



CHP Case Studies

Midwest CHP Application Center (MAC)

www.CHPCenterMW.org

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*University of Illinois at Chicago
Energy Resources Center*

CHP Case Studies

Elgin Community College



Presbyterian Homes



Elgin Community College

Northwest suburb of Chicago

- Main Campus 12 Buildings
- 672,235 sq ft
- Student Population - 25,000



Reasons to Install CHP

- **Energy Reliability**
- **Energy Savings**
- **On-Site Energy Control**

Cooling, Heating and Power Systems

4 Waukesha Engine Generators (Total 3.2 MW)

- Natural Gas
- 800 kW_e Each



Cooling, Heating and Power Systems

One York, Single Stage Absorption Chiller

- Steam Absorption
- 500 RT



Site Characteristics

CHP Coverage Area

- 11 Buildings
- 618,715 sq ft

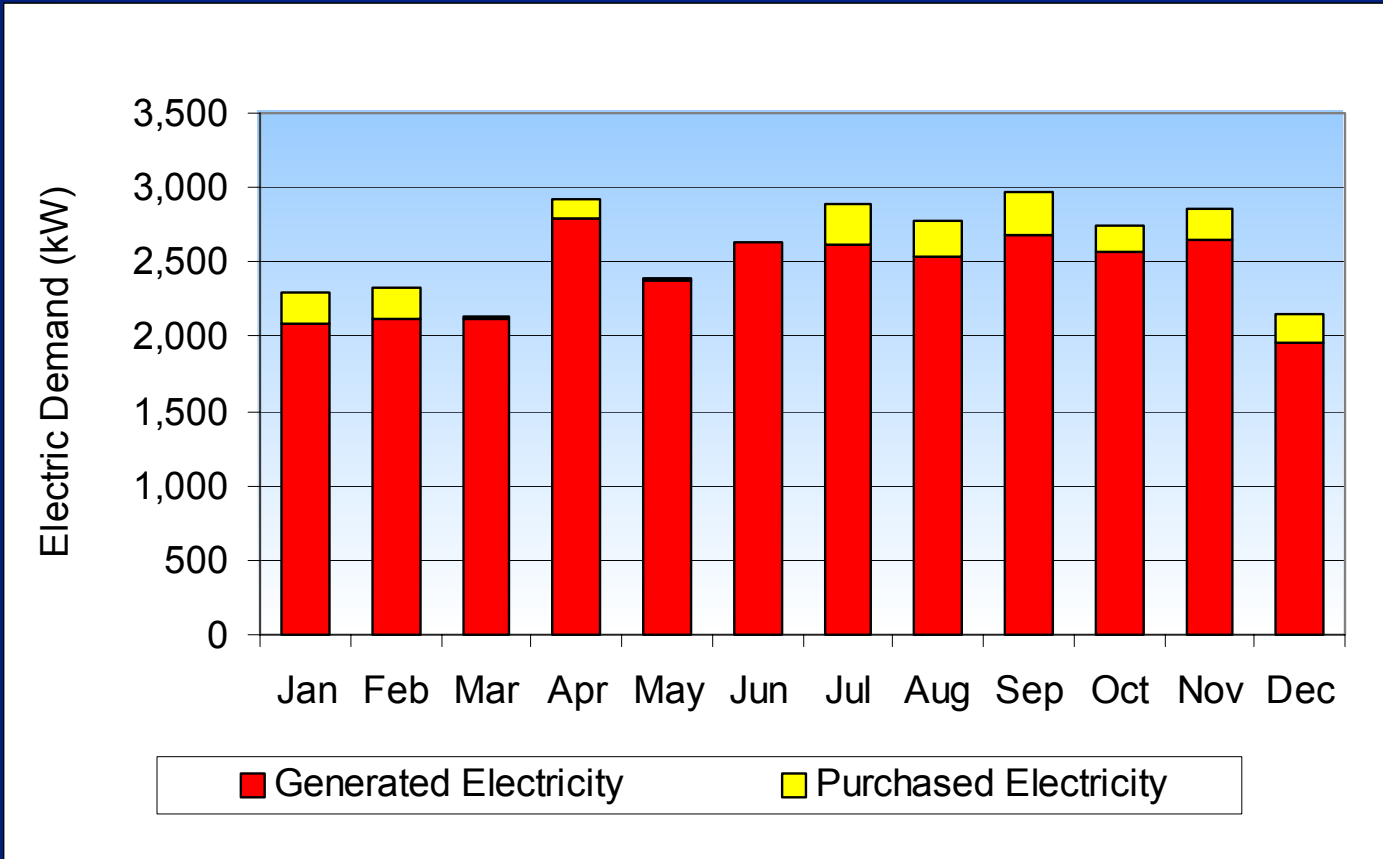
Electric Consumption

- Total Electric Usage: 13,678,806 kWh
- Purchased On-Peak: 436,438 kWh
- Generated On-Peak: 6,397,851 kWh

Natural Gas Consumption

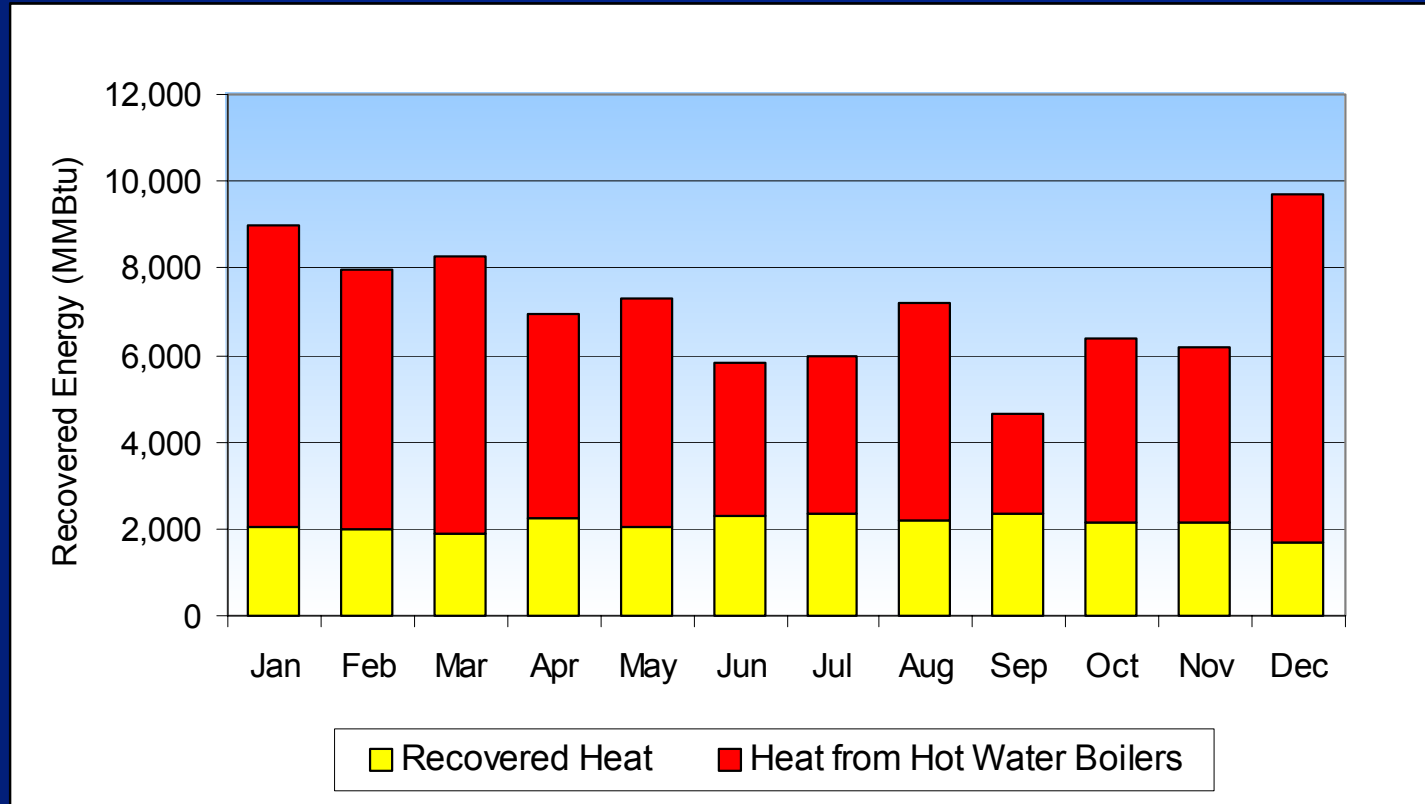
- Baseline: 1,066,824 therms
- CHP: 1,460,646 therms

