NYSERDA's DG/CHP Data System Website Study

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Exergy Partners Corp.

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Agenda

- Project scope
- Case study
- Lessons Learned

Project Scope

- **Select 20 sites reporting data on NYSERDA's DG/CHP Integrated Data System Website**
- **Investigate;**
  - system performance
  - data acquisition challenges
  - site installation using issues

  Using reported website data and site operating information
- **Develop energy and operating performance reports for each facility**
- **Note:**
  - These report uses HHV to report all performance
  - Based on a one year data snapshot ending July 31, 2011

http://chp.nyserda.org/home/index.cfm

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DG/CHP Integrated Data System

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Welcome to the NYSERDA web-based DG/CHP data system. This system includes monitored performance data and operational statistics for NYSERDA's Distributed Generation (DG)/Combined Heat and Power (CHP) demonstration projects.

The integrated database includes the following:

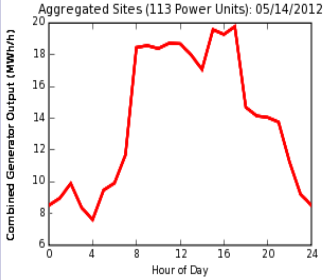
- Monitored Hourly Performance Data
- Operational Reliability and Availability Data
- Characteristics of Each Facility and its Equipment

DG/CHP systems offer the potential to reduce operating costs for end users as well as to improve reliability of the electric distribution and transmission system. NYSERDA's objective is to accelerate the deployment of these technologies in the market to create benefits for the state of New York. To accelerate market acceptance, NYSERDA is supporting efforts to demonstrated DG/CHP systems that show the economic, technical, and environmental benefits of these systems in a variety of commercial, institutional, and industrial applications. This database provides access to the measured performance and reliability data collected on NYSERDA's demonstration sites.

The Monitored Hourly Performance Data portion of the database allows users to view, plot, analyze, and compare performance data from one or several different DG/CHP sites in the NYSERDA portfolio. It allows DG/CHP operators at NYSERDA sites to enter and update information about their system. The database is intended to provide detailed, highly accurate performance data that can be used by potential users, developers, and other stakeholders to understand and gain confidence in this promising technology.

Monitored Power Generation Yesterday

Aggregated Sites (113 Power Units): 05/14/2012



Information Currently in the Database

Facilities:	129
Power Units:	298
Power Units With Monitored Data:	202

Results from Monitoring Yesterday

Power Units Monitored:	113
Energy Generated:	338142.0 kWh
Peak Power Generated:	20147.2 kW

Click Here for a complete summary

Information as of 05/15/2012 at 7:46 AM

The Operational Reliability Data portion of the database is intended to allow individual facility managers to better understand reliability, availability, and performance of their particular units and also determine how their facilities compare with other units. Information on reliability and availability performance will enable potential onsite power users to make a more informed purchase decision, and will help policy makers quantify reliability benefits of customer-sited generation.

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Website Project

Case Study – Toren Condominium

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Toren Condominium

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Return to Facility Listing

Toren Condominiums
150 Myrtle Ave
New York, NY 11201
Map It

DG/CHP Developed by Energy Concepts Engineering PC

Category: Multi-Family Residence
SIC: 70 - Hotels, Rooming Houses, Camps, and Other Lodging Places
ISO Zone: A - West
Electric Utility: National Grid - New York
Gas Utility: Consolidated Edison Co-NY Inc
Primary Fuel: Natural Gas
Number of Power Units: 5
Total Installed Capacity: 500 kW

Unit	Installation	Fuel	Prime Mover	Heat Recovery	Use	Technology Group	Installed Capacity (kW)
1		Natural Gas	Reciprocating Engine	Hot Water	Domestic Hot Water	100-800 Reciprocating Engine (Lean Burn)	100
2		Natural Gas	Reciprocating Engine	Hot Water	Domestic Hot Water	100-800 Reciprocating Engine (Lean Burn)	100
3		Natural Gas	Reciprocating Engine	Hot Water	Domestic Hot Water	100-800 Reciprocating Engine (Lean Burn)	100
4		Natural Gas	Reciprocating Engine	Hot Water	Domestic Hot Water	100-800 Reciprocating Engine (Lean Burn)	100
5		Natural Gas	Reciprocating Engine	Hot Water	Domestic Hot Water	100-800 Reciprocating Engine (Lean Burn)	100

Facility Details
Show Complete Details

Facility Documentation
Toren Condominiums - Database Notes

Project Webpages
None

Related Webpages
None

Online Monitored Data Reports
Monitored Data - Plots and Graphs
Monitored Data - Download (CSV file)
Utility Rate Calculation
Monitored Data Quality

Standardized Monitored Data Reports
Generator, Facility, and Meter Power
Generator Status, Gas Use, and Heat Recovery
Generator Power Quality
Facility Meter Power Quality

Summary Reports
Monthly Summary Table

Operational/Reliability Reports
None

Emissions Reports
None

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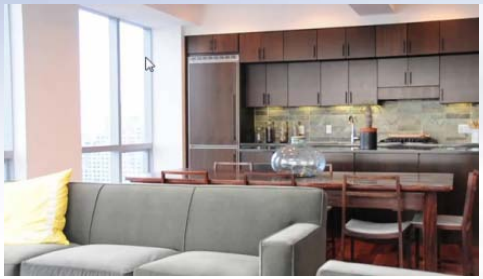
Toren Condominium



Toren Condominium is a 300,000 ft^2 mixed- use complex. The 37 story building offers 240 condominium homes with breathtaking floor-to-ceiling views of the Manhattan skyline and New York harbor as well as the opportunity to live in the most environmentally advanced high-rise residential building in New York. The building was completed in March 2010.

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CHP Plant

The Toren Condominium CHP plant consists of five Tecogen CM – 100 cogeneration units capable of a total output of 500 kW. The central plant also includes six 1,700 MBH natural gas fired modular hot water boilers to supplement the heat recovery, if needed. The heat recovery is used for temperature control and domestic hot water.

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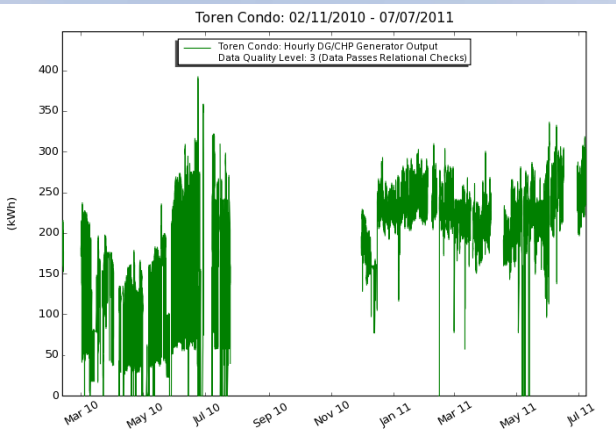
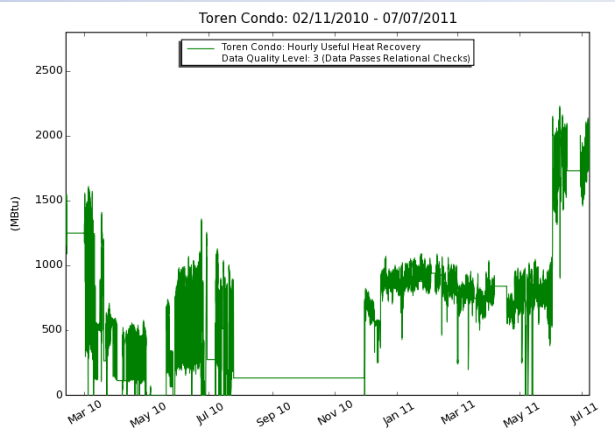
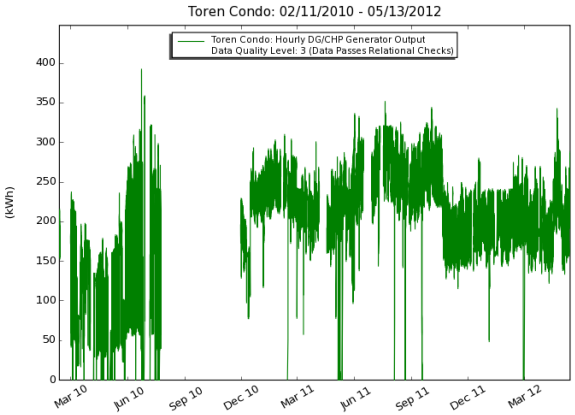
Project Sought to Explain Data Results

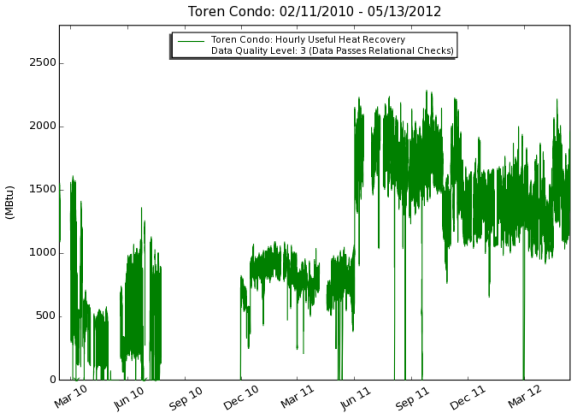




July 2011 Report Basis Data

May 2012 Available Data





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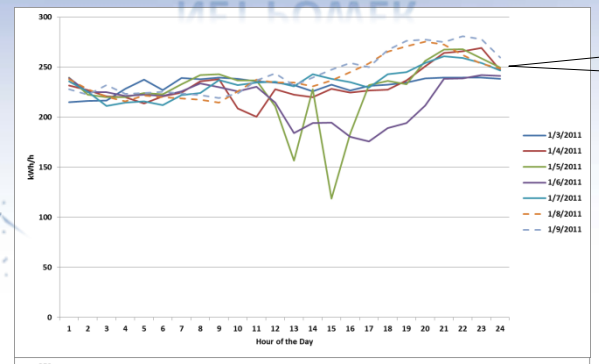
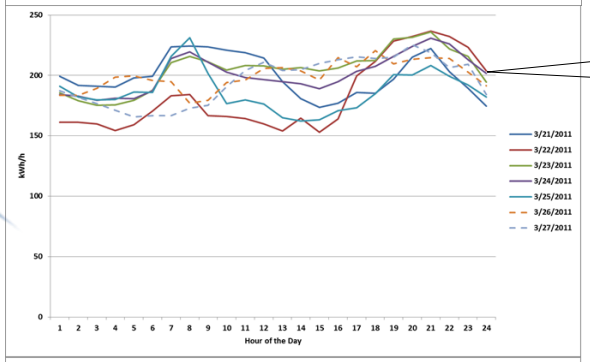
Weekly Performance

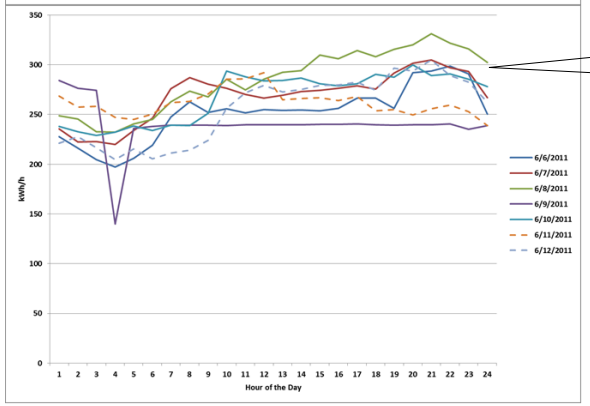
NET POWER



250 kW/h



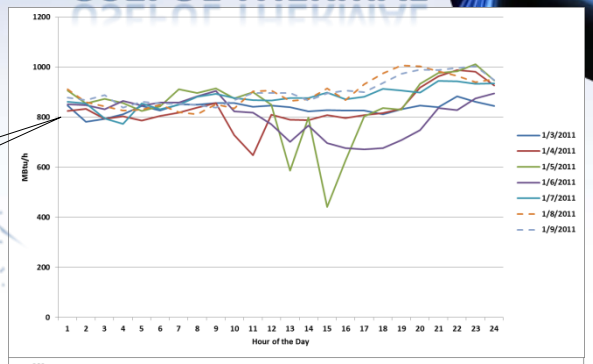
200 kW/h



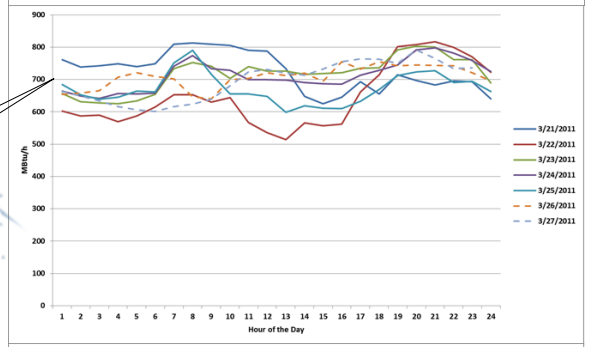
300 kW/h

USEFUL THERMAL

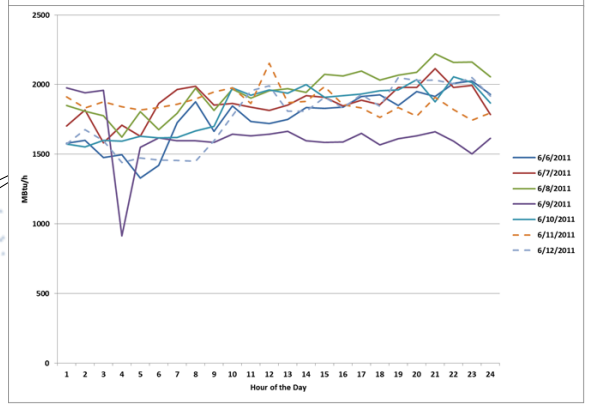
800 MBtu/h



700 MBtu/h



1,500 MBtu/h



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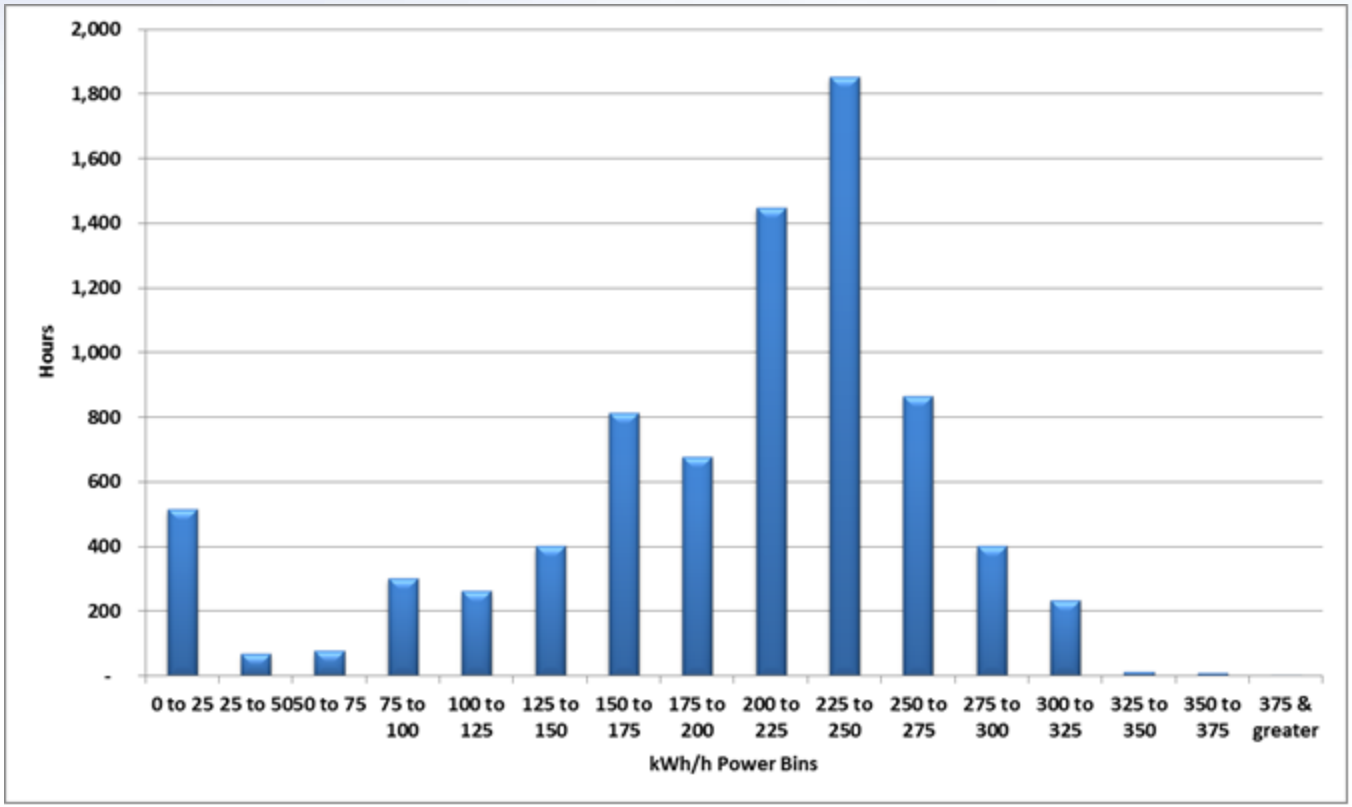
Power Profile



