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Presbyterian Homes – Evanston Campus

Midwest Regional Application Center
CHP for Buildings

Site Report MAC #2002-003

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1. Site Description

Figure 1: Presbyterian Homes - Evanston Campus

1.1. General

Presbyterian Homes is an independent, not-for-profit corporation providing quality residential communities, health care programs, and services for older adults from diverse social and economic backgrounds. This study was completed for the Presbyterian Homes' north Evanston campus located in Illinois.

The continuing care retirement community provides independent, assisted living, and nursing care facilities to approximately 600 elderly adults over the age of 65 in northern Evanston. In the winter of late 1998, a power outage resulting from an ice storm left the 600 Presbyterian Homes elderly residents without power for nearly nine hours on a cold, winter day. Due to this power outage and the added benefits of reduced cost of power, heating and cooling, the management at Presbyterian Homes made a decision to invest in a new state-of-the-art $2 million cogeneration system.

Energy reliability and reduced energy costs were the main drivers influencing the decision to purchase and install a cogeneration facility at the north Evanston campus of Presbyterian Homes. The system can now generate up to 2,400 kWe of its own electricity during the weekday hours when the local electric utility's peak rates are highest. Presbyterian Homes' new system was the first cogeneration plant at a retirement community on the North Shore of Chicago.

1.2. Site Location

Presbyterian Homes is located at 3200 Grant Street in north Evanston, Illinois - a northern suburb of Chicago and the home of Northwestern University. It is a 600 resident, 40-acre retirement community located in a residential community. The CHP (Cooling, Heating and Power) plant is located in the center of the Evanston campus and consists of two buildings, one housing the engine generators and controls and the second building containing the boilers, chillers, pumps, heat exchangers and remaining equipment.

1.3. Site Characteristics

The CHP Plant provides power, heating and cooling to the main buildings of the north Evanston campus. The campus consists of 12 main buildings located at the center of the campus with town homes and cottages on the surrounding grounds. The main buildings (including a Fitness Building, Service Center and other care facilities) totaling 600,000 square feet are all interconnected through basement tunnels. The CHP Plant helps supply electricity to:

- 12 Main Buildings
- 57 Townhouses
- 54 Cottages

The CHP Plant generates electricity, uploads it to the incoming local electric utility feeder, which then supplies electricity to the Presbyterian Homes and all of its buildings. The local electric utility, Commonwealth Edison (ComEd), supplies the remaining electric load to the campus via two separate feeders. The campus primary electric supply is metered by ComEd. The primary feeder comes from ComEd's electric facility in Skokie and the second feeder comes from Evanston.

Prior to cogeneration even being considered at the Presbyterian Homes, a second feeder was thought necessary for the retirement community for reliability. The second feeder from Evanston was brought in and installed on the campus supplying electricity as a secondary source in case the feeder from Skokie should fail. On the infamous winter day of 1998, both primary and secondary feeders from ComEd were knocked out.

2. Market Segment Evaluation

Health care facilities are generally good candidates for CHP applications because they have extended hours of operation, have critical heating, cooling and electric loads, operate during the entire year, and are usually heated and cooled by central district heating and cooling plants.

Another benefit of cogeneration is the ability to negotiate rates with the local gas utility to better control the costs involved. Major considerations in determining the feasibility and need for a CHP system are the energy cost savings and the need for added reliability of power.

3. Technical Description

3.1. Overview of CHP to Baseline/Original Installation

Prior to cogeneration, the campus utilized Commonwealth Edison to provide all of their electric power needs and Nicor Gas Company for their natural gas supply. Low-pressure steam was produced on-site with three boilers, and the Presbyterian Homes utilized one absorption chiller for lead cooling and three centrifugal chiller for supplemental cooling.

The CHP plant at Presbyterian Homes was decided upon quite suddenly when their residents suffered a power outage for nine hours during an ice storm in 1998. After approval by the board at the Presbyterian Homes, the Presbyterian Homes decided to install a 2.4 MWe CHP Plant that would generate electricity on-site and recover heat for building cooling and heating.

Figure 2: Caterpillar Engine Generator Set

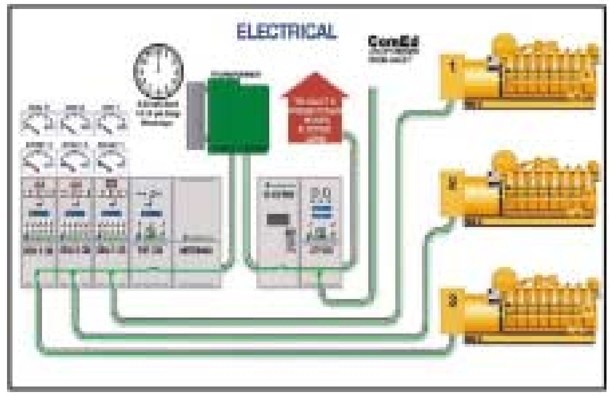

Figure 3: Operating PC Control Screen

3.2. CHP System Design

LaSalle Associates, Inc., an engineering firm and turnkey builder specializing in electric generation and cogeneration was contracted for the design and installation of the new CHP Plant. In order to minimize construction costs LaSalle was able to utilize one existing building and construct another one adjacent to it. Patten Power supplied the engine generators.