Electric Demand Profile



Case Study Year July 2001 – May 2002

Annual Thermal Energy Profile



Case Study Year July 2001 – May 2002

Waste Heat Recovery

Recovered Energy of CHP System @ Full Load

- Power Output: 3.2 MW
- Fuel Consumption: 32.9 MMBtu/hr
- Jacket Water Heat Recovered: 7.1 MMBtu/hr
- Exhaust Heat Recovered: 4.2 MMBtu/hr
- Steam Production: 11,340 lb/hr

Financial Statistics

3.2 MW CHP Plant *(Operational in 1996)*

- **Total Cost:** \$2.5M
- **Original Goal:** Payback in 6.5 years
- **Actual Performance:** Payback in 5.7 years
- **Operating Savings:** Approximately \$440K/yr

Financial Statistics

Average Cost of Electricity (¢/kWh)

	Annual	Summer	Winter
Baseline	7.22	7.81	6.91
On-Peak	12.09	13.05	11.61
CHP	5.19	5.10	5.24
Total On-Peak	7.45	7.16	7.59

(Total On-Peak includes CHP & Utility Costs)

On Peak Electric Savings 4.64 ¢/kWh



Gas Price Sensitivity

Natural Gas Average Price [¢/therm]	Annual Savings	
30	40%	\$527,154
35	37%	\$507,488
40	34%	\$487,797
45	32%	\$468,106
50	29%	\$448,414
52	28%	\$440,023
55	27%	\$428,723
60	25%	\$409,032

CHP Emissions

Pollutant	Tons/Year
NO _x	2.0
SO _x	0.012
CO ₂	0.0
CO	1.68
Misc.	0.414
Total	4.106

Additional Notes

- **Required to be a FEMA Shelter in Times of Emergency**
- **Funding by ICCB, Credits from Previous Projects, and Incorporated into Campus Addition Brought Actual Total CHP Cost Down to \$1.5 M**
- **Elgin Community College Plans to Add to Current CHP System Next Year**
 - **800 kW Waukesha Engine**
 - **800-ton York Absorption Chiller**

Presbyterian Homes

Evanston campus - northern suburb of Chicago

- 12 Main Buildings (600,000 sq. ft.)
- 57 Townhouses
- 54 Cottages



Reasons for CHP

- **Ice Storm in 1998 Knocked Out Both Electric Feeds Leaving Over 600 Elderly Residents Without Power for Nearly 9 Hours**
- **Reliability**
- **Reduced Cost of Power, Heating and Cooling**