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Performance Table

	Hours of Good (Pwr) Data	Net Electric Output (kWh)	Natural Gas Use (MCF)	Useful Heat Output (MMBtu)	Electrical Efficiency	Useful Thermal Efficiency	Fuel Conversion Efficiency
March-10	673	91,855	1,254.0	517.2	24.5%	40.4%	64.9%
April-10	552	61,859	910.5	215.7	22.7%	23.2%	46.0%
May-10	720	83,408	1,128.7	132.3	24.7%	11.5%	36.2%
June-10	671	130,790	1,763.6	453.7	24.8%	25.2%	50.0%
July-10	398	77,311	1,031.5	214.5	25.1%	20.4%	45.5%
August-10	Bad or Missing Data						
September-10							
October-10							
November-10							
December-10	744	149,982	1,898.3	557.3	26.4%	28.8%	55.2%
January-11	744	179,442	2,267.5	669.2	26.5%	28.9%	55.4%
February-11	540	122,511	1,548.7	465.2	26.5%	29.5%	55.9%
March-11	689	143,930	1,823.6	516.5	26.4%	27.8%	54.2%
April-11	432	87,320	1,105.1	316.3	26.4%	28.1%	54.5%
May-11	744	146,596	1,859.9	527.6	26.4%	27.8%	54.2%
June-11	384	97,706	1,237.3	668.8	26.4%	53.0%	79.4%
July-11	624	171,107	2,171.4	1,144.7	26.4%	51.7%	78.1%
Total preceding 8 months	**4901**	**1,098,593**	**13,912**	**4,866**	**26.4%**	**34.3%**	**60.7%**

New NYSERDA Data Table

New York State

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DG/CHP Integrated Data System

Toren Condominiums Summary Table

Date	DG/CHP Generator Output (kWh x 10^3)	Percent Valid Data: Generator Power (%)	DG/CHP Gas Input (cf x 10^3)	Percent Valid Data: Gas (%)	Useful Heat Recovery (MBTu x 10^3)	Percent Valid Data: Useful Heat Recovery (%)	Electrical Efficiency HHV (%)	Percent Valid Data: Electrical Efficiency (%)	Total Efficiency HHV (%)	Percent Valid Data: Total Efficiency (%)
November 2010	4.5	6.0	-	0.0	11.2	6.0	-	0.0	-	0.0
December 2010	150.0	100.0	1,898.3	100.0	557.3	100.0	26.2	100.0	54.7	100.0
January 2011	179.4	100.0	2,267.5	100.0	669.2	100.0	26.2	100.0	54.9	100.0
February 2011	122.5	80.4	1,548.7	80.4	465.2	80.4	26.2	80.4	55.4	80.4
March 2011	143.9	92.6	1,823.6	92.6	516.5	92.6	26.1	92.6	53.6	92.6
April 2011	87.3	60.0	1,105.1	60.0	316.3	60.0	26.2	60.0	54.0	60.0
May 2011	146.6	100.0	1,859.9	100.0	527.6	99.6	26.1	100.0	53.6	99.6
June 2011	97.7	53.3	1,237.3	53.3	668.8	53.3	26.2	53.3	78.6	53.3
July 2011	171.1	83.9	2,171.4	83.9	1,144.7	83.9	26.1	83.9	77.3	83.9
August 2011	180.4	96.8	2,285.1	96.8	1,207.6	96.6	26.2	96.8	77.5	96.6
September 2011	181.7	100.0	2,298.7	100.0	1,217.4	99.9	26.2	100.0	77.6	99.9
October 2011	178.6	100.0	2,259.4	100.0	1,206.8	100.0	26.2	100.0	78.0	100.0
November 2011	126.1	96.7	1,595.5	96.7	1,057.5	96.7	26.2	96.7	90.5	96.7
December 2011	131.7	90.3	1,667.9	90.3	928.8	90.3	26.2	90.3	80.2	90.3
January 2012	142.6	100.0	1,808.5	100.0	994.1	100.0	26.1	100.0	79.5	100.0
February 2012	136.2	100.0	1,729.1	100.0	916.9	100.0	26.1	100.0	77.6	100.0
March 2012	138.5	96.8	1,757.3	96.8	930.6	96.8	26.1	96.8	77.5	96.8
April 2012	149.2	100.0	1,900.7	100.0	1,027.8	100.0	26.0	100.0	78.5	100.0
May 2012	60.6	86.4	772.5	86.4	436.6	86.4	26.0	86.4	80.9	86.4
Total	**2,528.7**	**88.7**	**31,986.3**	**88.5**	**14,801.0**	**88.7**	**26.2**	**88.5**	**71.1**	**88.5**

New Data Since Report

Net Power Consistent with report data

10.4 points higher Useful Thermal Energy attributable to increased occupancy

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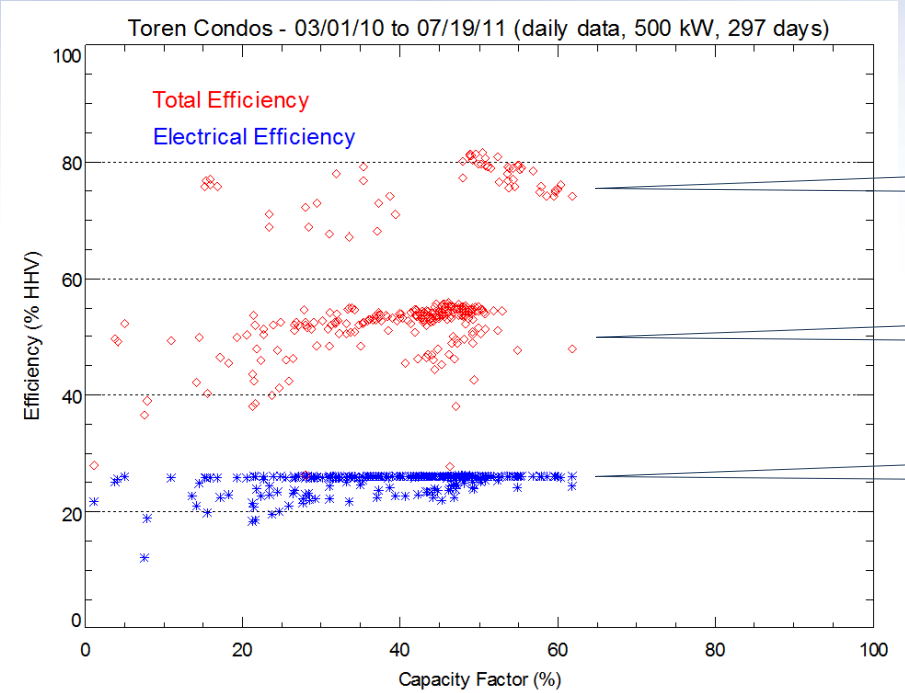
Capacity Factor



Reflects Cooling during this Time Period

Reflects Heating During this Time Period

Net Power Efficiency – contains some calculated data (see above preceding table gas flow

Capacity Factor presents the CHP generated power efficiency over a time period providing a good overview of the CHP power capacity versus site power requirements and a good understanding of the useful thermal energy recovered. Note that this curve will change as internal loading increases due to occupancy growth.

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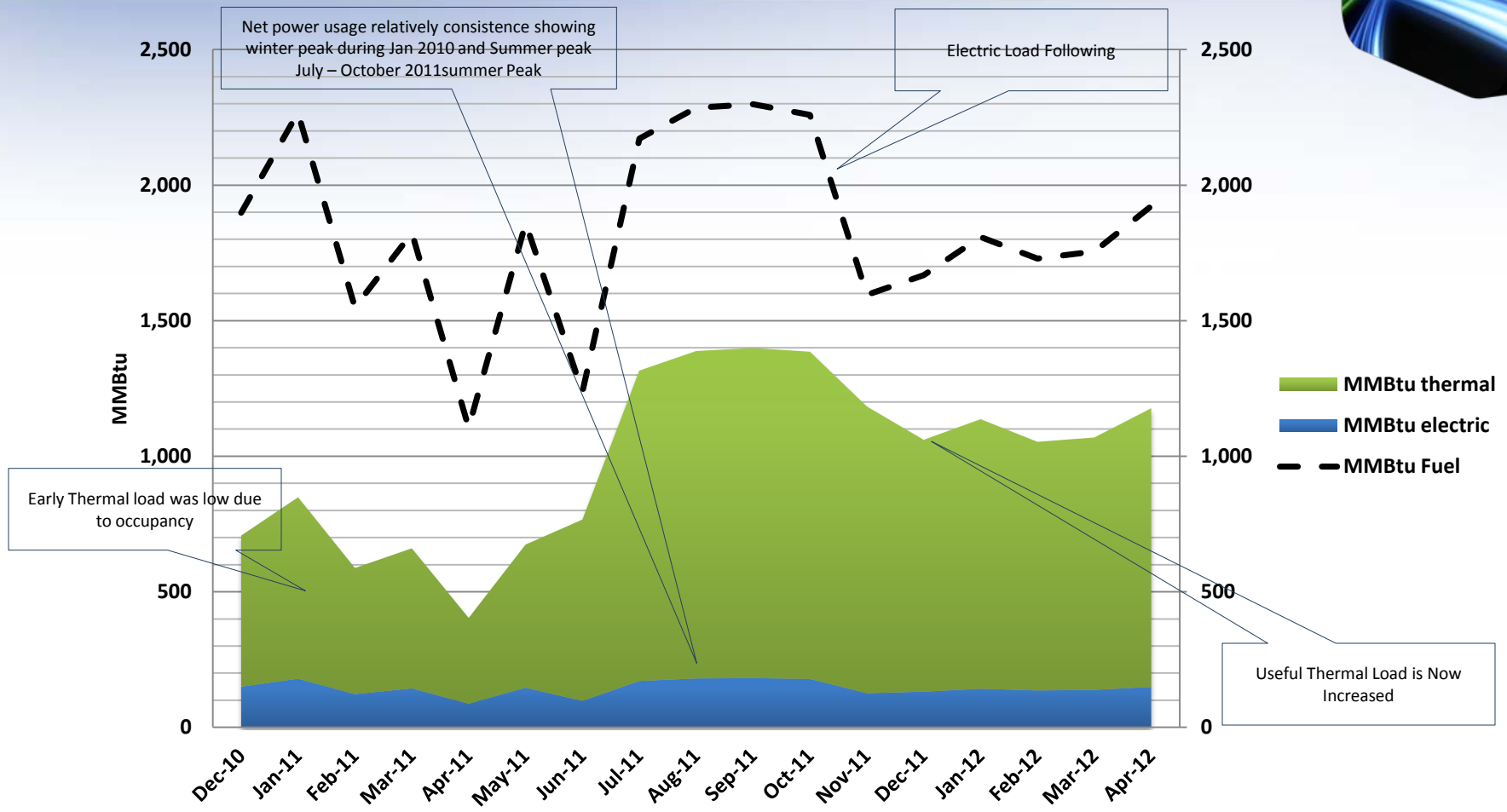
As Occupancy Increases



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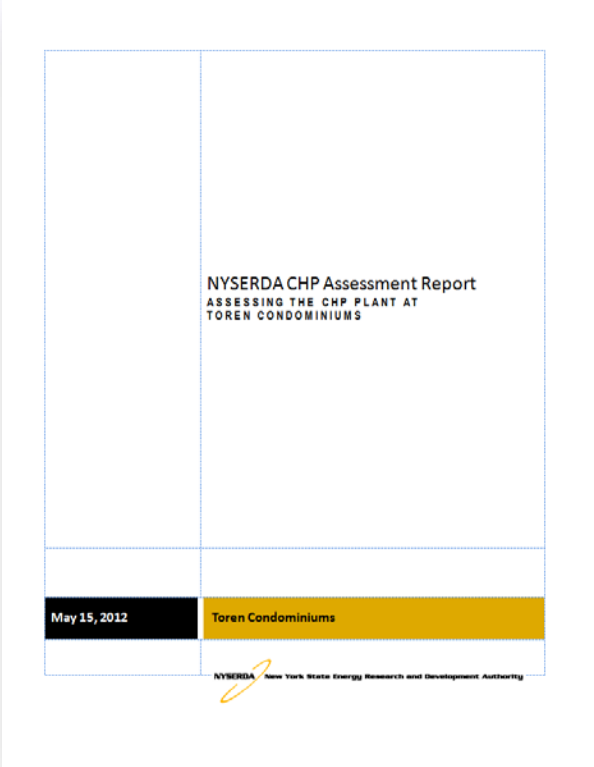
Toren Condominium Conclusions

- 500 kW CHP system in electric load following mode
- Peak CHP system demand ranges 300 to 325 in the Summertime
- Engines are consistently loaded and perform at 26.2% efficiency (HHV) or 28.7% (LHV)
- CHP performance data is a snapshot over time. In this case, a new condominium property is increasing occupancy.
- CHP system has a higher Fuel Conversion Efficiency (FCE) in 2012 vs 2011 due to higher occupancy


NYSERDA CHP Assessment Report

ASSESSING THE CHP PLANT AT TOREN CONDOMINIUMS

May 15, 2012

Toren Condominiums

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Website Project

Lessons Learned

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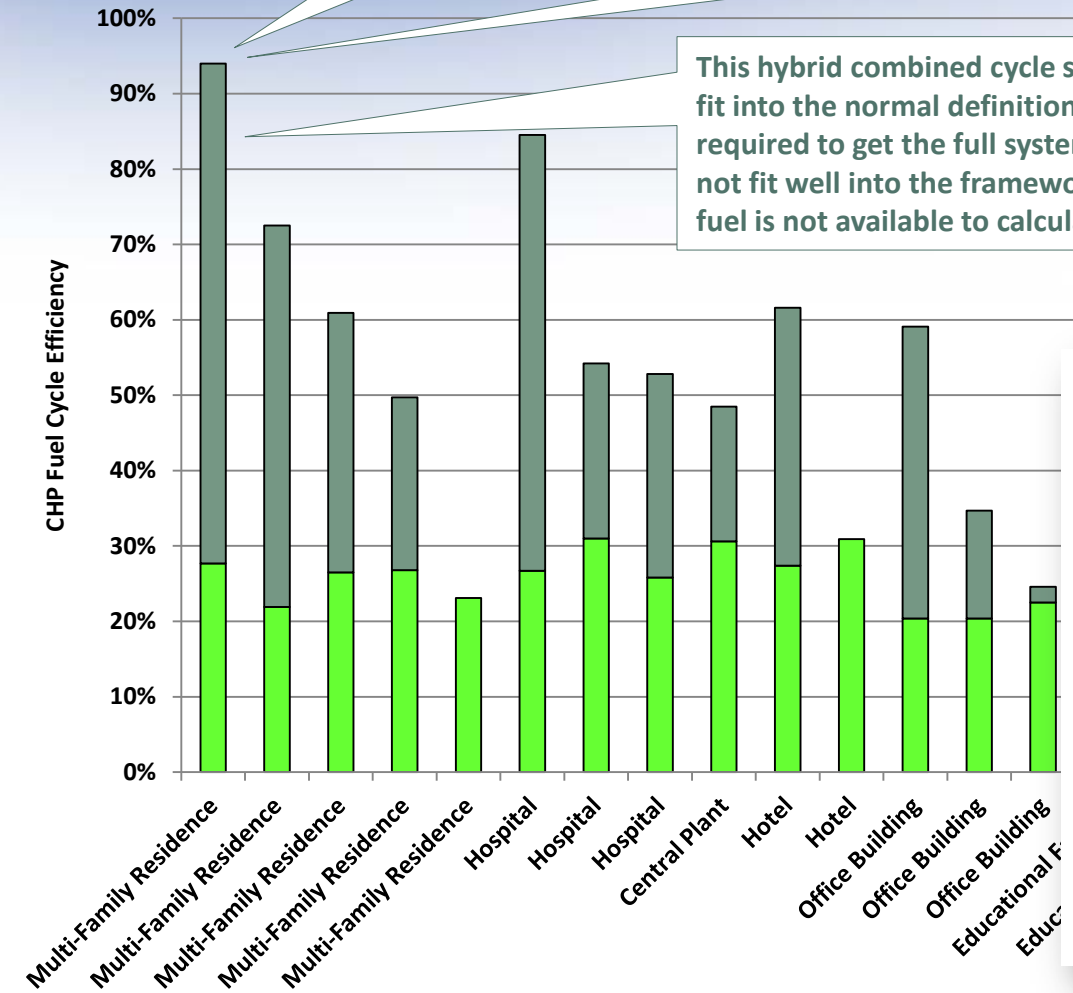
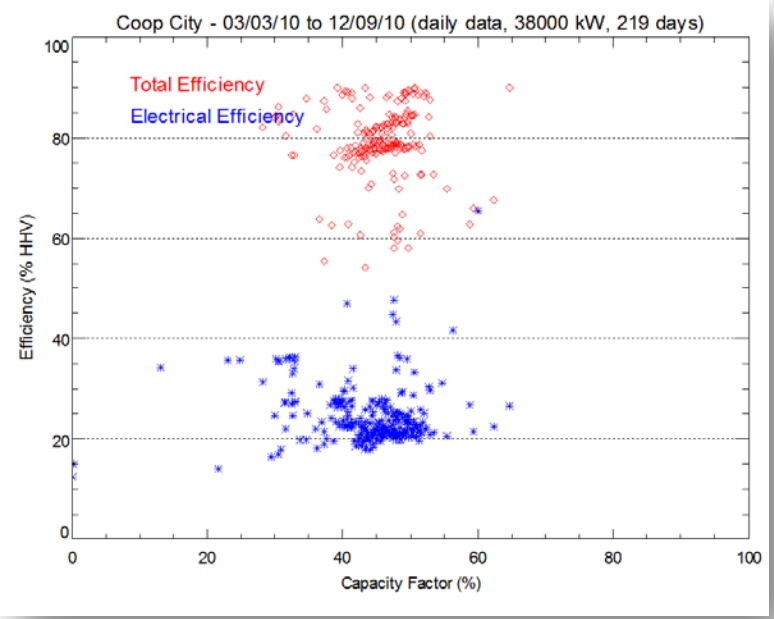
Studied Performance

Coop City - Riverbay

2 x 12.5 MW CTs & 1 x 13 MW ST = 38,000 kW Capacity

This hybrid combined cycle system –with a high pressure boiler – does not fit into the normal definition of a CCHP plant, since boiler operation is required to get the full system power output. Therefore this system did not fit well into the framework of the DG/CHP database system. Boiler fuel is not available to calculate the efficiency.