3.2.1. Electrical Parameters

3.2.1.1. Overview

The Presbyterian Homes CHP Plant operates weekdays from 9AM to 10PM. The majority of the time, the CHP plant generates enough electricity to meet the Presbyterian Homes demand with a capacity of 2.4 MWe. The electricity generated is sent to through ComEd feeders to the facility. At times when site demand exceeds generation, power is purchased from ComEd. ComEd supplies the Presbyterian Homes with two feeders from the towns of Skokie and Evanston with Skokie as the lead supplier of electricity. The Presbyterian Homes does not generate additional electricity for sale back to the utility.

3.2.1.2 Electrical Generation Prime Mover

Three (3) Caterpillar Model 3516 800 kWe natural gas fired reciprocating engine generator sets are installed at Presbyterian Homes.

Table 1: Fuel Consumption and Exhaust Rates of Engine Generator Sets

Generator Output	***Percent Load***	***Fuel Consumption***	***Jacket Water***	***Exhaust***
kWe	%	Btu/hr	Btu/hr	Btu/hr
810	*100*	*8,130,136*	*2,395,380*	*1,456,980*
608	*75*	*6,158,733*	*1,975,680*	*1,081,680*
405	*50*	*4,393,970*	*1,590,060*	*750,660*

3.2.1.1.1. Generator (Type/Size)

Each engine is rated at 1,200 rpm, 60Hz, 4,160 volts, and with low NOx emissions. The total generating capacity of the three engines at full load is 2,400 kWe.

3.2.1.1.2. Fuel Type

The Caterpillar reciprocating engine generator sets operate on low-pressure natural gas at 5 psi.

3.2.1.1.3. Waste Heat Profile

Waste heat is recovered from the jacket water and exhaust heat from the Caterpillar engines and converted to 12 psi steam for building cooling and heating needs. As shown in Table 1, at 100%, the fuel consumption is 8,130,136 Btu/hr and the output jacket water and exhaust heat is 2,395,380 Btu/hr and 1,456,980 Btu/hr. As the generators operate at lower level loads, the engines operate at a lower efficiency.

3.2.1.2. Backup/Standby Power

Two emergency generators supply backup power to the Presbyterian Homes. The first is located by the cogeneration building. It feeds the BED –1. This in turn feeds the following buildings: Kimble Health Care Center, Geneva Bldg Emergency Panel, and the Huss Building and Lower Level Electrical Room. It is tapped before the automatic transfer switch (ATS) in the main electrical switchgear room (in the boiler house) and feeds the manual switchboard, also located in the main electrical switchgear room. The second generator is located in the Foster Pavilion Building. It handles the power for the McGaw Healthcare Center, Critical Care and Life Safety panels.

3.2.1.3. Grid Supply

Each engine generates power at 4,160 volts and transforms up to meet the local utility's incoming line at 12,470 volts.

3.2.2. Fuel Supply Description

The fuel supplied to the Evanston campus of the Presbyterian Homes is primarily low-pressure natural gas at 5 psi. Prior to the installment of the engines the facility operated on 2.5 psi natural gas. All existing equipment on site operated within range of the upgraded 5 psi natural gas except for the boilers which were then modified to operate with the 5 psi natural gas.

3.2.3. Thermal Recovery Systems

3.2.3.1. Steam

A vaporizer located on each engine generator set brings in boiler feed water from an adjacent building. All three 14 foot vapor-phase heat recovery silencers convert jacket water and exhaust heat to 12 psi low-pressure steam. A single-cell Marley cooling tower provides cooling using another heat exchanger for the after-cooler water circuit and condensation of any excess steam produced by the engine generator sets. The heat recovery silencers are capable of recovering 8,000 lbs. of low-pressure steam.

3.2.3.2. Absorption Cooling (Type/Size/Manufacturer)

The low-pressure steam recovered from the engine generator sets is supplied to a 225 ton Li-Br steam absorption chiller. The absorption chiller is the lead cooling equipment of the Presbyterian Homes.

3.2.4. Non-Recovery Thermal Systems

The Presbyterian Homes utilize boilers to provide heat during the winter months. Cooling needs are supplied by the steam absorption chiller and three electrical centrifugal chillers with the absorption leading. As described above, heat recovered from the engine-generators is used to supplement low-pressure steam to these systems.

