribution for the Paris District Heating System (one of Trigen's shareholders) and an expert on steam pipe commissioning, came to Nassau County with a team of his colleagues during the last week of April 1991 and helped to commission the new, buried steam pipe.

Thermal service to the Medical Center was introduced and in early May, the cogeneration plant itself reached substantial completion and was turned over to Trigen.

\$90 Million in Benefits to Nassau County

Upon assuming operation of the CUP in 1987, and as part of the interim operating agreement, Trigen received a cost of services fee and was allowed to split, with the County, any savings it could produce versus the base case operation — all adjusted for weather variation and inflation. In the past three years, total savings exceeded \$1 million, half of which went to the County. However, this benefit to Nassau County is minor compared to the project now in service.

In the final stages of evaluation and approval of contracts for the new cogeneration plant, the County retained the firm of Ernst & Young to help them assess the value of the project to Nassau County. Ernst & Young's January 1990 report studied the base case, plus a number of other scenarios involving potential additional sales to new customers. Their conclusion underscored the enormous success of the privatization deal, described as follows:

The base case reveals that the County can expect a total benefit, in nominal dollars, of \$90 million or an average benefit of \$3.6 million per year. This benefit consists of cash and of thermal efficiency in the form of thermal rates which are lower than the trended historical cost to the County of producing the same thermal energy. An average of 62.6 percent of the total benefits are derived from thermal efficiency. The remaining benefit is derived from cash payments by Trigen to the County of rent and a payment in lieu of taxes.

Continued on page 14

LESSONS IN PRIVATIZATION

Nassau County's experience in pioneering the process of privatizing a government facility offers insights for other governments considering a similar course of action.

1. Understand the fundamental differences between a request for bids and a request for proposals (RFP). In a request for bids, an organization predetermines and specifies the scope and components of the project, and asks for prices. In a request for proposals addressing privatization, you are enlisting the creativity of specialist organizations. Offer maximum latitude for the specialists to respond to your opportunity.

2. Hire a qualified, unbiased industry expert to help assemble all of the data that respondents will want or need. Package that information clearly and cleanly. Invite all interested parties to tour the facility and receive the data package.

3. Ask for a preliminary, proposed approach (without economics) if you anticipate receiving many responses to your RFP. Then, narrow the list down to 3-4 firms to develop detailed proposals.

4. Offer \$25,000 (or some like amount) to each of the 2-3 losing respondents, particularly if the project is of significant size and complexity. Potential respondents may hold back because of the cost to prepare proposals, coupled with the uncertainty about whether the project will in fact be awarded. The cash incentive will significantly increase the quality of the proposals by signaling that you are serious with your request. It will also help development officers in private firms secure the resources they need to make their most creative proposal. This was not offered by Nassau County, but has been used elsewhere with good results.

5. Develop a time table and make sure that everyone at your end sticks to that schedule. Many of the best private firms shy away from government bids because the decision process often drags out forever. The more certain the schedule and the more timely your actions, the better the proposals.

WHAT'S NEW AND WHAT'S NOT

Trigen's Nassau project is state-of-the-art, but not novel. Many gas turbine combined cycle cogeneration plants have been built in the past 10 years to supply a heat load. Most of those projects were built to supply a single thermal host such as a chemical plant, oil refinery, food processor, etc. Urban buildings have seldom benefitted directly from large-scale cogeneration.

In the past seven years, there has been progress in using cogeneration to supply district heating and cooling. Trigen's Trenton project was the third facility to be qualified by the U.S. Federal Energy Regulatory Commission under PURPA. The project cogenerates 12 megawatts, with heat going to the Trenton heating and cooling loop. New cogeneration has also been installed to power district heating in Jamestown, New York, and St. Paul. In Hartford, Connecticut, Energy Networks Inc. now purchases recovered heat from a General Electric, Frame 6 gas turbine plant similar to the Nassau plant.

What is unique about the Nassau County project is the introduction of trigeneration to a government-owned district energy system and the privatization of its operation. The privatization component is key, for it is unlikely that many local governments, or non-profit entities like universities, can afford the \$85 million to build a cogeneration plant whose main output is sold to public utilities. Nevertheless, this big investment is the key to the huge savings in Nassau County. Even with an existing, government-owned district energy network, it would be inefficient for a governmental unit to continue to operate the network and backup boilers, then have a third party cogenerator build an electric plant and heat recovery boiler, and operate that. Two crews; no logic.

Logic prevailed in Nassau County. A single management and a single team of operators is responsible for the electric plant, the heat recovery boilers, the chillers, and the distribution system, saving duplicate labor.