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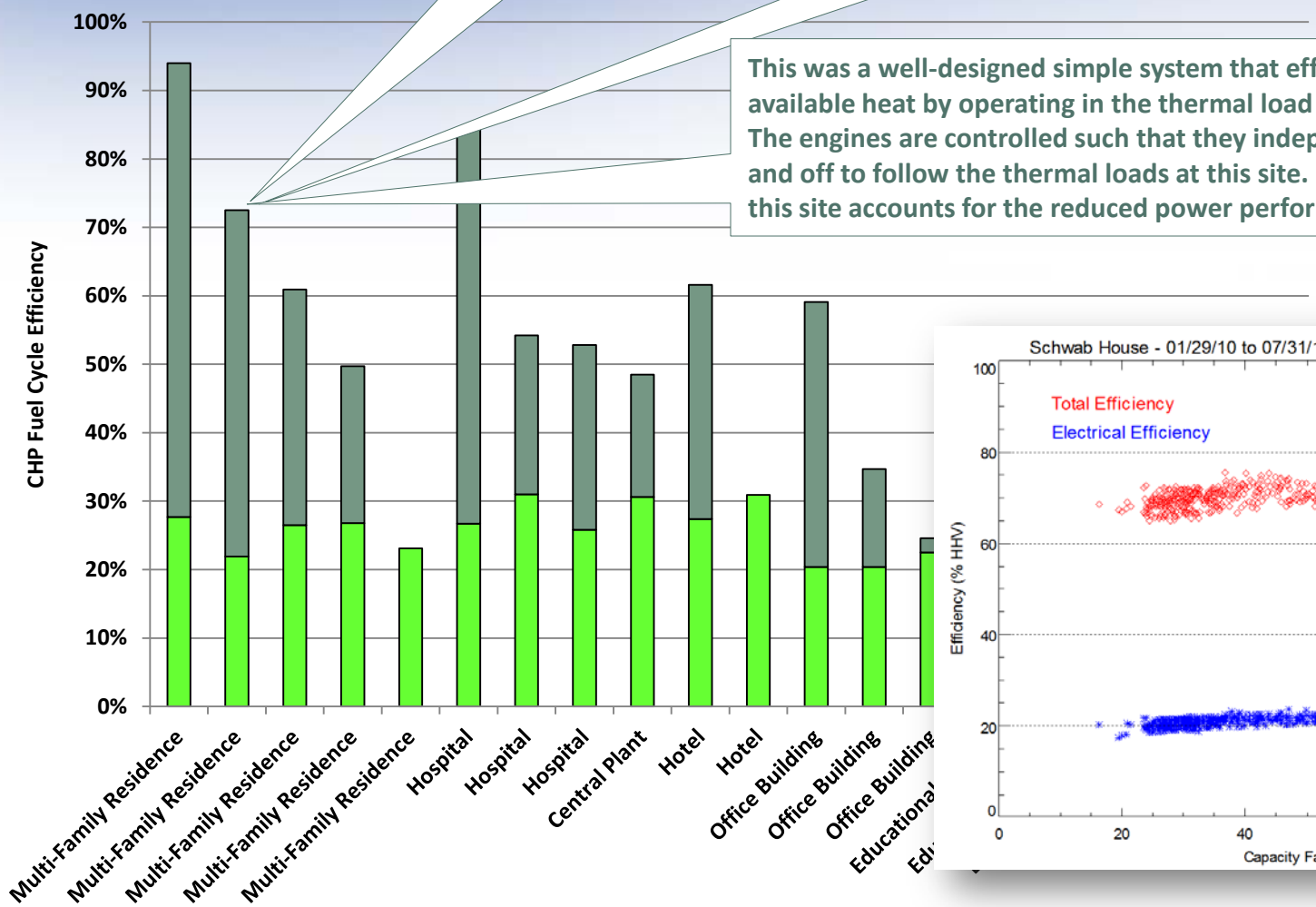
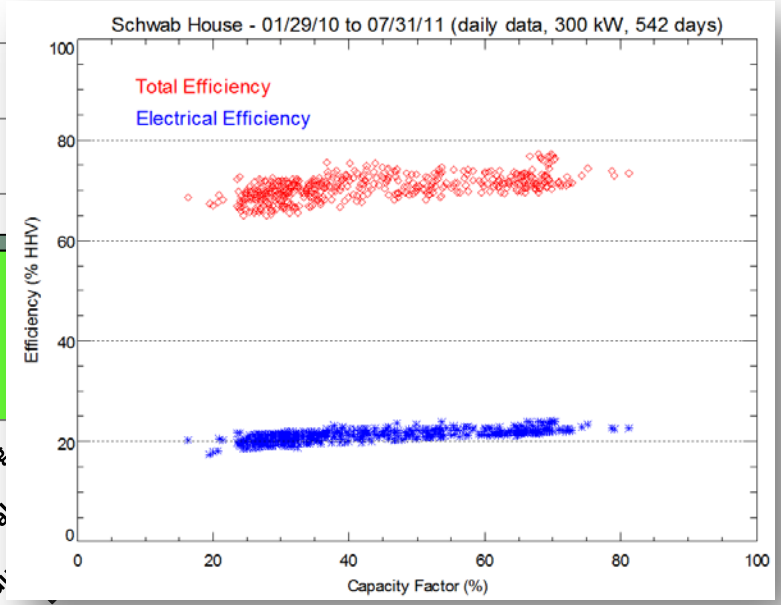
Studied Performance

Schwab House

4 x 75 RE = 300 kW Capacity

This was a well-designed simple system that effectively used the available heat by operating in the thermal load following mode. The engines are controlled such that they independently cycle on and off to follow the thermal loads at this site. Engine cycling on this site accounts for the reduced power performance.





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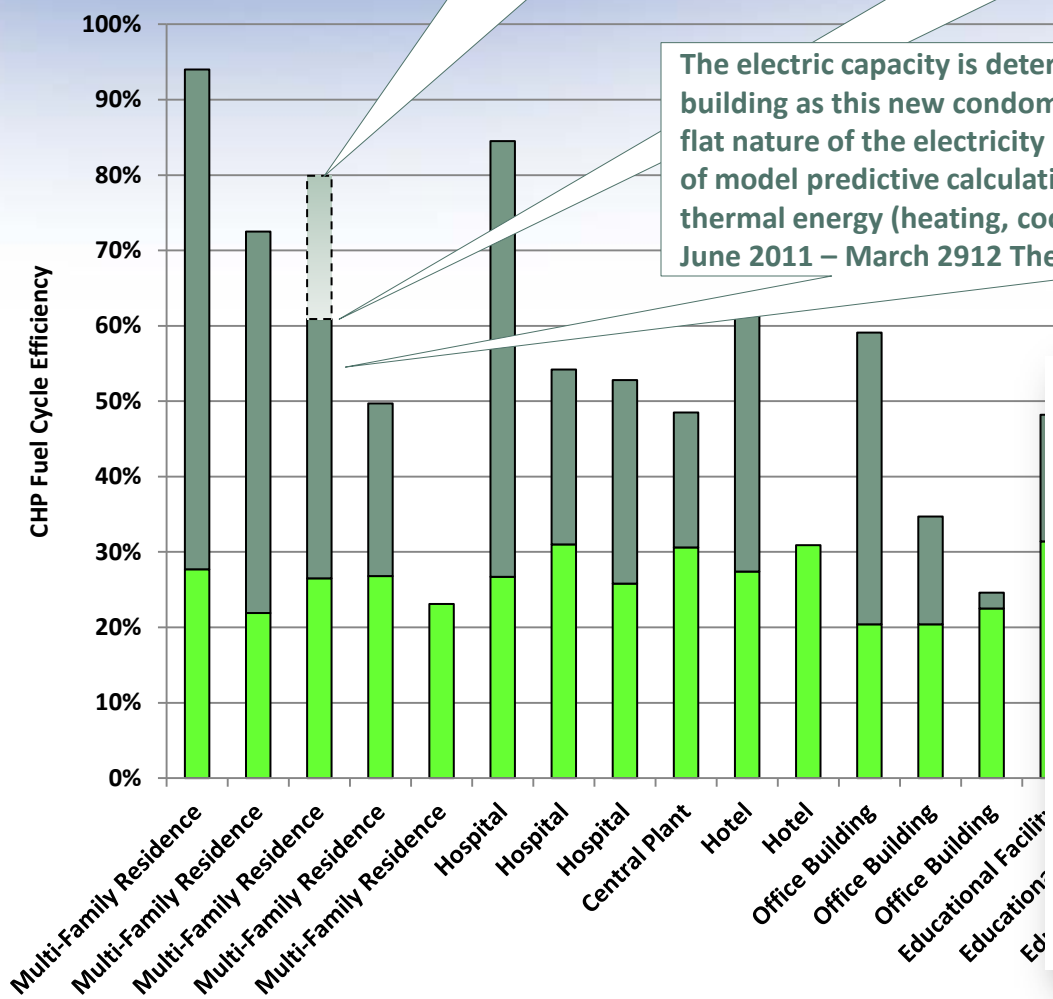
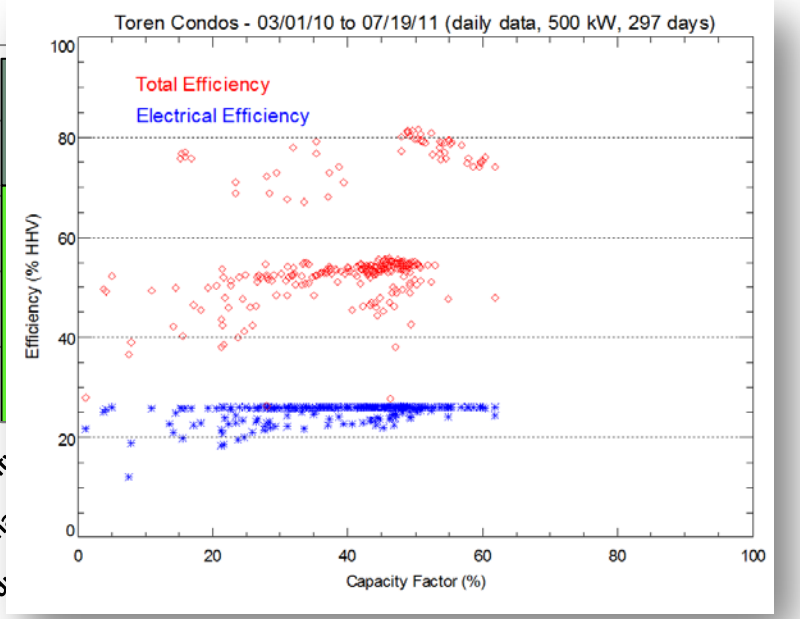
Studied Performance

Toren Condominiums

5 x 100 RE = 500 kW Capacity

The electric capacity is determined, in-part, by the occupancy of the building as this new condominium becomes occupied. Note the generally flat nature of the electricity performance curve reflects a certain amount of model predictive calculation due to incomplete data. The useful thermal energy (heating, cooling and domestic hot water). Examining June 2011 – March 2912 Thermal recovery = 53.5%





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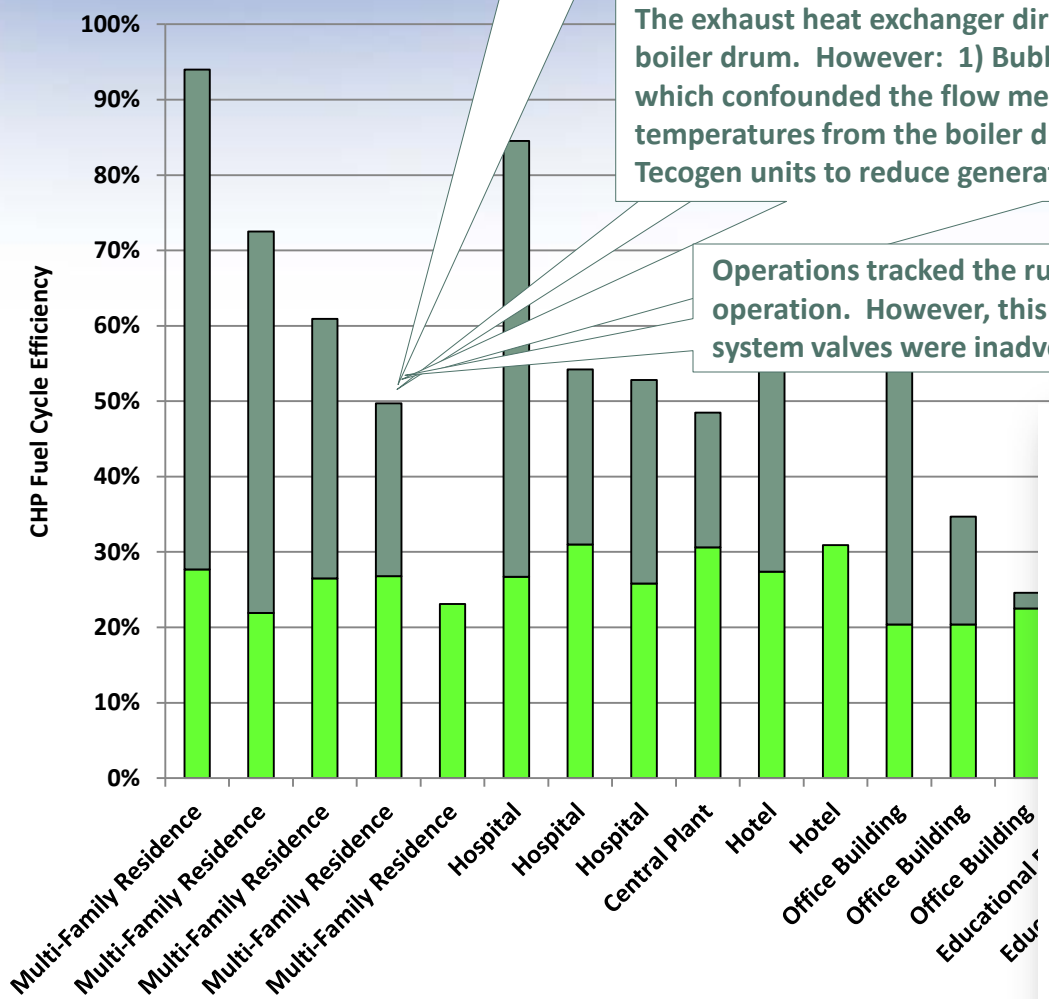
Studied Performance

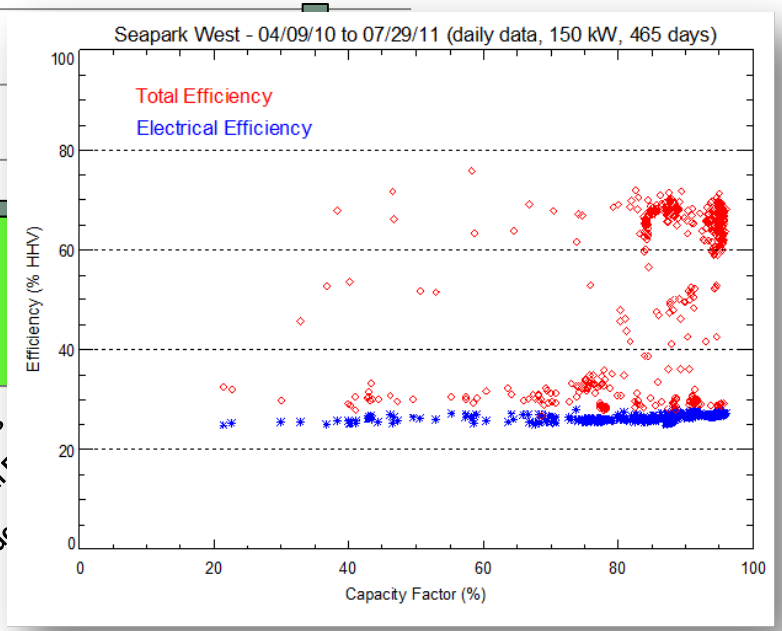
Sea Park West

2 x 75 RE = 150 kW Capacity

The exhaust heat exchanger directly heats water in the low pressure boiler drum. However: 1) Bubbles formed in the exhaust heat exchanger, which confounded the flow measurement, and 2) high water temperatures from the boiler drum caused the safety limits on the Tecogen units to reduce generator power output.