Table 2: Cooling Equipment of Presbyterian Homes

Type	*Size* (RT)	*Number of Chillers*	*Manufacturer*
Absorption Chiller	*225*	*1*	*Trane*
Centrifugal Chiller	*370*	*2*	*Trane*
Centrifugal Chiller	*500*	*1*	*York*

3.3. Original/Baseline System Configuration

Prior to cogeneration, the Presbyterian Homes purchased electricity from the local electric utility, ComEd, and produced low-pressure steam on-site via three boilers. An absorption chiller and three centrifugal chillers provided the cooling needs for the campus. The Baseline system that will be compared to the current CHP system will be referred to as the Baseline Plant. The cogeneration/CHP system will be referred to as the CHP Plant. The Baseline Plant will include the same equipment as the CHP Plant, excluding the engine-generator set and it's associated heat recovery equipment. Heating and cooling will be supplied via a central plant to the campus buildings in the same manner as the CHP Plant. Heat will be supplied via the boilers and cooling will be supplied via the absorption chiller (supplied by boiler steam)and centrifugal chillers.

4. Energy Analysis (Baseline verses CHP)

The analysis in this report will incorporate data from the months of June 2001 to May 2002. This time period will be referred to as the Case Study Year. In the analysis, the current CHP Plant's electric and natural gas operating expenses will be compared to the Baseline Plant's operating expenses. During the Case Study Year, the CHP Plant consumed a total of 1,182,920 therms of natural gas and used 10,093,396 kWh of electricity. The engine generator sets consumed 491,712 therms of natural gas to generate 4,409,333 kWh during the Case Study Year. The CHP Plant supplied 44% of the total electric load of the Presbyterian Homes. The Baseline Plant consumed 843,770 therms of natural gas, 28% less than the CHP Plant during the Case Study. The Baseline case electric load was equal to that of the CHP case. For analysis of the two Plants, the generators were assumed to operate during on-peak periods of 9AM to 10PM at an average output of 75% efficiency and use 55% of the energy of from the recovered exhaust heat and jacket water heat off the engines.

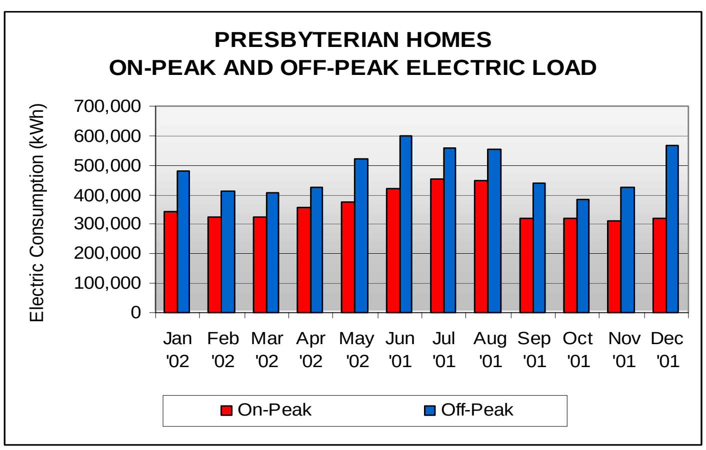

Figure 4: On-Peak versus Off-Peak Electric Load

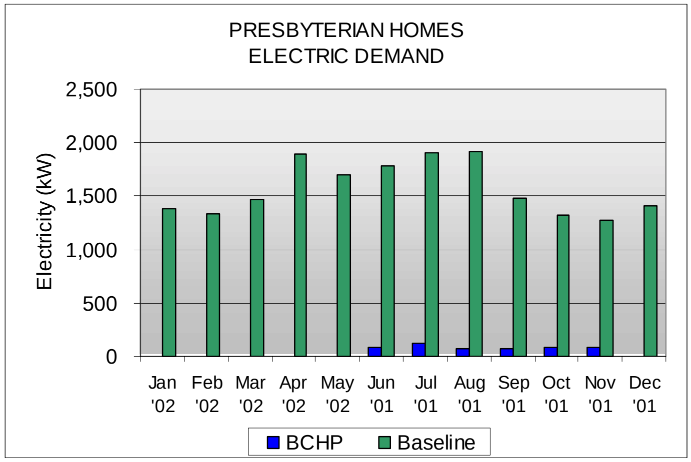

Figure 5: Electric Demand Profile

4.1. Electrical Parameters

The CHP Plant has a total electric generating capacity of 2,400 kWe. During the Case Study year, the generators supplied 4,409,333 kWh to the campus, consuming 491,712 therms of natural gas during this process. During the on-peak periods shown in Figure 6, the generators were able to cover nearly 98% of the Presbyterian Homes' electric load. (On-Peak Generation = 4,210,589 kWh, On-Peak Load = 4,316,391 kWh). The electricity generated significantly brought down the electric demand usage and charges from the local electric utility (Figure 5).