Cooling, Heating and Power Systems

3 Caterpillar Engine Generator Sets (Total 2.4 MW)

- Natural Gas
- 800 kW_e Each



Cooling, Heating and Power Systems

One York, Single Stage Absorption Chiller

- Steam Absorption
- 225 RT



Site Characteristics

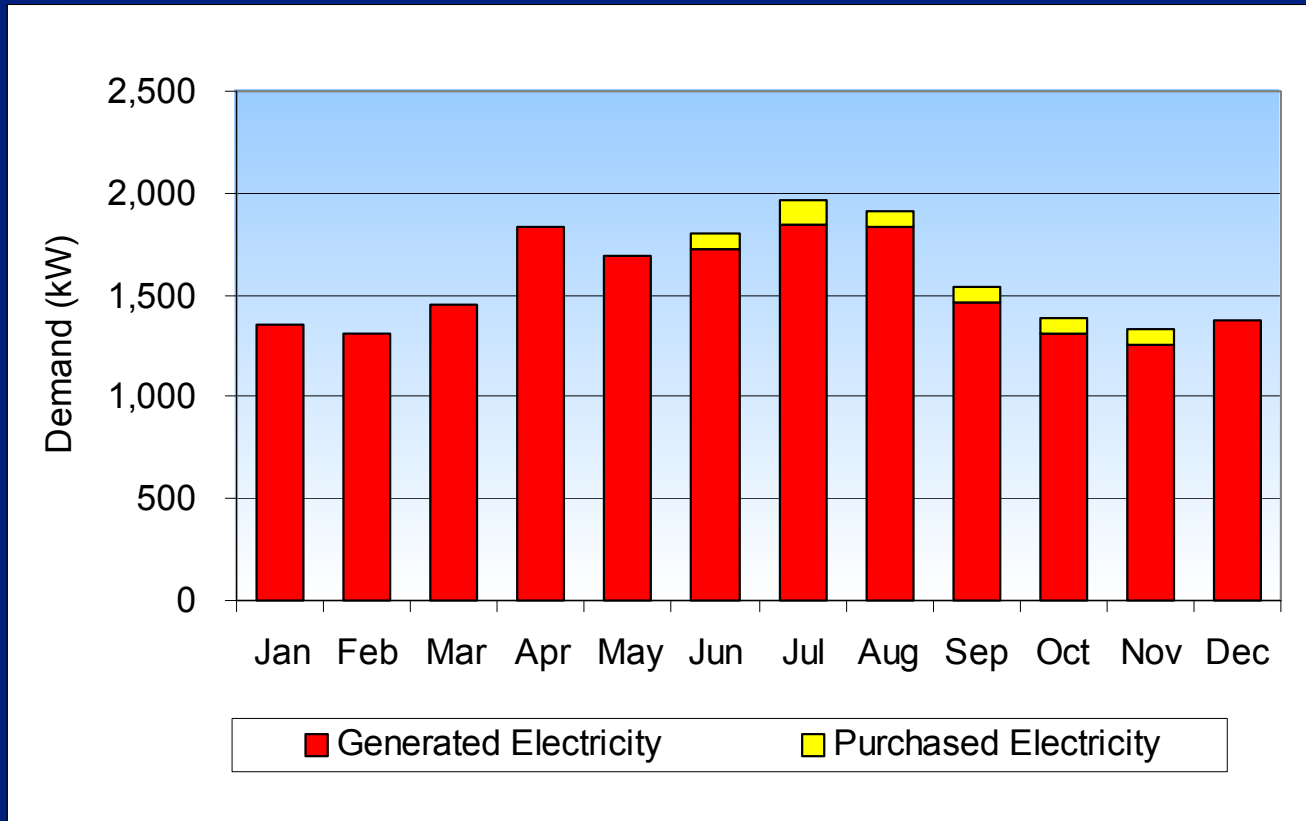
Electric Consumption

- Total Electric Usage: 10,093,845 kWh
- Purchased On-Peak: 107,802 kWh
- Generated On-Peak: 4,210,589 kWh