Operations tracked the runtime of the dump radiator fans to confirm proper operation. However, this metric did not detect the loss of heat transfer when system valves were inadvertently changed in the winter of 2011.





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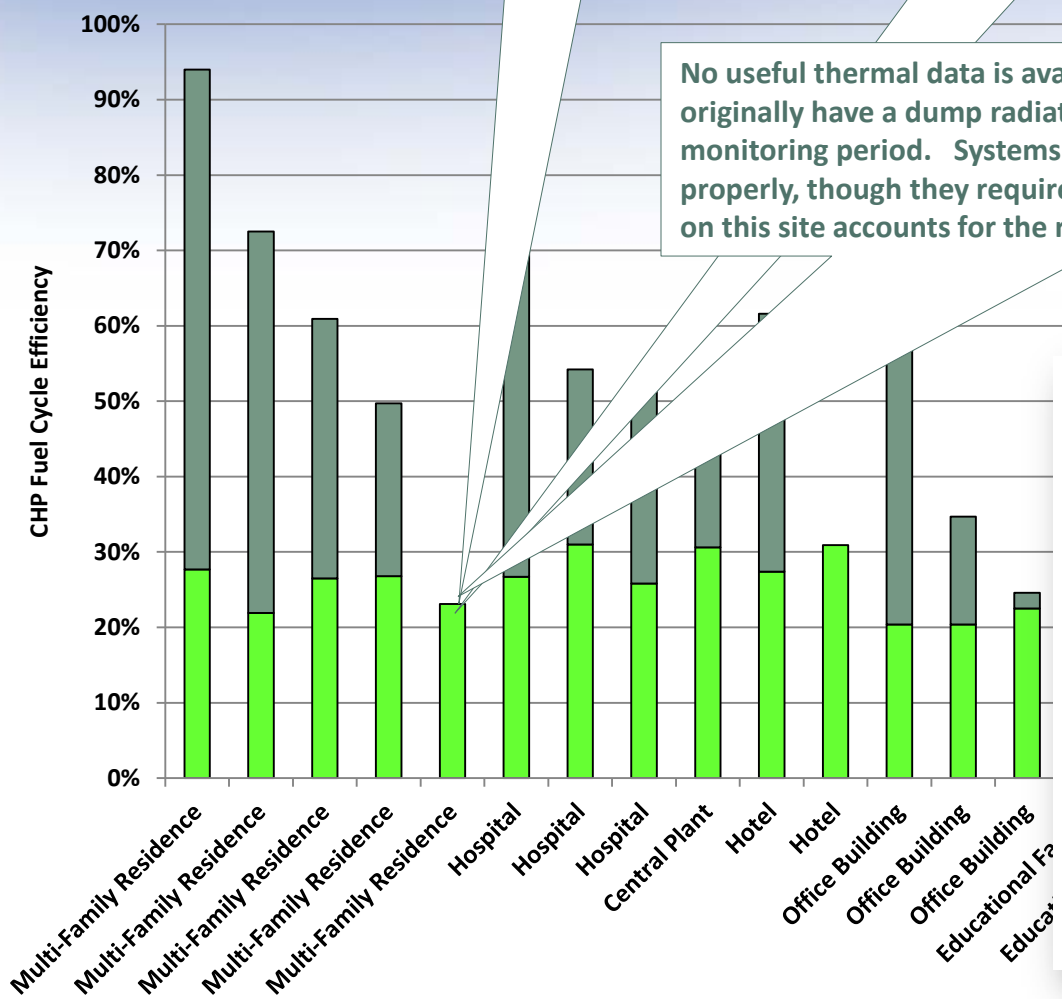
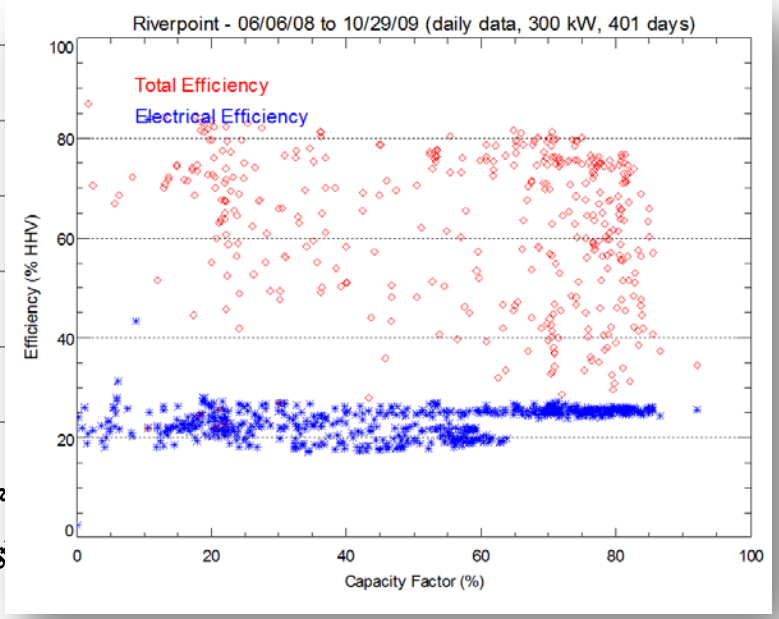
Studied Performance

River Point Towers

4 x 75 RE = 300 kW Capacity

No useful thermal data is available for this site. This system did not originally have a dump radiator, but one was added part way through the monitoring period. Systems without dump radiators can operate properly, though they require predictable thermal loads. Engine cycling on this site accounts for the reduced power performance.





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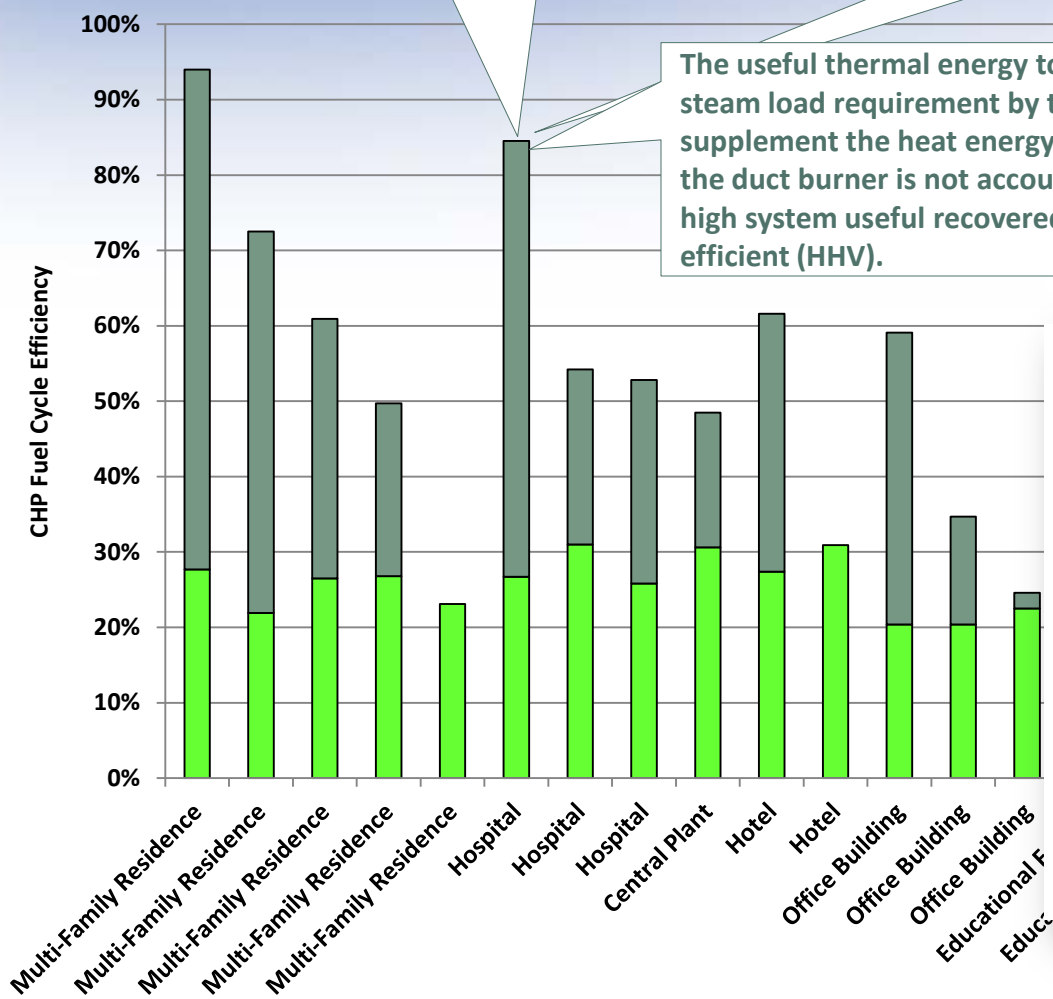
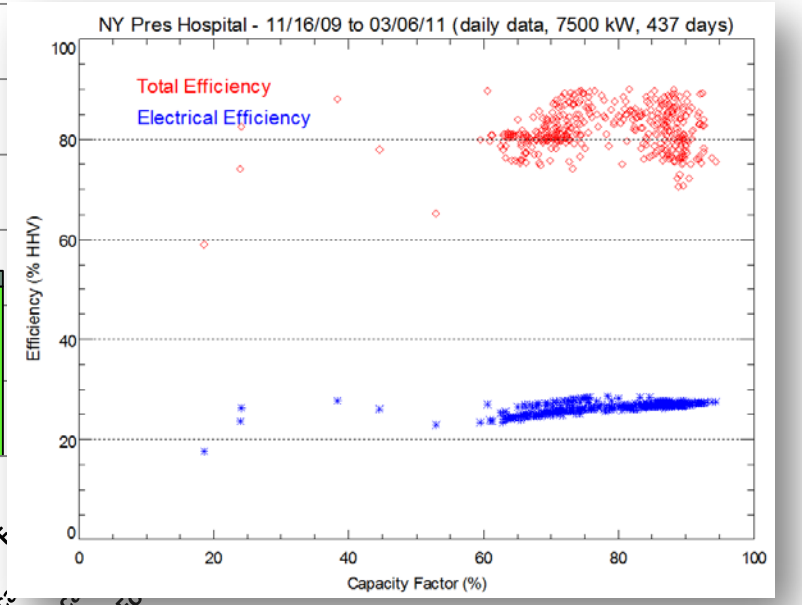
Studied Performance

NY Presbyterian Hospital

7.5 MW CT = 7,500 kW Capacity

The useful thermal energy to produce steam remains very high owing to high steam load requirement by the facility and that a duct burner is used to supplement the heat energy from the combustion turbine. Note the fuel to the duct burner is not accounted for in the data acquired which leads to the high system useful recovered thermal energy which is 57.8% thermally efficient (HHV).





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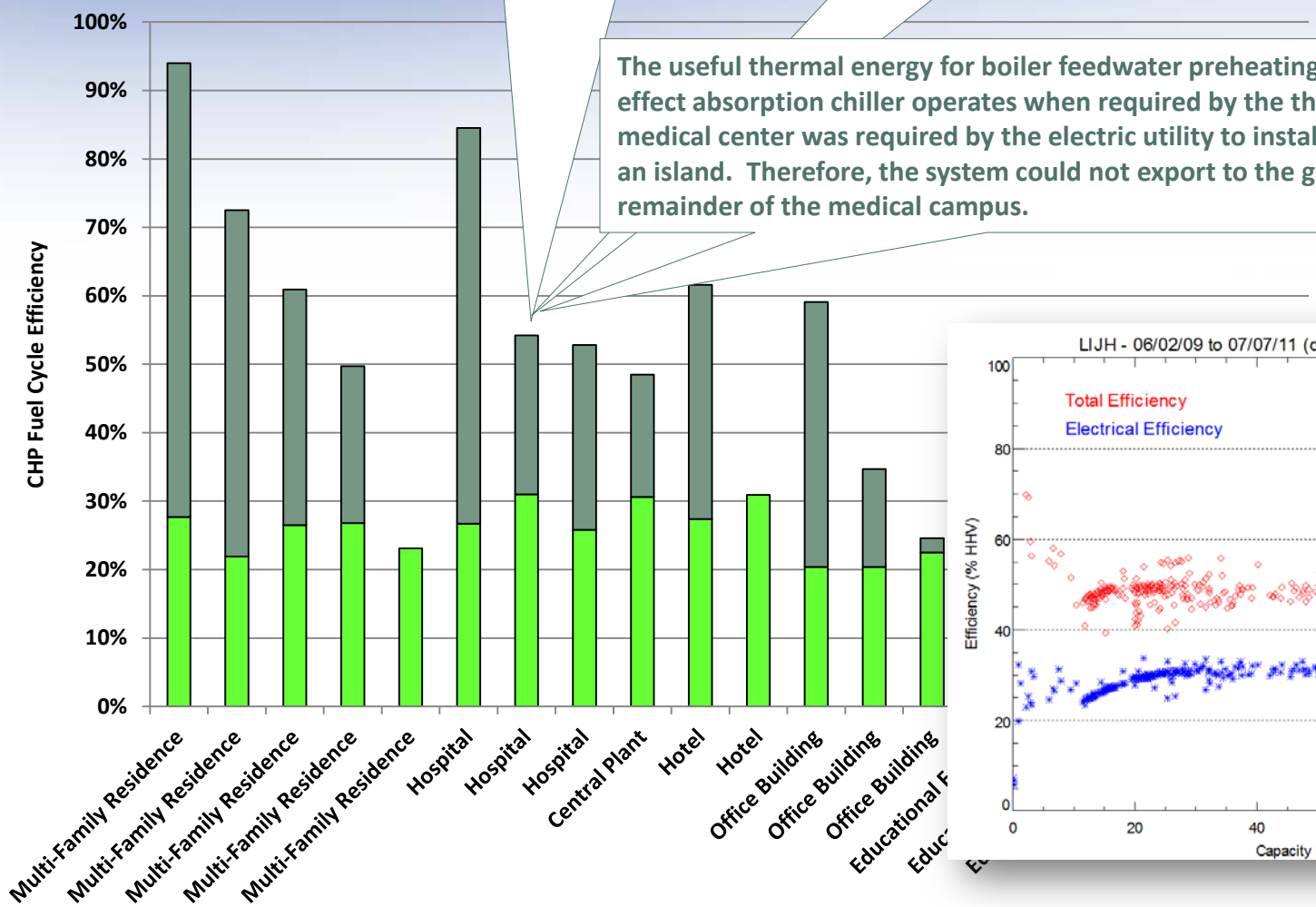
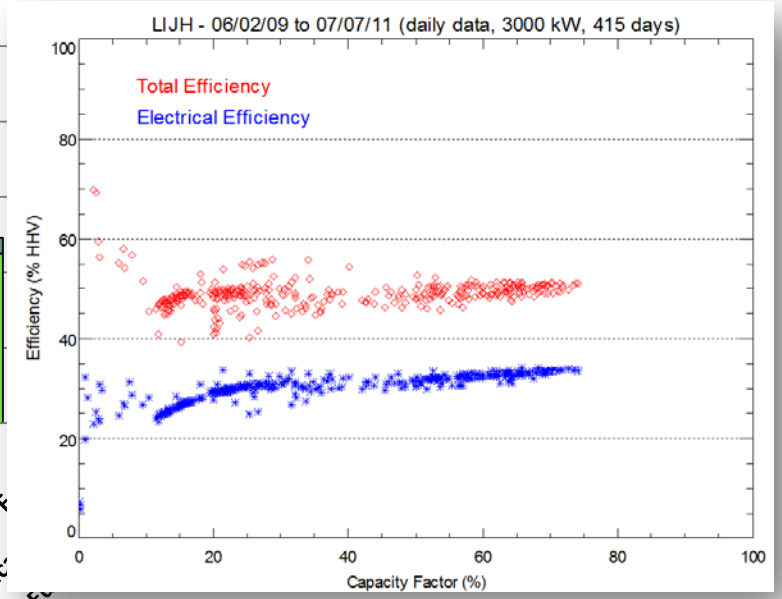
Long Island Jewish Medical Center

2 x 1,425 RE = 2,850 kW Capacity

The useful thermal energy for boiler feedwater preheating and for a single effect absorption chiller operates when required by the thermal load. The medical center was required by the electric utility to install the system as an island. Therefore, the system could not export to the grid or even the remainder of the medical campus.