Table 3: CHP and Baseline Annual Electric Usage

	CHP Plant				Baseline Plant	
Month	**Peak Demand**	**Generated**	**Purchased from Utility**	**Delivered to Pres Homes**	**Peak Demand**	**Purchased from Utility**
	kW	*kWh*	*kWh*	*kWh*	*kW*	*kWh*
Jan '02	0	362,070	463,320	825,390	1,351	825,390
Feb '02	0	340,066	399,068	739,134	1,314	739,134
Mar '02	0	339,521	392,801	732,322	1,453	732,322
Apr '02	0	370,456	411,853	782,309	1,832	782,309
May '02	0	389,195	505,610	894,805	1,688	894,805
Jun '01	79	420,907	598,579	1,019,486	1,727	1,019,486
Jul '01	122	455,909	553,634	1,009,543	1,840	1,009,543
Aug '01	70	450,911	551,622	1,002,533	1,839	1,002,533
Sep '01	77	317,811	442,493	760,304	1,465	760,304
Oct '01	80	319,954	384,940	704,894	1,307	704,894
Nov '01	80	313,341	423,557	736,898	1,253	736,898
Dec '01	0	329,192	558,030	887,222	1,373	887,222
Totals		**4,409,333**	**5,685,507**	**10,094,840**	**18,443**	**10,094,840**

The Presbyterian Homes have been extremely efficient in providing all of their electricity during on-peak periods in 2002. The Presbyterian Homes incurred no demand charges during the months of January through May of 2002. This greatly improves the economics and annual savings by the facility that is further explained in Section 5. Electric consumption is normally greater in the summer due to the greater electric loads of cooling needed by the facilities. The trend can be seen in Figures 5 and 6. The electric demands and consumptions trend upward in January and December because of the extended hours during the off-peak periods. The generators are not operated on ComEd's off-peak periods increasing the facility electric loads.

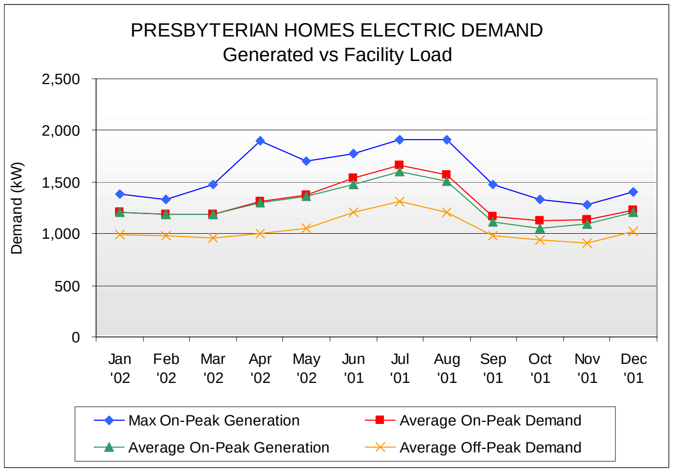

Figure 5: CHP Electric Demand – Generated vs Facility Load

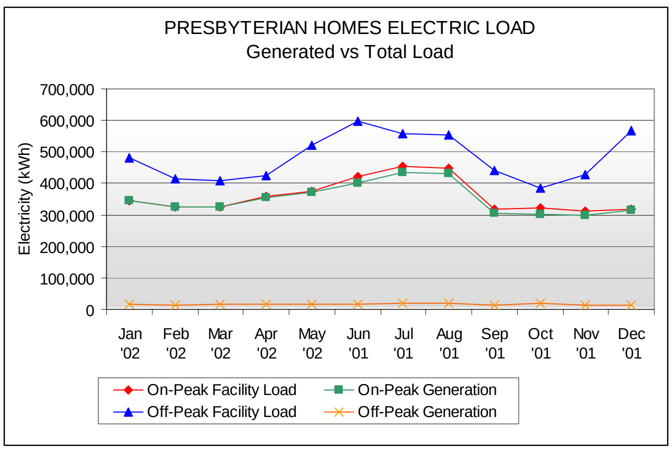

Figure 6: CHP Electric Load – Generated vs Total Load

4.2. Thermal Requirements

The Presbyterian Homes' average steam load varies between approximately 4,500 lbs/hr to 9,000 lbs/hr with an average load of approximately 6,000 lbs/hr. The CHP Plant supplies an average of approximately 5,000 lbs/hr. The Presbyterian Homes during the Case Study Year recovered a total of 122,043 therms (12,204 MMBtu) of recovered heat energy. This resulted in 61% system efficiency of usable energy for the engine generator sets with heat recovery. This was assuming 55% of the waste heat from the jacket water heat and exhaust heat was recoverable and usable. Without heat recovery the engines would have an efficiency of approximately 34%. The heat recovery credit shown in Table 4 would have been provided in the Baseline Plant by the steam boilers.