Nassau County *Continued from page 12* Turning Challenges Into Cost Savings and Environmental Benefits

Long Island, like many areas that have undergone rapid population growth, faces a number of challenges. Among the most pressing of them is the long, unfortunate battle over the Shoreham Nuclear Plant which left LILCO severely weakened and short on generating capacity. Through 1988, '89 and '90, there were brown-outs during the hottest days of summer. LILCO had to ask some of its largest industrial customers to trim their electric usage. The utility's problems were complicated by the geographical isolation of Long Island and the relative scarcity of transmission lines from other generating stations.

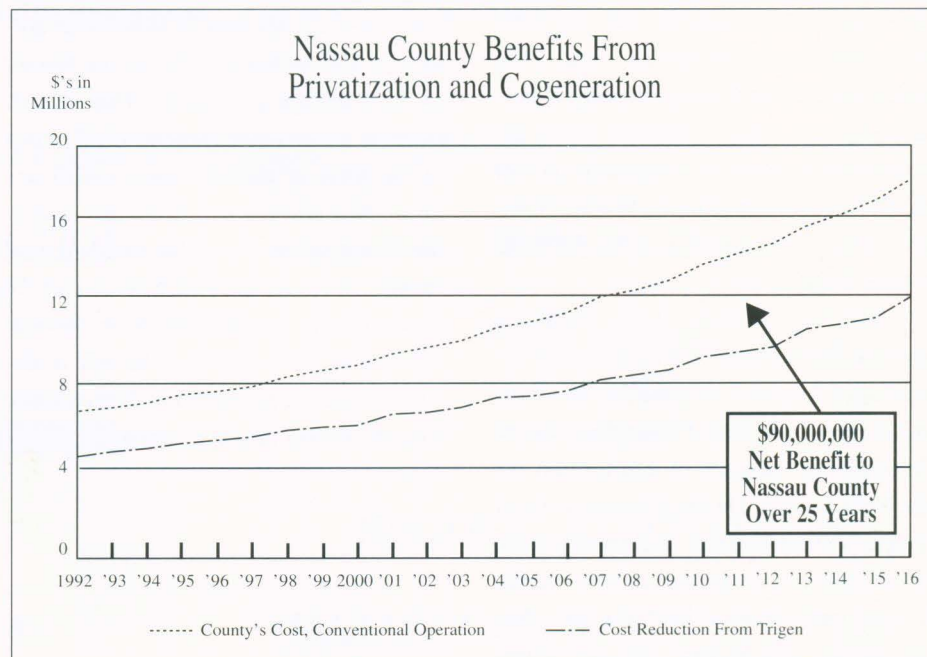
Trigen's new cogeneration plant now provides Long Island with 57 megawatts of added peak generating capacity, producing enough electricity for LILCO to meet the needs of 45,000 homeowners on Long Island. Further, a variety of analyses were run by the New York State Public Service Commission, projecting substantial savings to the electric consumers on Long Island.

Yet another problem facing Long Island is the shortage of potable water. The most severe environmental constraint that

Trigen faced was that the plant could not use any more water annually than had been consumed by the CUP alone. Think about it. How do you operate an existing plant, plus a new power plant for 45,000 homes, with no additional water consumption?

**BY TRIGENERATING,
THE PLANT WILL PRODUCE
USEFUL ENERGY WHILE
SAVING 17 MILLION
GALLONS OF OIL OR OIL
EQUIVALENT
ANNUALLY.**

Trigen met this goal by instituting numerous engineering changes focused on water conservation. Where combined cycle electric generating plants normally use large quantities of water for wet cooling towers to reject the heat from condensing steam, Trigen sends much of the steam to thermal users, effectively making them Trigen's "cooling tower." The remaining steam is cooled in dry cooling towers that use air instead of water. With this technology, the new, expanded plant is projected to actually consume *less* water than the



Nassau County Benefit from Privatization and Cogeneration

Since the new plant's main fuel is natural gas, which is virtually devoid of sulfur, the plant has minuscule SO₂ emissions. Steam injection will reduce NO_x production to .0065 percent of the exhaust gas flow, a number that can be even lower if water becomes available for more steam injection.

This plant proves that trigeneration is a prudent and responsible way for any community — no matter the size — to address global environmental and ecological concerns in a way that will contribute substantially to decreasing dependency on foreign energy resources, while increasing air quality, comfort, and municipal budget flexibility.



for their collaboration in preparing this article. FROM TRIGEN ENERGY CORPORATION: Eugene E. Murphy, vice president and general counsel, and Gary M. Fechter, director of operations. FROM TRIGEN-NASSAU DISTRICT ENERGY CORPORATION: James A. Monk, Jr., president; Richard Brody, director of operations; and Gisela Panico, administrative assistant.

*Providing innovative
reliable natural gas
services to Nassau
District Energy Corp.*

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- > Seasonal, monthly, daily take flexibility
- > Transportation management
- > Supply aggregation and pooling

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