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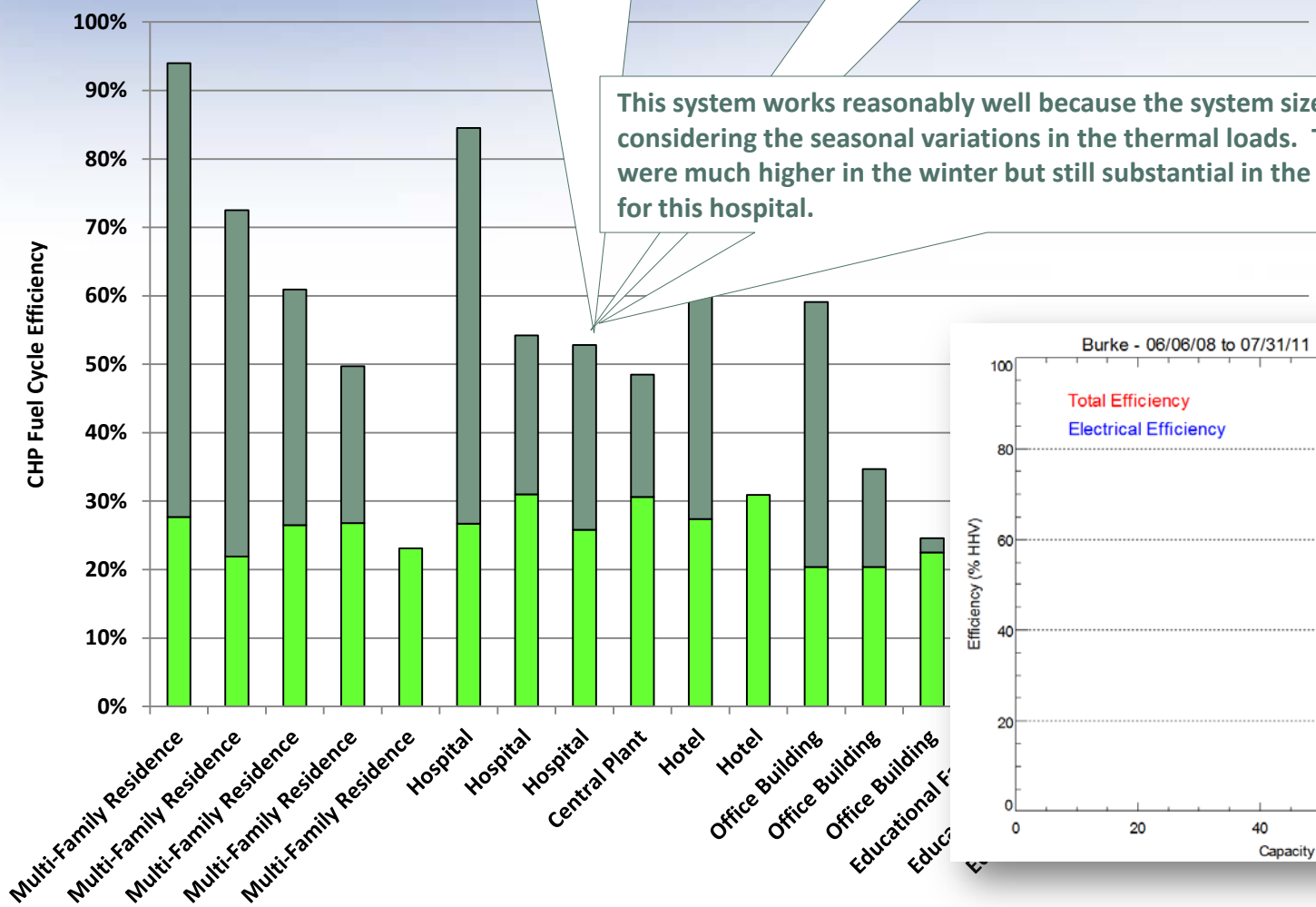
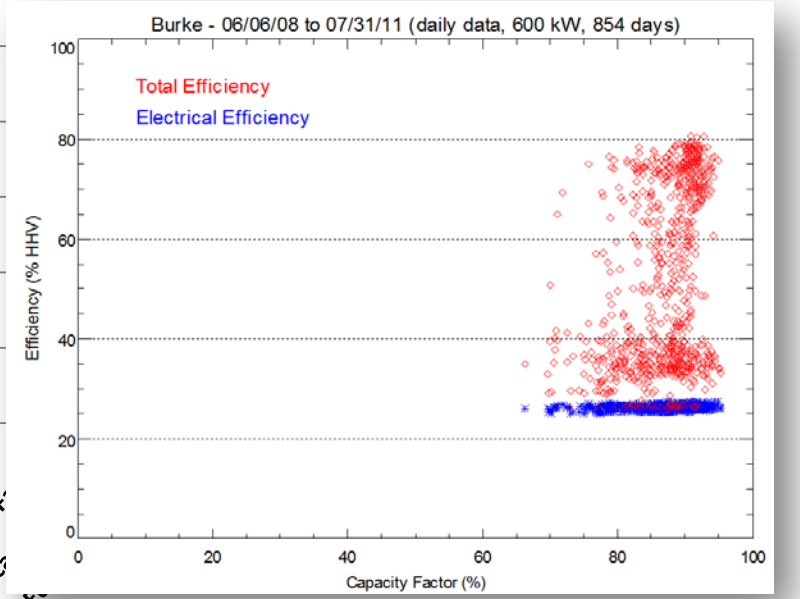
Burke Rehabilitation Hospital

8 x 75 RE = 600 kW Capacity

This system works reasonably well because the system size was selected considering the seasonal variations in the thermal loads. Thermal loads were much higher in the winter but still substantial in the summer time for this hospital.





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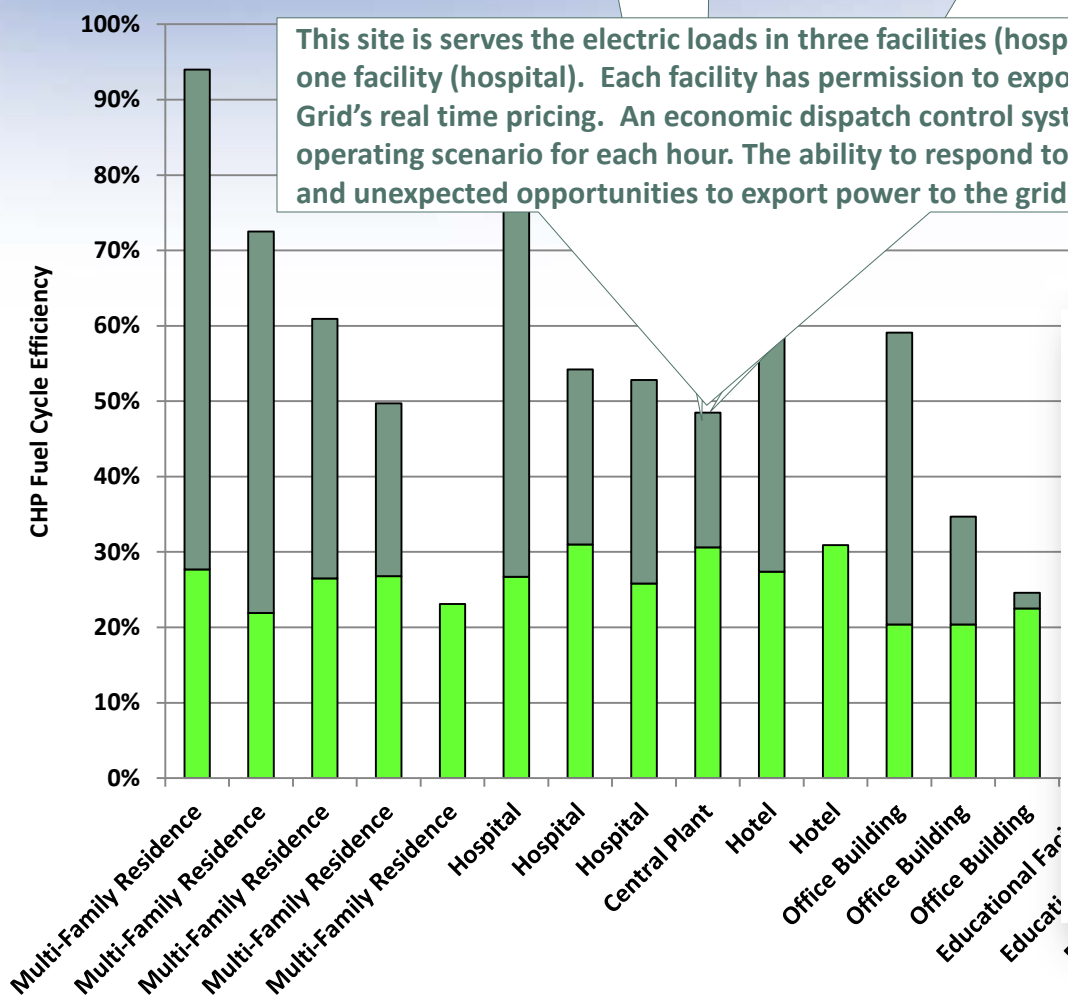
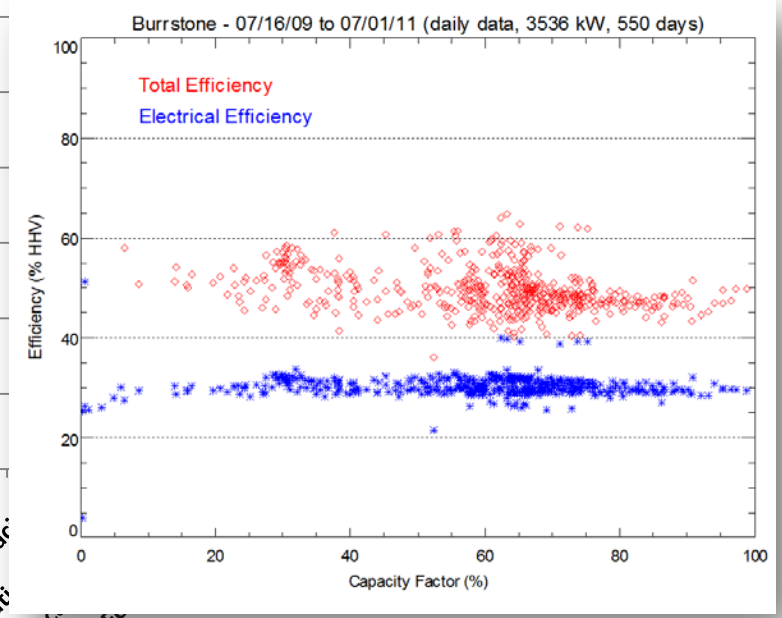
Burrstone Energy Center

3 x 1,100 & 1 x 330 kW RE = 3,630 kW Capacity

This site is serves the electric loads in three facilities (hospital, home, college) while meeting the thermal loads in one facility (hospital). Each facility has permission to export power to the grid and all the facilities are on National Grid's real time pricing. An economic dispatch control system selects the most economically advantageous operating scenario for each hour. The ability to respond to real time electric prices, daily as-used demand charges, and unexpected opportunities to export power to the grid enhanced the economic value of this CHP system.





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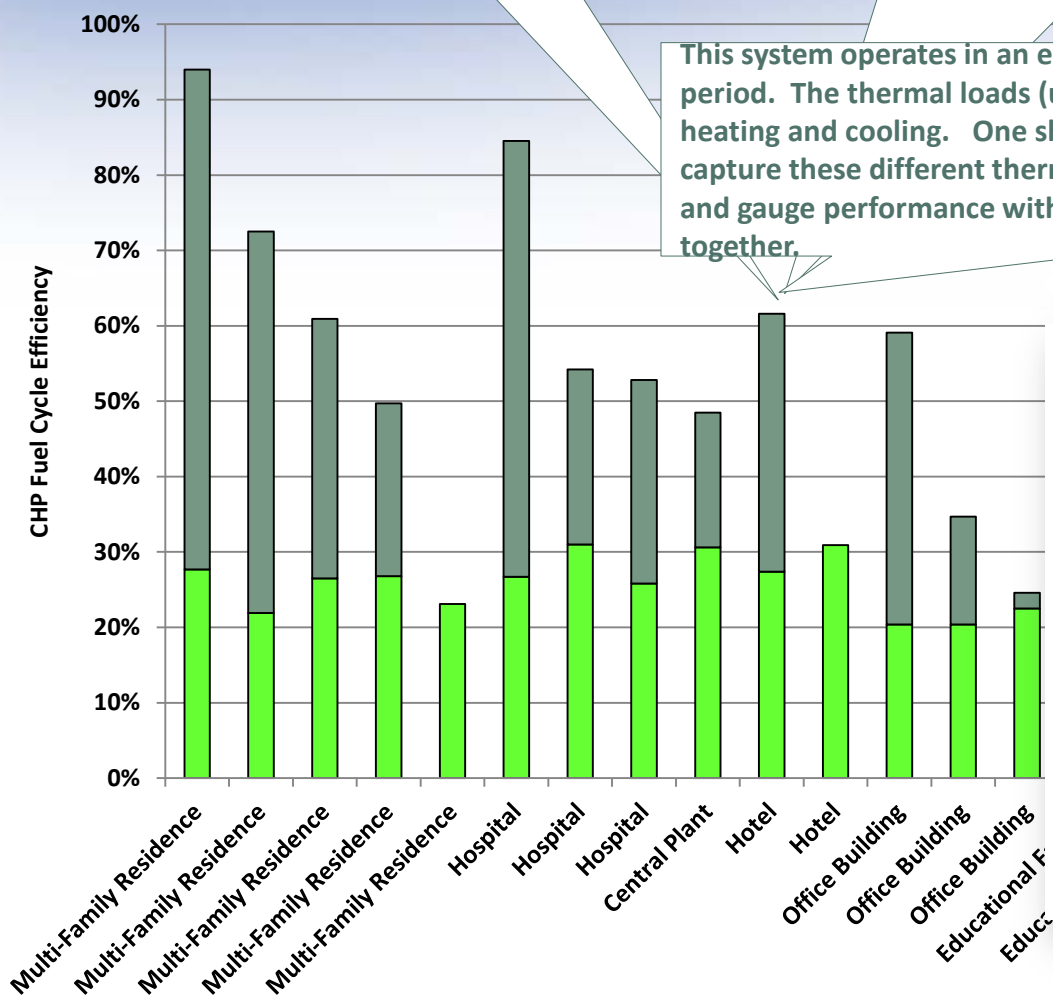
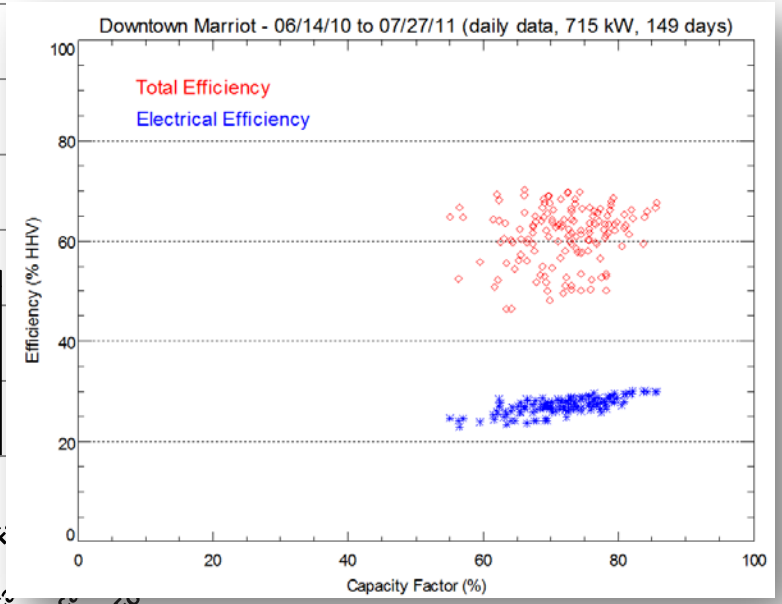
NYC Marriott Downtown

5 x 60 kW MT 149 RT & 6 x 60 MT w 173 RT, 524 kW Capacity

This system operates in an electric load following mode for the entire period. The thermal loads (useful thermal output) are the sum of the heating and cooling. One shortfall of the CHP is inability to separately capture these different thermal outputs. It is difficult to fully understand and gauge performance with these different thermal outputs combined together.