Table 4: Boiler and Generator Natural Gas Consumption and Heat Recovery Credit

Month	Boiler NG Consumption	Electricity Generated	Generator NG Consumption	Heat Recovery Credit
	therms	*kWh*	*therms*	*therms*
Jan '02	76,435	362,070	40,377	10,022
Feb '02	66,112	340,066	37,923	9,413
Mar '02	70,220	339,521	37,862	9,398
Apr '02	44,724	370,456	41,312	10,254
May '02	43,848	389,195	43,402	10,773
Jun '01	46,708	420,907	46,938	11,651
Jul '01	58,390	455,909	50,841	12,619
Aug '01	64,750	450,911	50,284	12,481
Sep '01	58,123	317,811	35,441	8,797
Oct '01	55,341	319,954	35,680	8,856
Nov '01	42,781	313,341	34,943	8,673
Dec '01	63,775	329,192	36,710	9,112
Totals	**691,208**	**4,409,333**	**491,702**	**122,043**

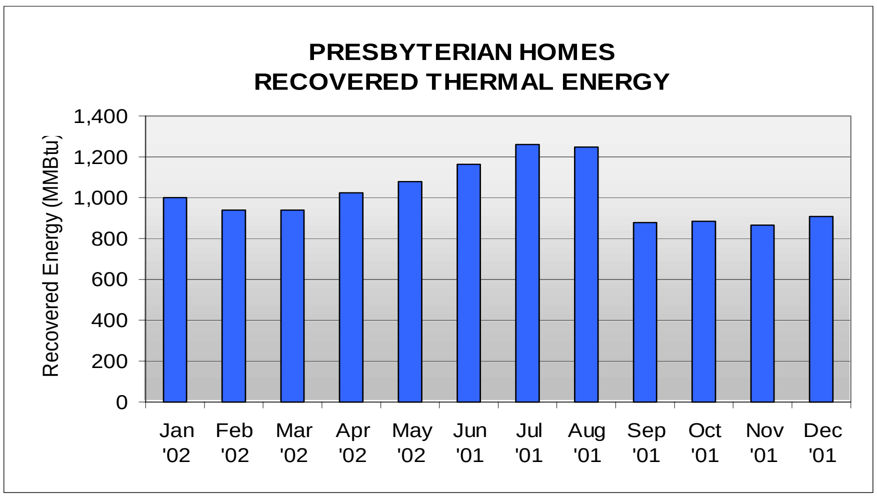

Figure 6: CHP Recoverable Thermal Energy

Figure 7: Heat Recovery Equipment

4.3. Fuel Usage

The Evanston campus of Presbyterian Homes imports natural gas at 5 psi from the Nicor Gas Company. The CHP Plant consumed 1,182,920 therms of natural gas while the Baseline Plant consumed only 843,770 therms (Figure 8). The CHP Plant consumed nearly 29% more fuel than the Baseline Plant, but economics later revealed in Section 6 show how insignificant the price of natural gas is when generating electricity. The generators consumed 691,208 therms, 58% of the total natural gas consumption of the CHP Plant.