Natural Gas Consumption

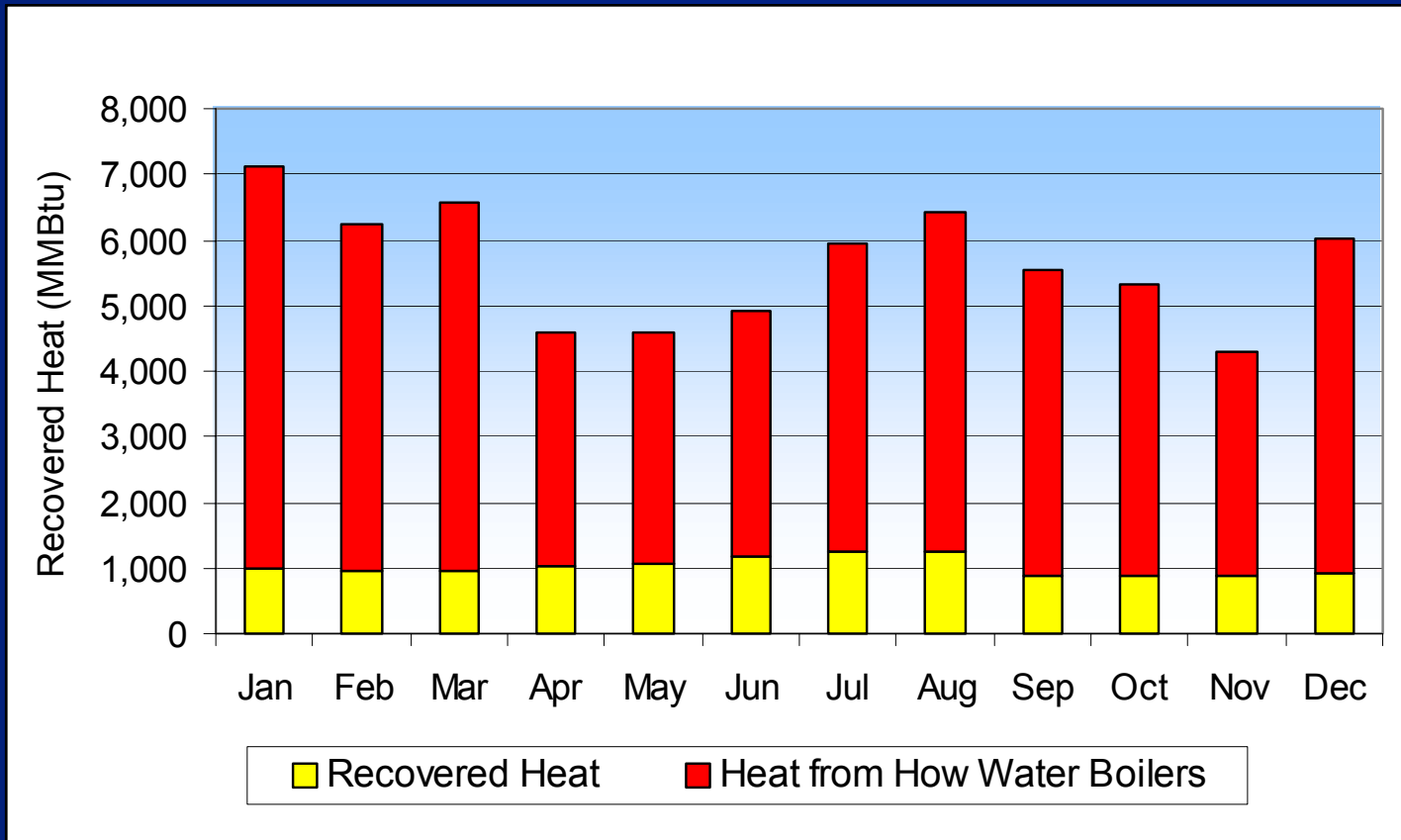
- Baseline: 843,770 therms
- CHP: 1,182,920 therms

Electric Demand Profile



Case Study Year of July 2001 – May 2002

Annual Thermal Energy Profile



Case Study Year of July 2001 – May 2002

Waste Heat Recovery

Recovered Energy of CHP System @ Full Load

- Power Output: 2.4 MW
- Fuel Consumption: 24.4 MMBtu/hr
- Jacket Water Heat Recovered: 4.0 MMBtu/hr
- Exhaust Heat Recovered: 2.4 MMBtu/hr
- Steam Production: 8,000 lb/hr

Financial Statistics

2.4 MW CHP Plant *(Operational January 2001)*

- **Total Cost:** \$2.0M
- **Original Goal:** Payback in 5+ years
- **Calculated Performance:** Payback in 5.5 years
- **Operating Savings:** Approximately \$363K/yr
- **Internal Rate of Return:** 17.5%

Financial Statistics

Average Cost of Electricity (¢/kWh)

	Annual	Summer	Winter
Baseline	7.42	7.83	7.17
On-Peak	13.64	14.57	13.17
CHP	4.42	4.48	4.39
Total On-Peak	6.42	6.58	6.32

(Total On-Peak includes CHP and Utility Costs)