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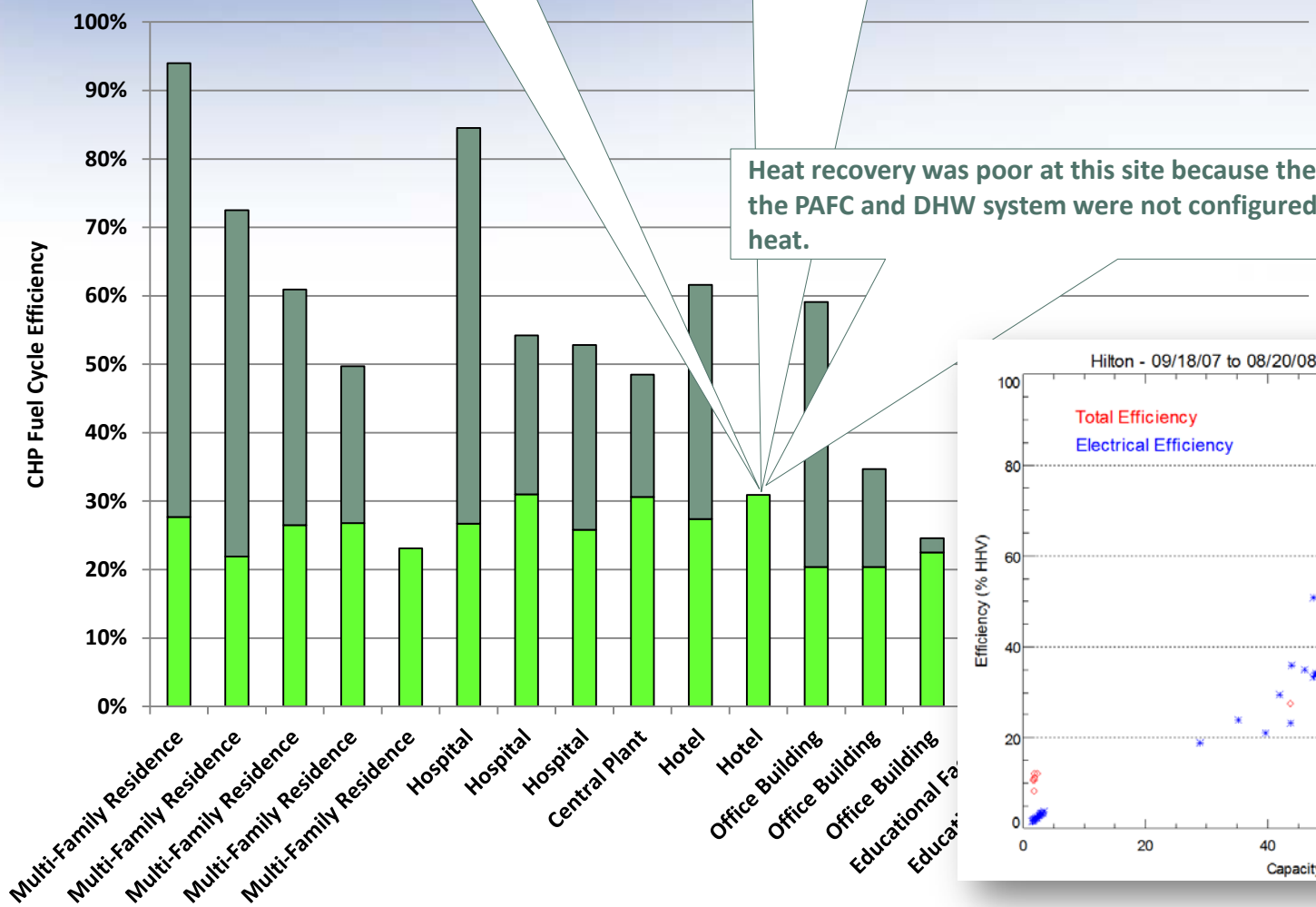
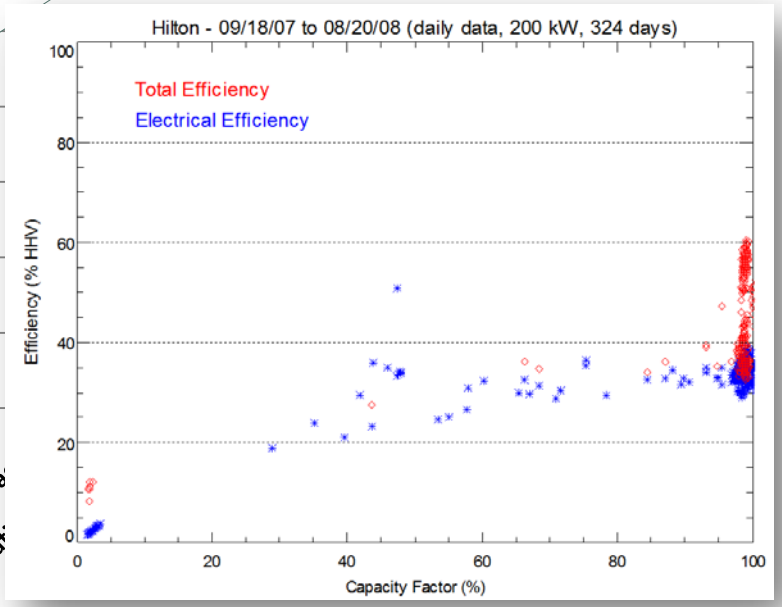
Hilton-New York

1 x 200 kW PAFC = 200 kW Capacity

Heat recovery was poor at this site because the heat exchangers between the PAFC and DHW system were not configured to use the available waste heat.





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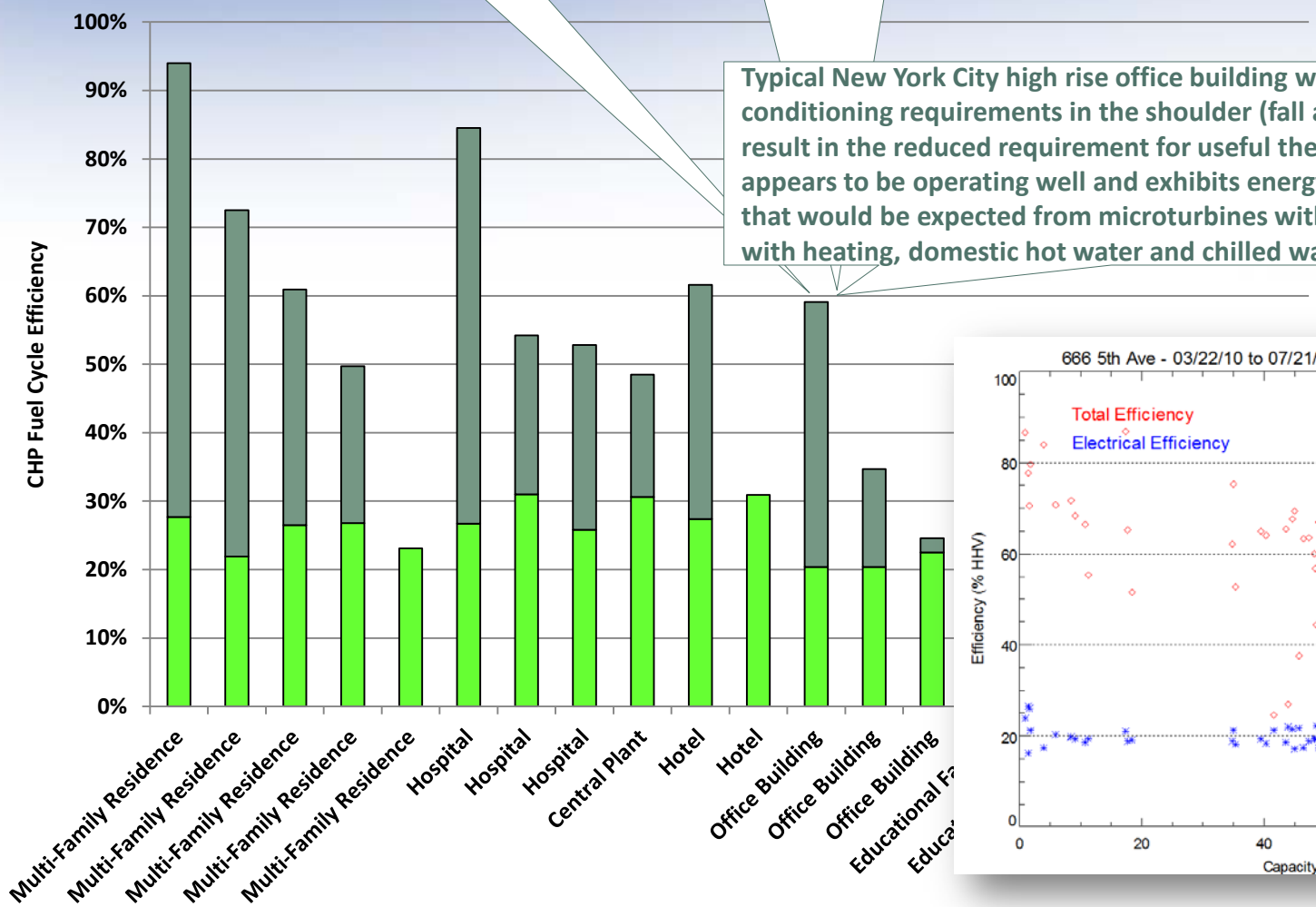
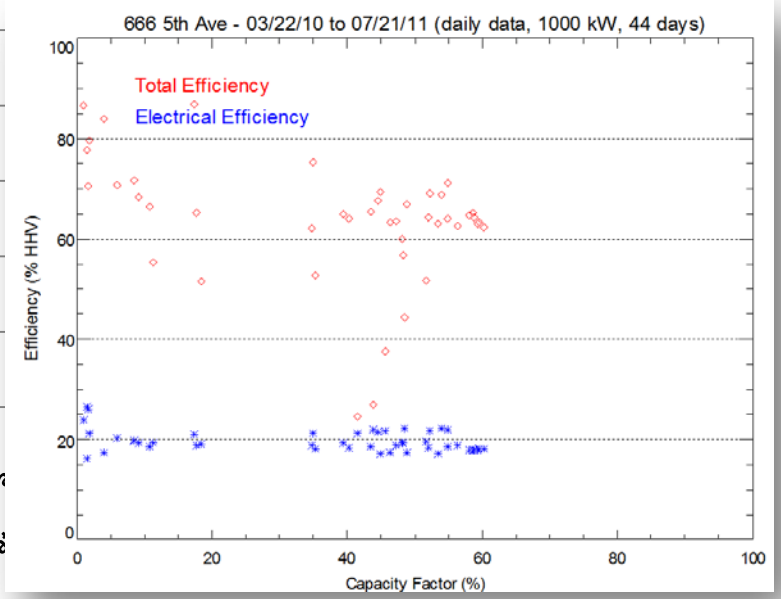
666 5th Avenue

10 x 100 kW MT = 1,000 kW Capacity

Typical New York City high rise office building with little or no space conditioning requirements in the shoulder (fall and spring) months which result in the reduced requirement for useful thermal energy. This system appears to be operating well and exhibits energy efficiency performance that would be expected from microturbines with waste heat integrated with heating, domestic hot water and chilled water systems.





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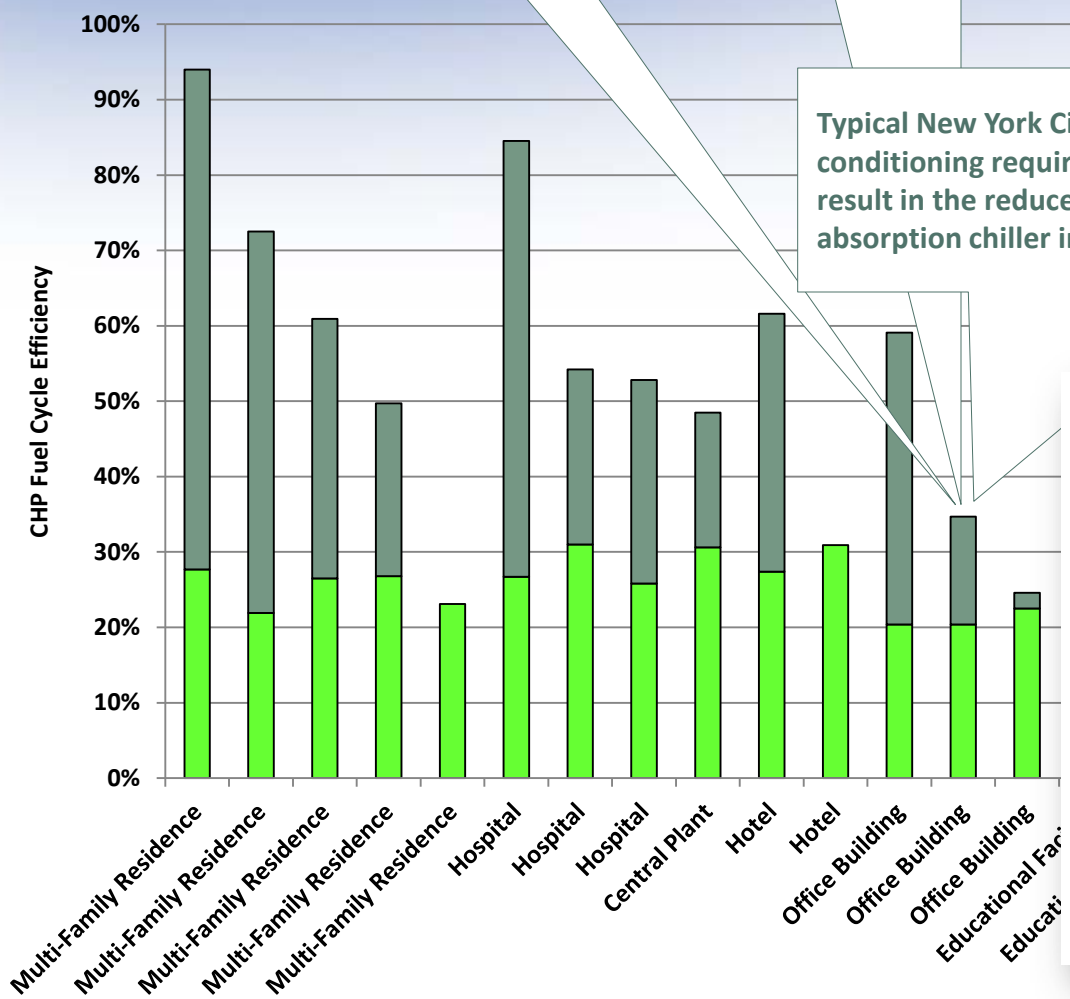
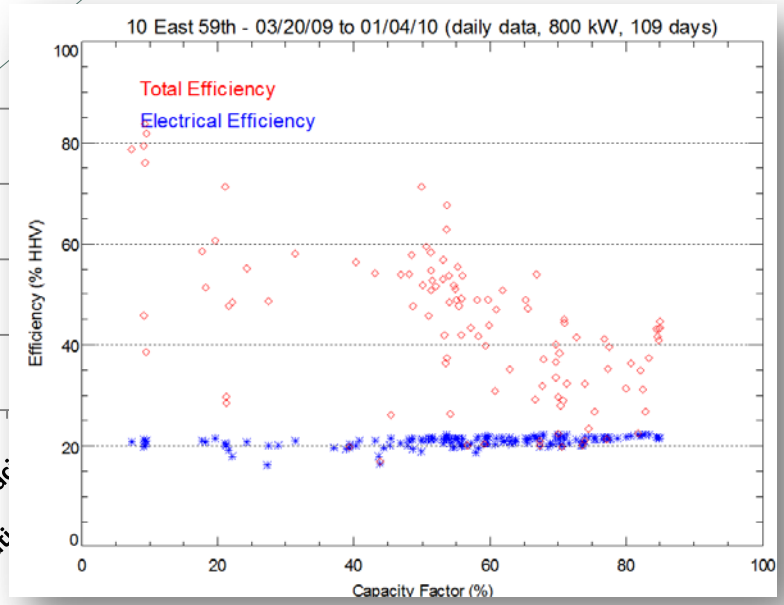
110 E 59th Street

8 x 100 kW MT = 800 kW Capacity

Typical New York City high rise office building with little or no space conditioning requirements in the shoulder (fall and spring) months which result in the reduced requirement for useful thermal energy. An absorption chiller installed in 2012 to provide cooling.