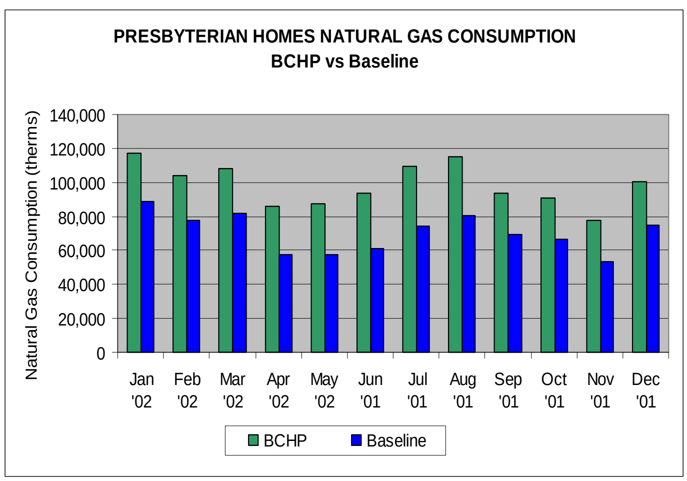

Figure 8: Natural Gas Consumption - CHP vs Baseline

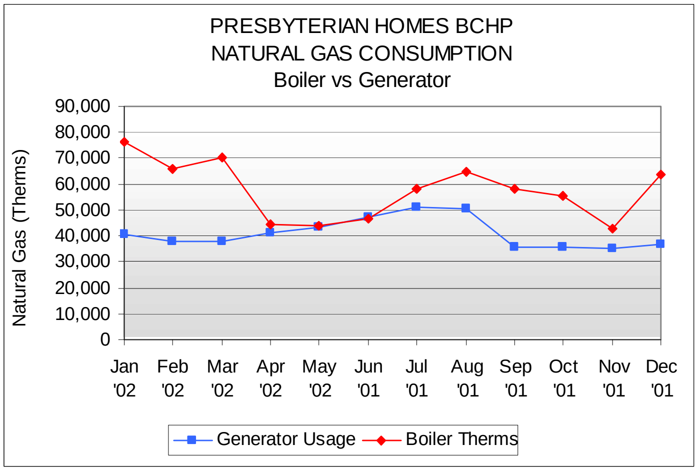

Figure 9: Natural Gas Consumption - Boiler vs Generator

5. Financial Analysis (Baseline verses CHP)

5.1. Assumptions

For analysis of the CHP Plant and Baseline Plant certain assumptions were made in order to complete the calculations. The CHP Plant purchased electricity from ComEd under Rate 6 (General Time-of-Service) and Rate 18 (Standby) shown in Table 5. The Baseline Plant electric charges were calculated under ComEd's Rate 6L, a large general time-of-use service charge. This charge is for all facilities incurring a 30 minute electric demand of 1,000 kWe or higher during the demand on-peak period between 9AM and 6PM. The Baseline Plant incorporated the tax rates applied from the CHP data. The price of natural gas was assumed to be 40¢ per therm. Due to the fluctuation in gas prices, a natural gas sensitivity analysis was performed with results displayed in Section 5.3.2.

Table 5: ComEd Electric Rates

Charge Type	Rate 6	Rate 6L	Rate 18
Summer Demand ($/kW)	$14.24	$12.85	Varies
Winter Demand ($/kW)	$11.13	$16.41	Varies
On-Peak ($/kWh)	0.05599	0.05022	0.05022
Off-Peak ($/kWh)	0.02341	0.02123	0.02123
Generator Capacity ($/kW)	NA	NA	$2.99

5.2. Project Cost

The total cost of the CHP Plant installation cost nearly $2 million.

5.2.1. Equipment

The steam absorption chiller was not part of the CHP Project installation and cost. The Presbyterian Homes operated the absorption chiller prior to cogeneration. The major equipment supplied during the installation of the CHP Plant is listed in Table 6.

Table 6: New Equipment installed during CHP Installation

Number of Units	Equipment
3	Caterpillar Model 3516 Lean Burn Engine Generator Sets
1	2-Cell Marley Cooling Tower
3	Vaporphase VP-4870 Packaged bare fire tube Jacket Water and Exhaust Waste Heat Recovery Silencers
2	Plate and Frame Heat Exchangers: One for After Cooling and One for Condensing Unused Steam
1	1,500 Gallon Cooling Tower Water Storage Tank with Dual Pumps
1	Allen-Bradley PLC and Rockwell Software for System Automation and Control

5.3. Annual Costs

The costs involved and compared in this section reflect the maintenance costs of the CHP Plant and the electric and natural gas costs supplied to the Presbyterian Homes.

5.3.1. Maintenance Costs

The maintenance costs of the CHP equipment at the Presbyterian Homes were assumed at 1.1¢ per kilowatt-hour generated by the engine generator sets. This is a standard number used in the industry for cogenerating equipment. The maintenance costs for the Case Study Year were $48,503 for generating 4,409,333 kWh (approximately $4,000 per month).

5.3.2. Operating Costs

5.3.2.1. Electrical Costs

Actual electric utility bills from ComEd were used to calculate the electric costs for the CHP Plant. The applicable rates and riders specified in the ComEd tariff book, “ComEd Tariffs”, in effect for the Presbyterian Homes are as follows:

- Rate 6, General Service – Time-of-Day, which defines monthly, demand and energy charges for a delivery with maximum demand established during on-peak period under 1,000 kWe;

- Rate 6L, Large General Service – Time-of-Day, which defines monthly, demand and energy charges for a delivery with maximum demand established during on-peak over 1,000 kWe;

- Rate 18, Stand By Service – This rate is applicable to any customer who has installed their own electric generating facility (or uses the output of a third party company) and/or uses ComEd’s electric service as a standby, reserve or auxiliary service;

5.3.2.2. Fuel Costs

The fuel costs for the Presbyterian Homes were calculated using the price of 40¢ per therm. The price of natural gas can vary from time to time affecting the operating costs of natural gas using equipment and their resulting savings. The gas price sensitivity was accounted for in comparing the overall savings between the CHP Plant and the Baseline Plant shown in Table 7.