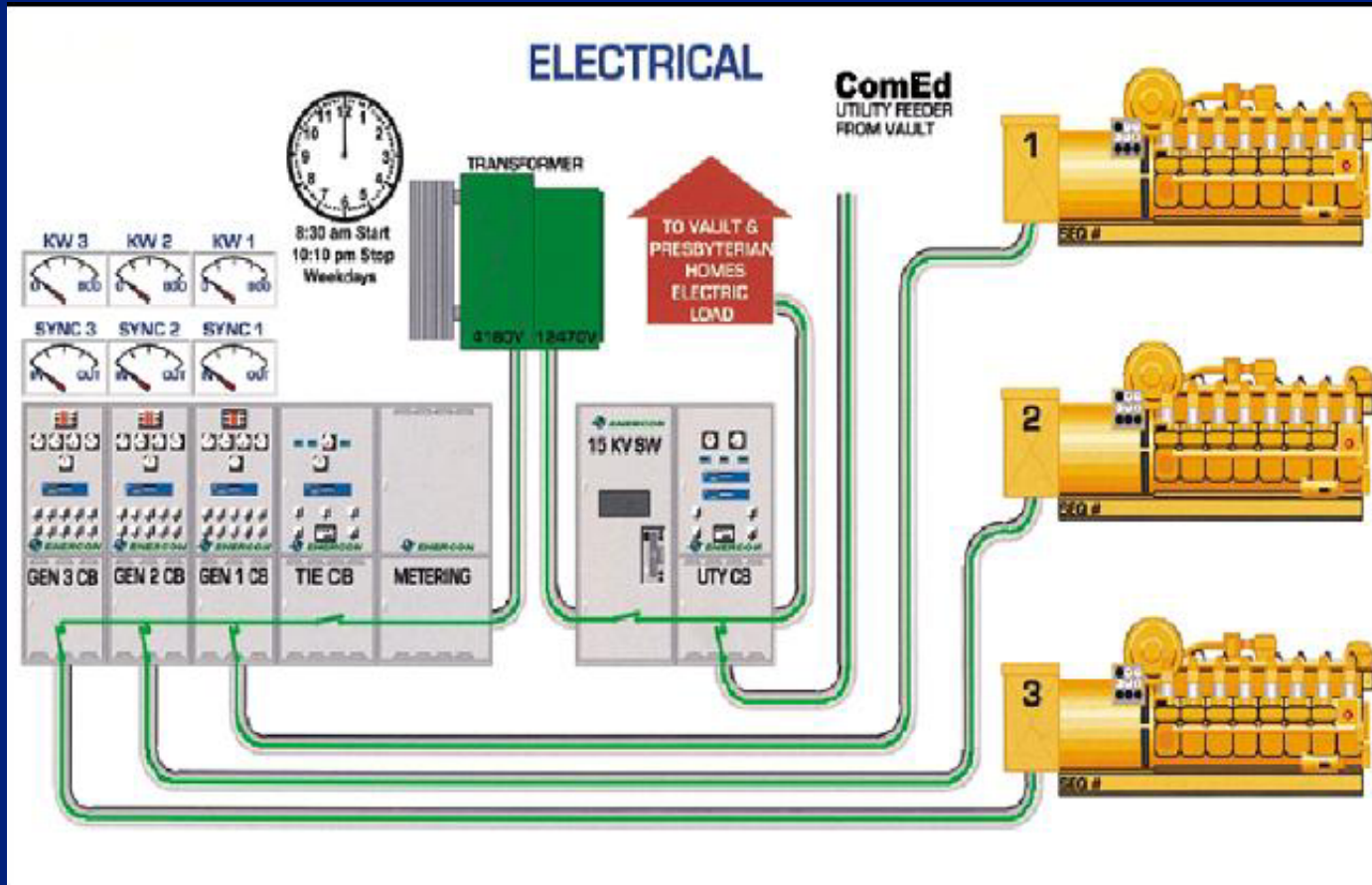
On-Peak Electric Savings 7.22 ¢/kWh



Gas Price Sensitivity

Natural Gas Average Price [¢/therm]	Annual Savings	
30	40%	\$396,910
35	36%	\$379,953
40	33%	\$362,995
45	31%	\$346,038
50	28%	\$329,080
55	26%	\$312,123
60	24%	\$295,165
70	20%	\$261,250

On-Site Monitoring



On-Site Computer Screen

CHP Emissions

➤ No Emission Issues

Additional Notes

- **Satisfied with CHP System Performance**
- **Due to Residential Location**
 - **Noise Considerations**
 - **Passed Acoustic Study**
- **CHP Building Complied with Neighboring Building Aesthetics**
 - **Landscaping**
 - **Brickwork**