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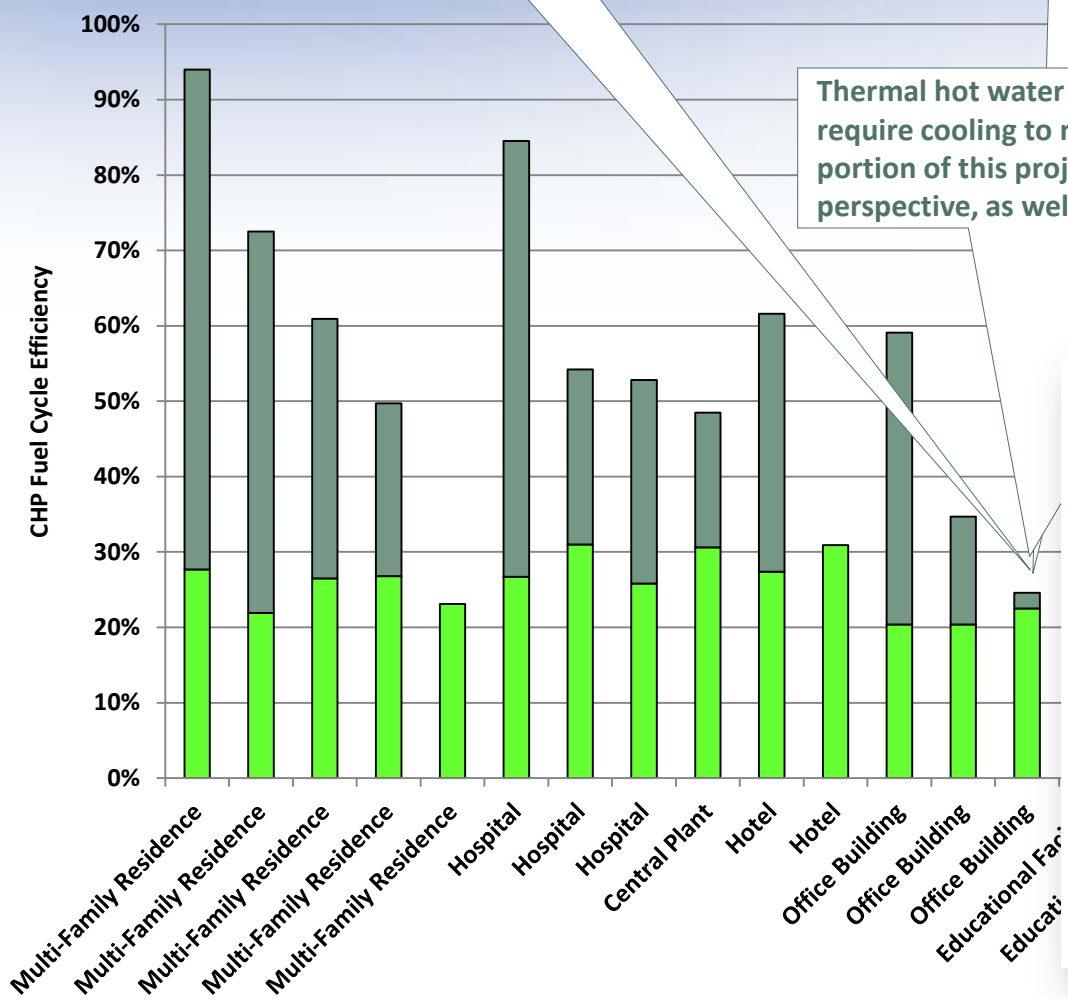
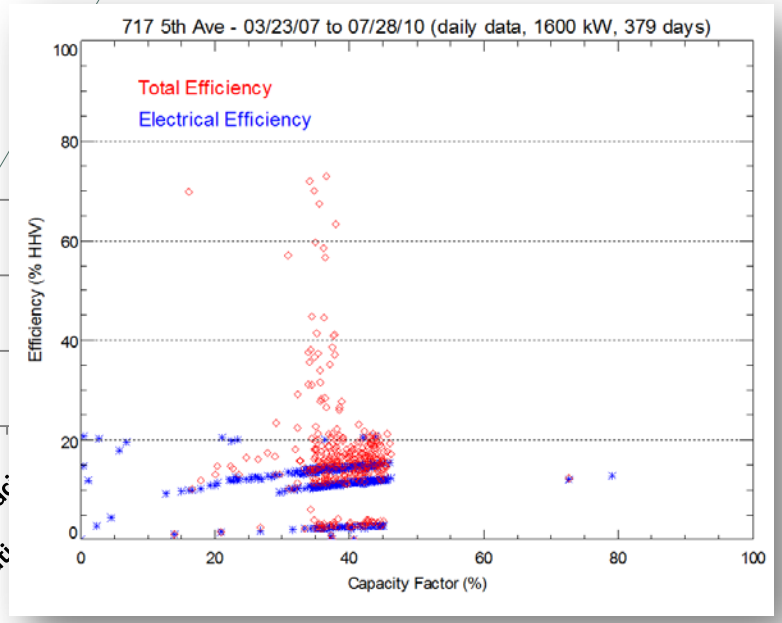
717 5th Ave

2 x 820 kW RE = 1,640 kW Capacity

Thermal hot water loads in office buildings are modest in the summer and require cooling to maintain system performance. The useful thermal portion of this project has been problematic from a general performance perspective, as well as, having unresolved data collection issues.





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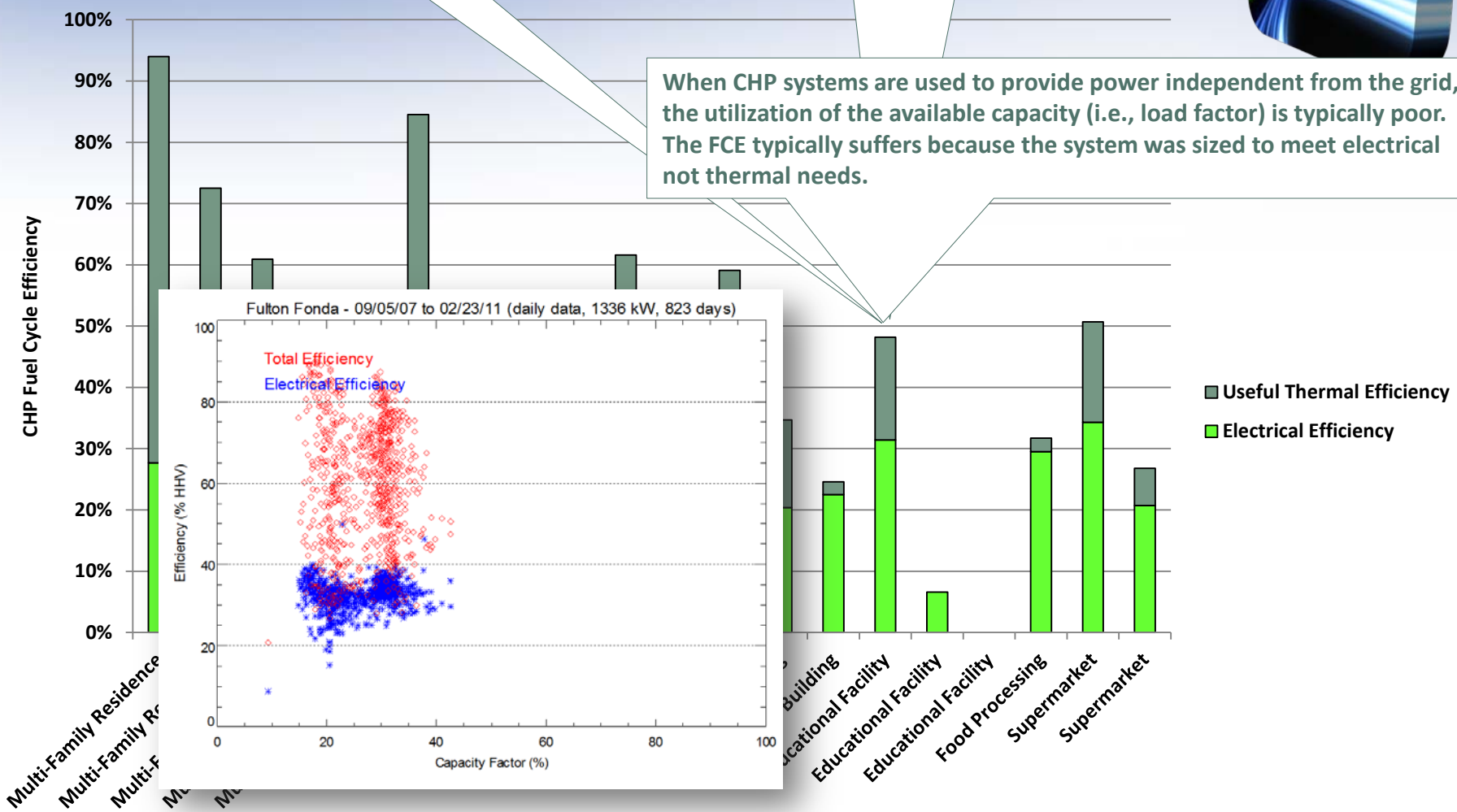
Fonda Fultonville CSD

4 x 330 kW RE = 1,320 kW Capacity

When CHP systems are used to provide power independent from the grid, the utilization of the available capacity (i.e., load factor) is typically poor. The FCE typically suffers because the system was sized to meet electrical not thermal needs.



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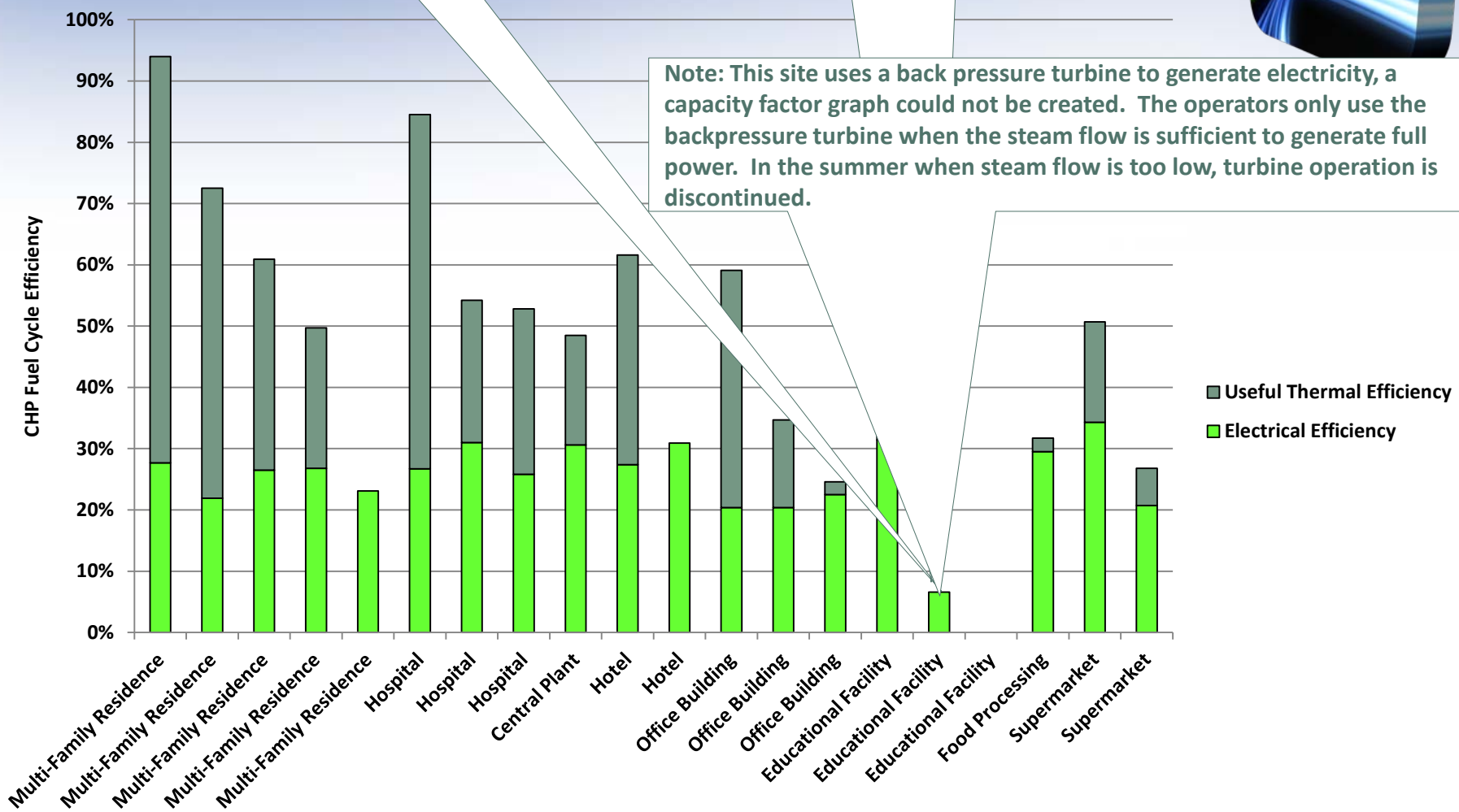
Vassar College

1 x 250 BPST = 250 kW Capacity

Note: This site uses a back pressure turbine to generate electricity, a capacity factor graph could not be created. The operators only use the backpressure turbine when the steam flow is sufficient to generate full power. In the summer when steam flow is too low, turbine operation is discontinued.



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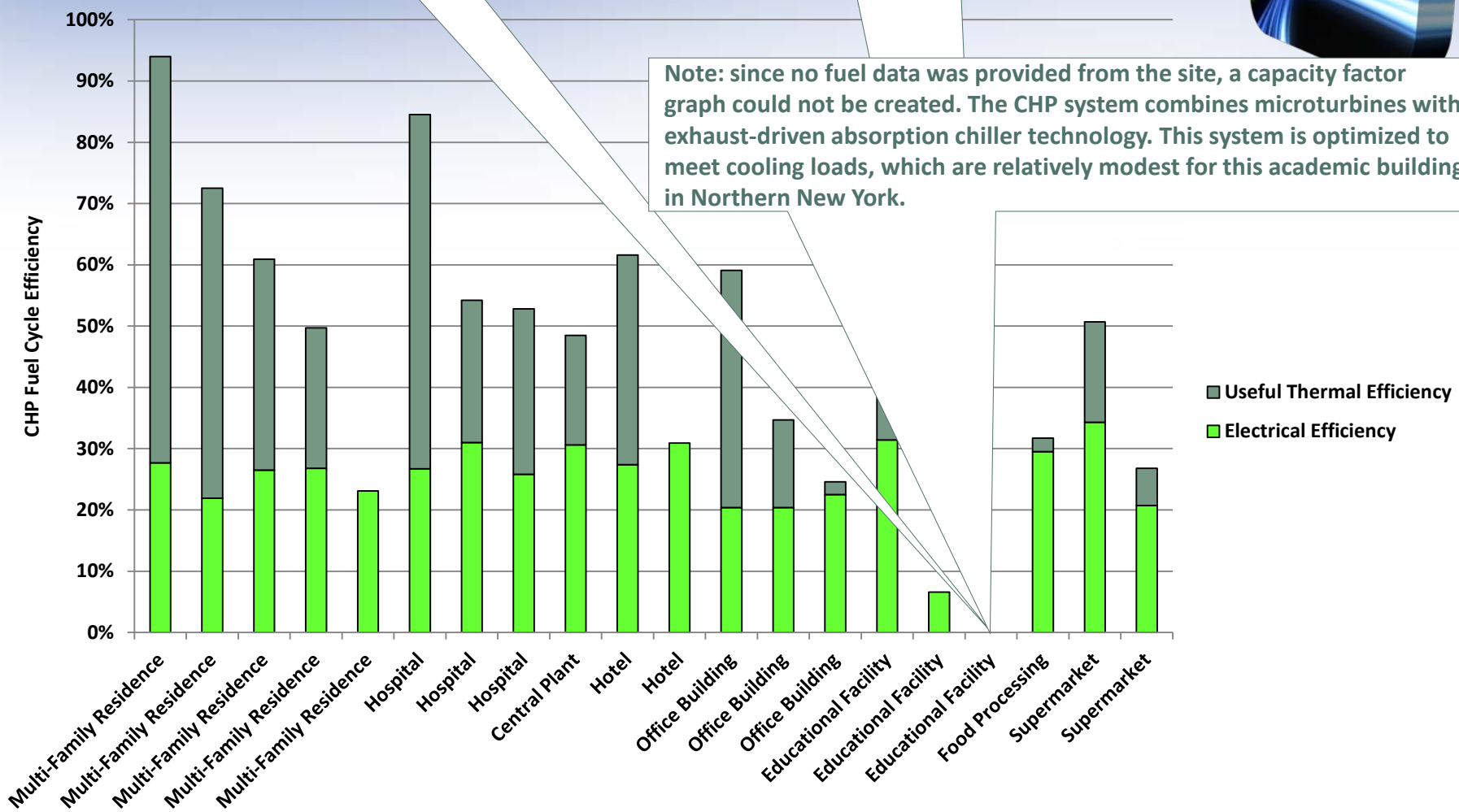
Clarkson University

3 x 65 kW MT = 195 kW Capacity

Note: since no fuel data was provided from the site, a capacity factor graph could not be created. The CHP system combines microturbines with exhaust-driven absorption chiller technology. This system is optimized to meet cooling loads, which are relatively modest for this academic building in Northern New York.