Table 7: Natural Gas Sensitivity Accounted for in CHP Annual Operating Savings

Natural Gas Average Price *(¢/therm)*	**Annual Savings**		**Monthly Savings**
30	40%	$396,910	$33,076
35	36%	$379,953	$31,663
40	33%	$362,995	$30,250
45	31%	$346,038	$28,837
50	28%	$329,080	$27,423
55	26%	$312,123	$26,010
60	24%	$295,165	$24,597
70	20%	$261,250	$21,771
80	16%	$227,335	$18,945
90	13%	$193,420	$16,118

5.3.3. Total Costs

The total annual operating costs of the CHP Plant and the Baseline Plant during the Case Study Year were $723,094 and $1,086,090 with average monthly operating costs equaling $60,258 and $90,508 (Figure 10 and Table 9). This resulted in a savings of $362,995 for the year and an average monthly savings $30,250 (Table 9). The savings increased during the summer months due to the higher electric demand for cooling and all of the electricity being purchased from the utility by the Baseline Plant. This widening gap can be seen in Figure 10. Table 9 breaks down the charges and electric and natural gas consumptions for the CHP and Baseline Plants.

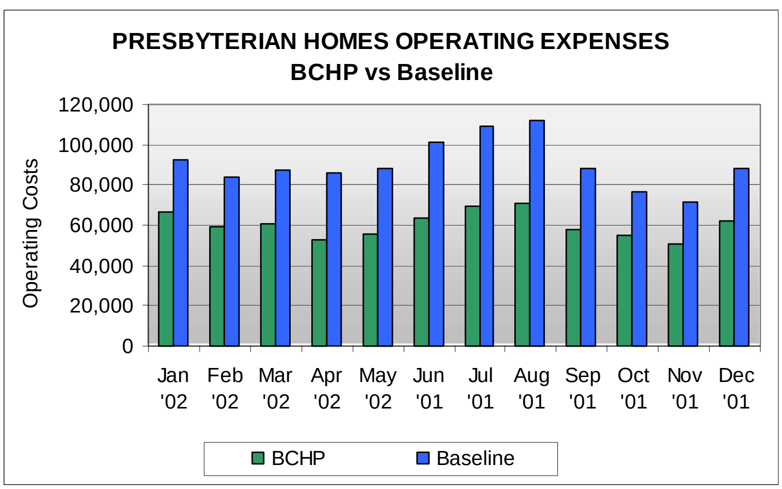

Figure 10: Operating Expenses - CHP Plant versus Baseline Plant

Table 8: Average Cost of Electricity for the Presbyterian Homes - CHP versus Baseline

AVERAGE COST OF ELECTRICITY (¢/kWh)			
	Yearly	Summer	Winter
Baseline	7.42	7.83	7.17
CHP	3.94	4.00	3.91

The average cost of electricity is shown in Table 8. The number is given at a rate of ¢ per kilowatt-hour used by the facility. The Baseline Case takes into account only the electric costs charged by the electric utility while the CHP Case factors in the additional cost of natural gas consumed by the engine generator sets. The on-peak average cost of electricity is greater in the summer than the winter due to the higher electric demand and the higher electric rates. The CHP Plant is generating average savings of 3.48 ¢/kWh annually.

Table 9: Presbyterian Homes CHP Annual Operating Savings

ANNUAL BCHP OPERATING SAVINGS						
	Utility and O&M Costs		**Annual Energy Consumption**			
Item	**Baseline**	**BCHP**	**Baseline**		**BCHP**	
Utility Electricity:	$748,582	$201,424	10,093,845 kWh		5,684,512	kWh
Generated Electricity:	---	---	---		4,409,333	kWh
			10,093,845	Total	10,093,845	kWh
Natural Gas						
Boilers	$337,508	$276,483	843,770 therms		691,208	therms
Engines	---	$196,685	---		491,712	therms
Total	$337,508	$473,168	843,770 therms		1,182,920	therms
Maintenance (1.1¢/kWh)		$48,503				
Total	$1,086,090	$723,094				
Annual Savings:		**$362,995**				

6. Financial Considerations

The Presbyterian Homes has been in operation nearly 1.5 years beginning on January 22, 2001. The facility has not experienced a 100% payback as of the date when this report was completed. The original payback estimated in the feasibility study was 5 years with the price of natural gas at 28¢/therm. The calculated payback from the Case Study Year can be seen below.

6.1. Payback Period

The calculated simple payback period of the CHP Plant installed at the Presbyterian Homes using data for the Case Study year June 2001 to May 2002 is 5.5 years. This included the initial cost of $2 million and the calculated annual savings of $362,995.

6.2. Internal Rate of Return

The projected Internal Rate of Return of the Presbyterian Homes CHP Plant is 17.58% over a 20 year life period for the equipment. The maintenance costs of $48,503 were broken down over the 20 year period including overhauls every 5 years.

7. Operability Analysis

Not only from a financial point of view, but also from an operational point of view, the CHP Plant is providing excellent service to the Presbyterian Homes. The staff of the Presbyterian Homes is very satisfied with their cogenerating equipment. No ice storms have caused a repeated outage at the

Presbyterian Homes, nor have they experienced any blackouts continuing the comfort and protection of the residents from the elements.

7.1. Efficiency

The efficiency of the CHP Plant operating at an average 75% load on the engines is near 61% with heat recovery. The efficiency of the engine generator sets without heat recovery is near 34%. The addition of heat recovery to engine generator sets is a significant factor in efficiency.

7.2. Reliability

The CHP Plant at the Presbyterian Homes since installation in January of 2000 has experienced no major down time nor has the system failed. The CHP Plant at the Presbyterian Homes provides greater reliability than when they purchased all of their electricity from the local electric utility.

8. Installation Analysis

8.1. Installation Requirements

The CHP installation plans and requirements included the following:

- New 35 foot by 50 foot building with a 10 inch thick concrete – slab floor to house the Caterpillar engines
- A depressed floor section, housing the heat recovery silencers, to allow for a lower overall building height (necessary to meet building codes)
- Indoor water storage tank for the cooling tower
- Adequate sound attenuation through wall and roof insulation
- FPE silencer for further noise reduction
- Aesthetically pleasing brick/limestone building materials to match the existing buildings
- “Clean hands” oil change system that utilizes large storage tanks piped directly to each engine
- Complete system automation utilizing Enercon Engineering paralleling switchgear
- Six rooftop ventilation fans, three for air supply and three for exhaust

8.2. Time to Install (Estimated/Actual)

The Presbyterian Homes’ cogeneration project was completed in approximately 10 months. This time frame included permitting, design and construction. The Presbyterian Homes selected LaSalle Associates in the fall of 1999 to be the turnkey design and builder. Ground breaking took place in April of 2000. Construction was completed in nearly 9 months. The system went into operation on January 22, 2001.

9. Environmental Considerations

The emission levels of the CHP Plant have reported significantly under the EPA (Environmental Protection Agency) requirements providing no problems. The emissions are nearly nonexistent.

10. Lessons Learned

10.1. Severe Power Outage

Presbyterian Homes made the decision to generate their own electricity using a cogeneration process following a severe winter storm. Although consideration may have been given to this project earlier, the Board of Directors decided that they needed the energy reliability afforded by cogeneration to prevent another incident such as the ice storm that hit in 1998. When a facility has critical loads such as a health care facility; power, heating and cooling can be necessary issues that need to be addressed for the security, safety and comfort of all residents.

10.2. Residential Issues

10.2.1 Noise Considerations

The north Evanston campus of Presbyterian Homes is located within a suburban community surrounded by residential homes. When Presbyterian Homes came to the city of Evanston with the proposed CHP Plant installation, issues were raised by the city regarding noise factors in the residential neighborhood.

The Board of Presbyterian Homes was required to conduct an acoustical study of the noise pollution taking ambient readings of noise that a cogeneration plant would make on the surrounding community. The community was well-impressed with the study. With positive results from the noise study, no objection from the city of Evanston occurred when the Board of Directors of Presbyterian Homes requested permission to go forward with the CHP project.

Specifically in residential areas, during the design phase of the project potential users of CHP technologies must consider the noise that a generator engine set makes so appropriate equipment or sound-absorbing materials can be incorporated. Local zoning and the relationship with the local community must be considered before committing to a specific CHP project. Presbyterian Homes was an example case with noise issues because of its location within a residential community and not in a business and/or industrial sector.

10.2.2. City Zoning Issues

The city of Evanston required Presbyterian Homes to provide drawings of what the CHP building would look like from the neighborhood when constructed. The CHP building was at least 150 feet from any outside residents, and the building was barely visible from the outside neighborhood because of the landscaping of the campus and their trees. The brickwork of the CHP building also coincided with the other buildings from Presbyterian Homes keeping the normal flow of the building structures. The floors housing the heat recovery silencers were depressed, lowering the overall height of the building to meet building codes. Again, most cogeneration applications are not installed in residential neighborhoods where neighborhood and building requirements are as strict.

10.3. Utilities

10.3.1. Local Utilities

Ongoing discussions with both electric and gas utilities can keep staff current on rate changes and incentives that may affect the economics of the operation. The support of the local utilities is often beneficial in the overall economics of the project.

10.3.2. Transformer

The issue of renting versus purchasing the transformers is a consideration when installing a CHP system. The Presbyterian Homes viewed the decision to be economical by purchasing the transformers from the local utility rather than incurring a high monthly rental charge from the local electric utility.

10.3.3. Natural Gas Price Sensitivity

The impact of gas prices is not quite as significant as may seem. Many cogeneration systems can still accumulate energy savings over baseline equipment when the gas prices go up. This can be seen in Table 7.

10.3.4. Natural Gas Upgrade

Prior to cogeneration at the Presbyterian Homes, the campus brought in natural gas at 2.5 pounds of pressure. The to-be-installed Caterpillar engines operated on natural gas at 5 pounds of pressure. Other existing operating equipment from the Presbyterian Homes was checked with pressure regulators and found to be within range operating at 5 pounds of pressure of natural gas except for the boilers. These were upgraded to operate on natural gas rated at 5 pounds of pressure.