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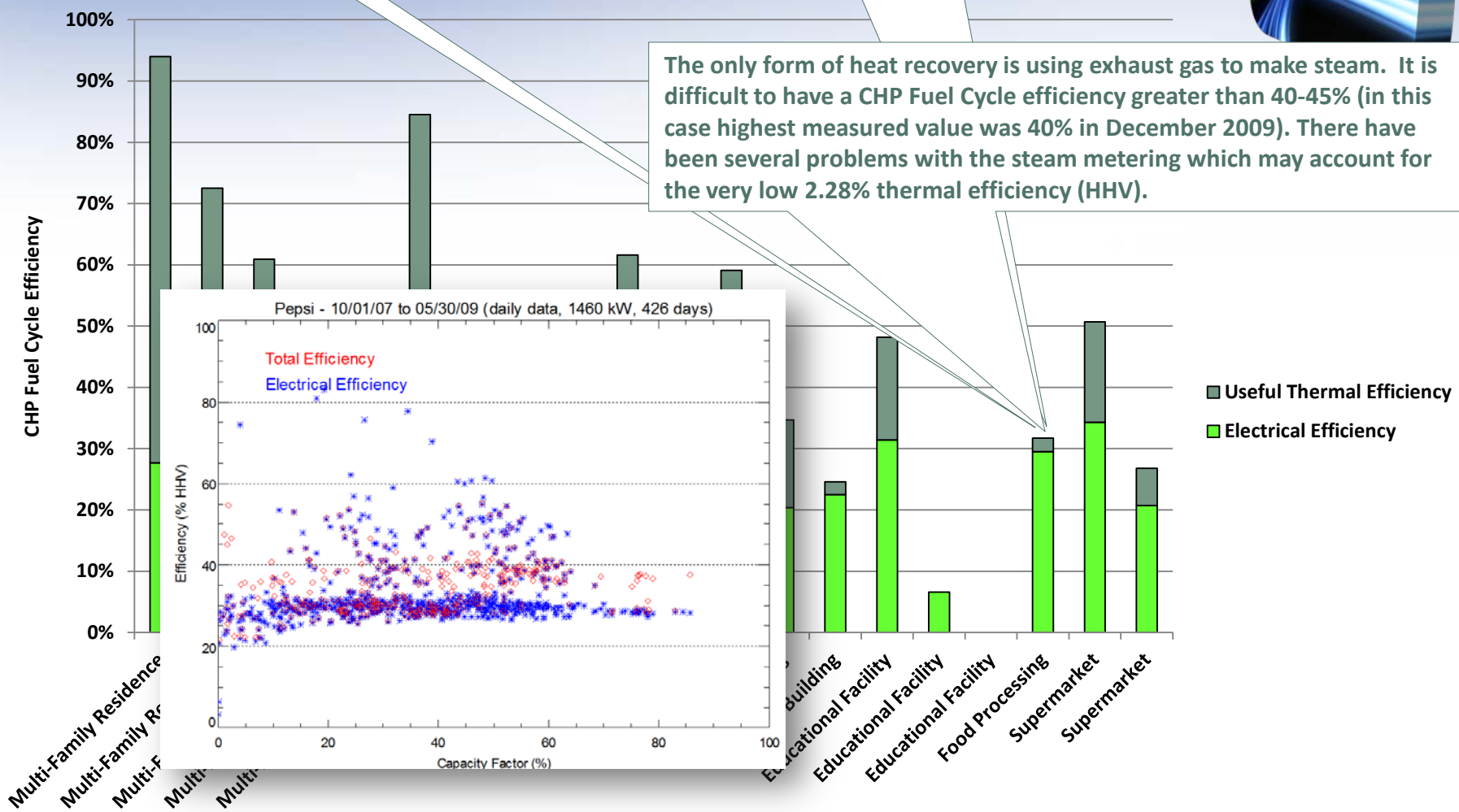
Pepsi Co.

4 x 365 kW RE = 1,460 kW Capacity

The only form of heat recovery is using exhaust gas to make steam. It is difficult to have a CHP Fuel Cycle efficiency greater than 40-45% (in this case highest measured value was 40% in December 2009). There have been several problems with the steam metering which may account for the very low 2.28% thermal efficiency (HHV).



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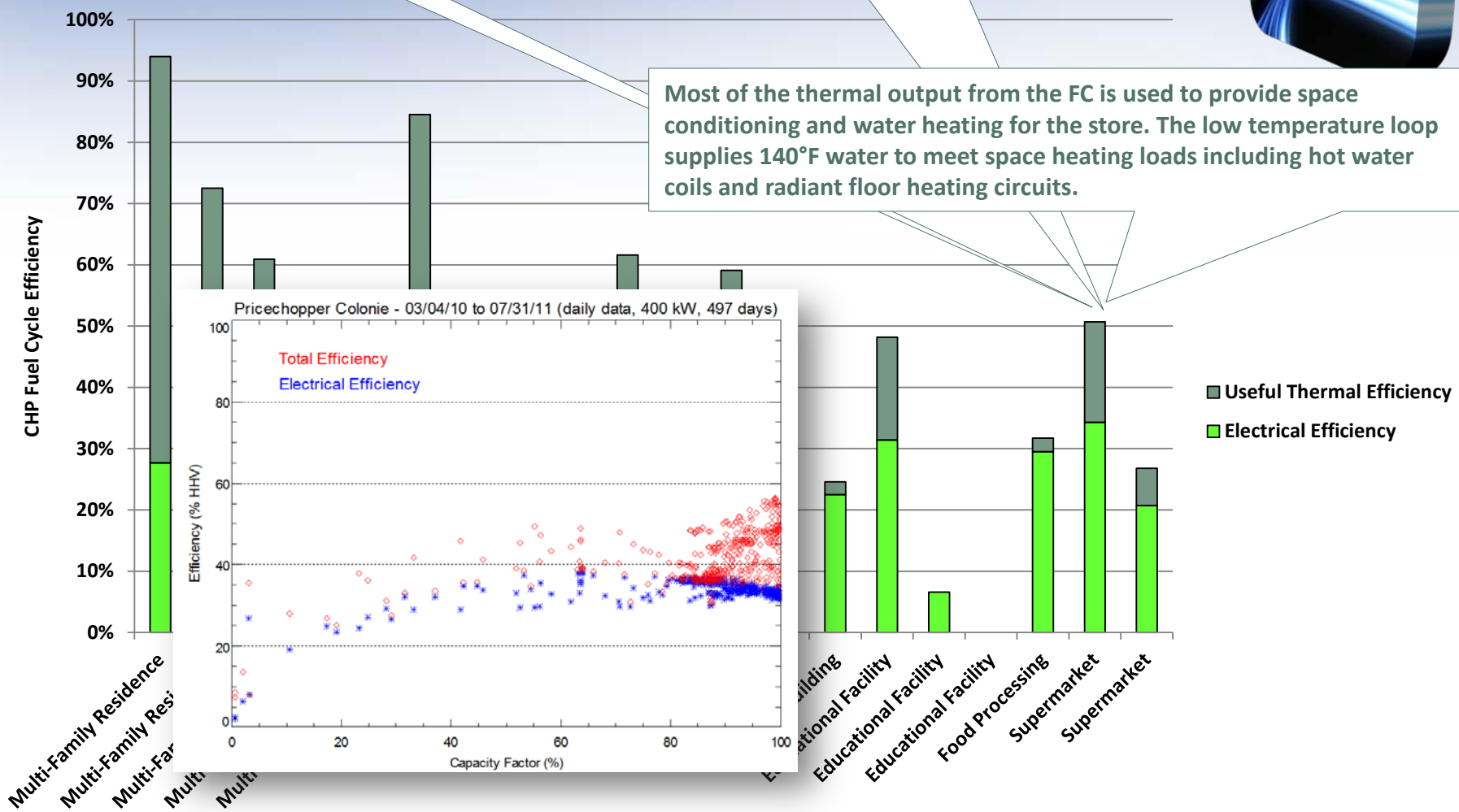
Price Chopper

1 x 400 kW PAFC = 400 kW Capacity

Most of the thermal output from the FC is used to provide space conditioning and water heating for the store. The low temperature loop supplies 140°F water to meet space heating loads including hot water coils and radiant floor heating circuits.



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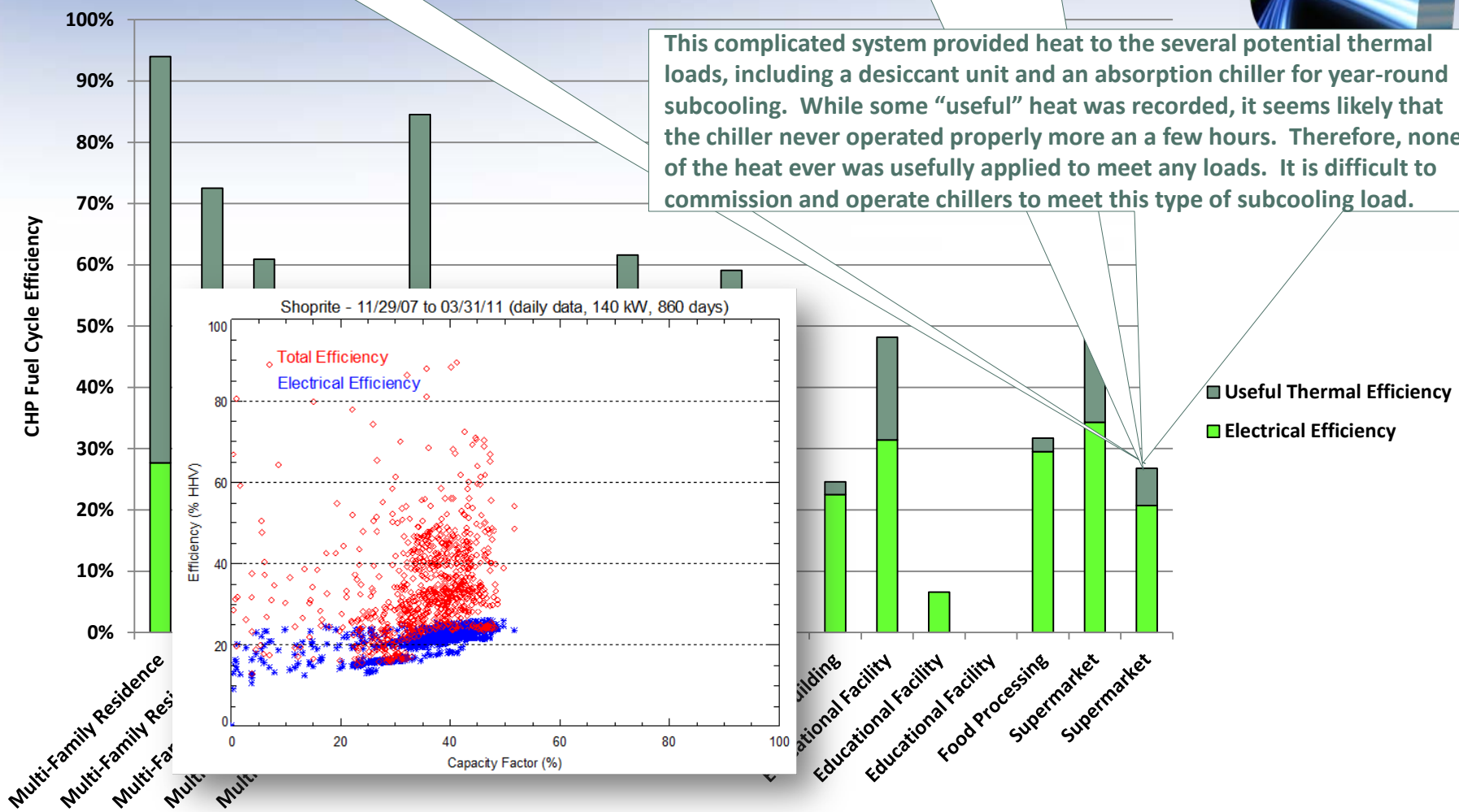
Shoprite Supermarket

1 x 140 kW RE & 1 x 15 RT = 140 kW Capacity

This complicated system provided heat to the several potential thermal loads, including a desiccant unit and an absorption chiller for year-round subcooling. While some "useful" heat was recorded, it seems likely that the chiller never operated properly more an a few hours. Therefore, none of the heat ever was usefully applied to meet any loads. It is difficult to commission and operate chillers to meet this type of subcooling load.



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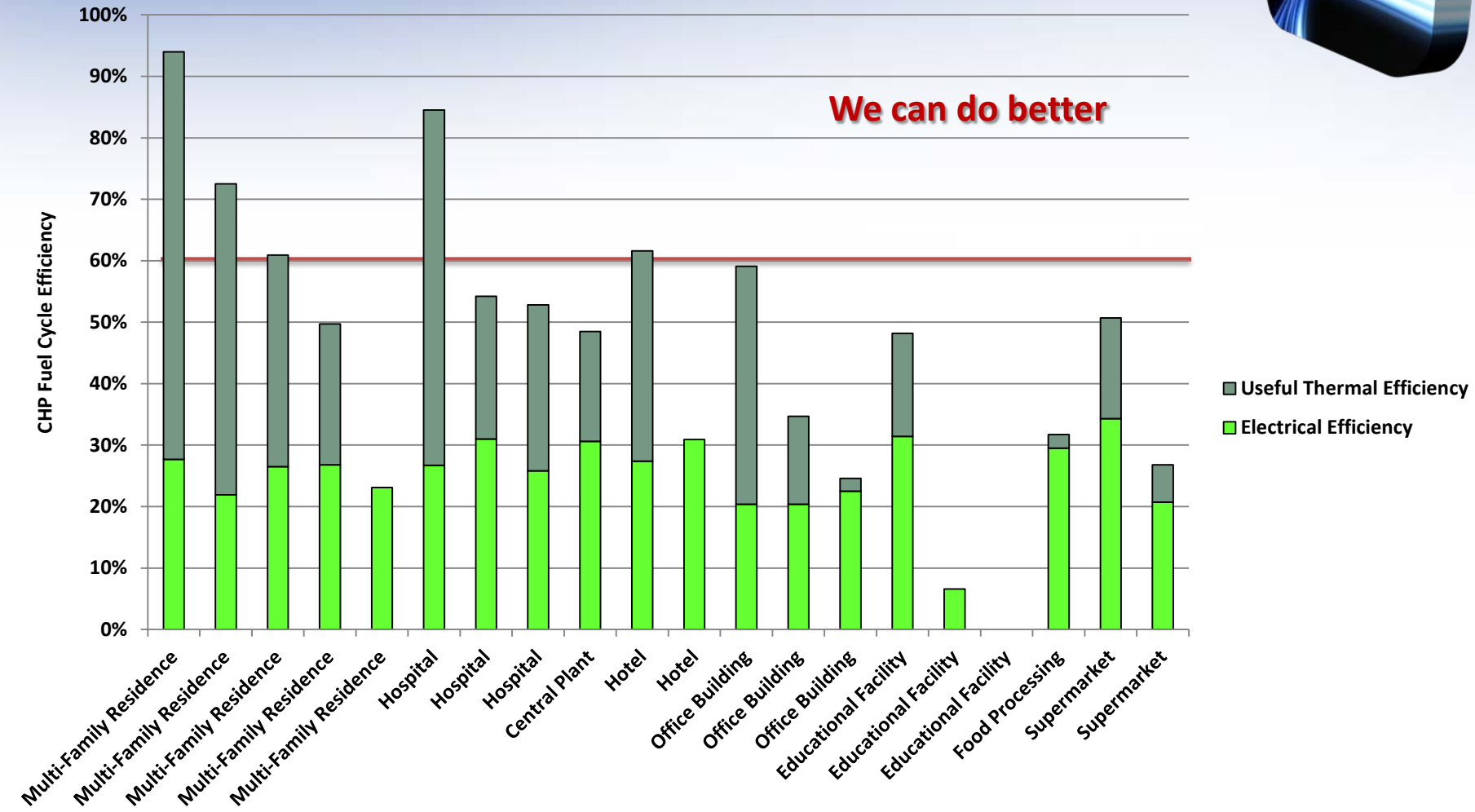
Conclusions



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Conclusions

- **Data Related:**

  Many CHP systems have various forms of thermal output: steam mass flow, chilled water, hot water from various sources, etc. All these types of thermal output need to be combined into one variable for the NYSERDA CHP (i.e., "Useful Thermal Output" variable). This simplification often eliminates information that is necessary to fully understand the performance of the CHP system.

Conclusions

- At the Burrstone site, multiple generators serve three different electric services and all the heat output serves one of the facilities. In addition some of the facilities are allowed to sell electricity back to the grid. This dispatch system provides better economic value than an operating scenario based on an scenario established from the initial feasibility analysis.
- The smaller engines showed some degradation in electrical efficiency over the first 2 years of operation. This finding confirms the need to have a long term maintenance plan for servicing and tuning engines in order to realize the expected life-cycle performance of these systems.
- Engine cycling accounts for the reduced power performance.
- Office buildings have limited thermal loads in the summer and swing seasons unless an absorption chiller can be used.
- Microturbines have a lower electrical efficiency than other technologies, especially in the summer when ambient temperatures are high.

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