



MIDWEST
CHP
APPLICATION
CENTER

Stevenson High School Heat Recovery Analysis



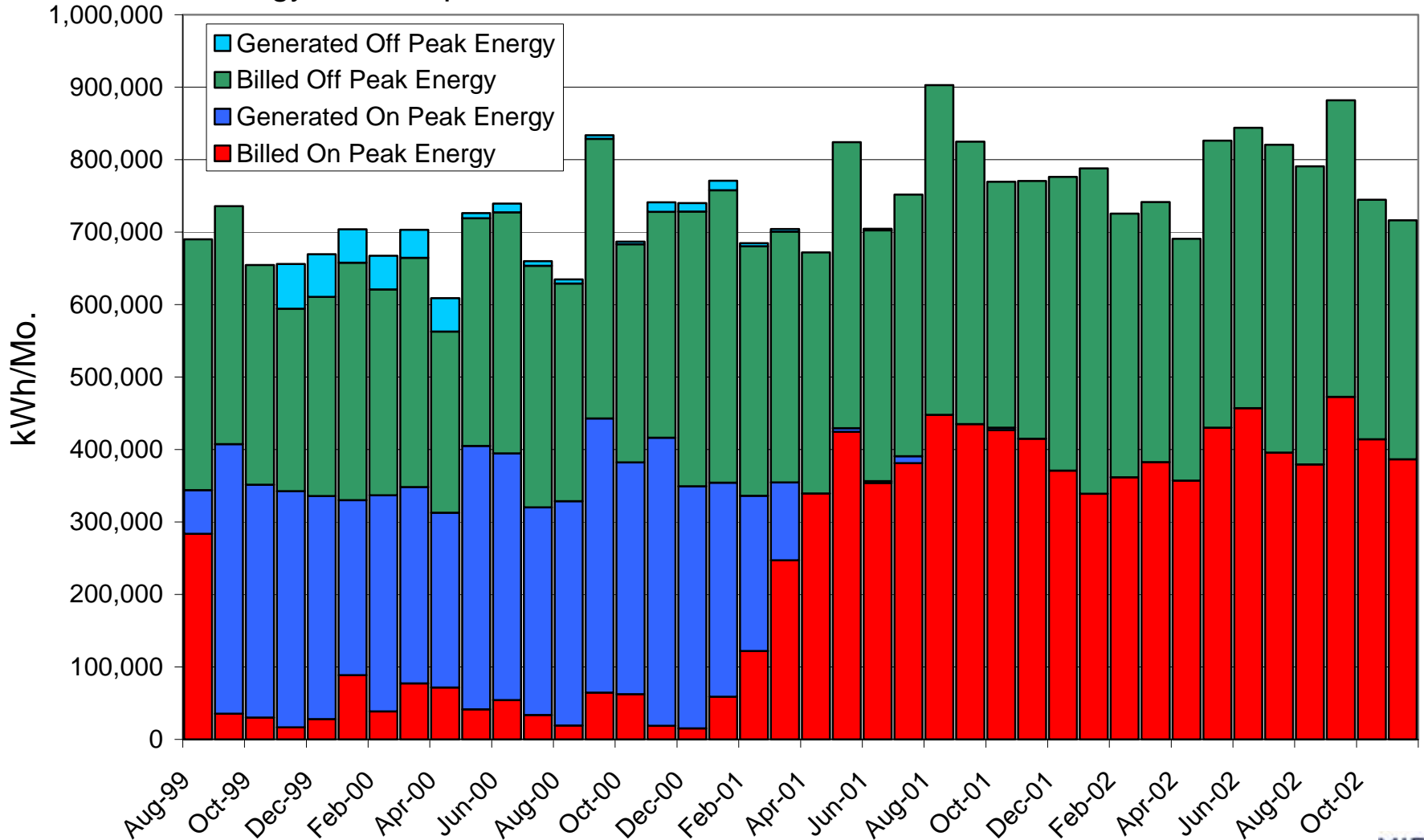
The Department of Energy
Midwest CHP Center
University of Illinois at Chicago
312-996-4302

Overview

- Large High School Facility
 - ~5,000 Students
 - Two Wings – East and West
 - Independently Served for Heating and Cooling
- Currently Has 2,250 kW of Generation
 - Has Been Out of Service Since Feb 2001
 - No Heat Recovery
 - Convenient Location to Pass Recovered Heat to Heating and Cooling System Serving East Wing

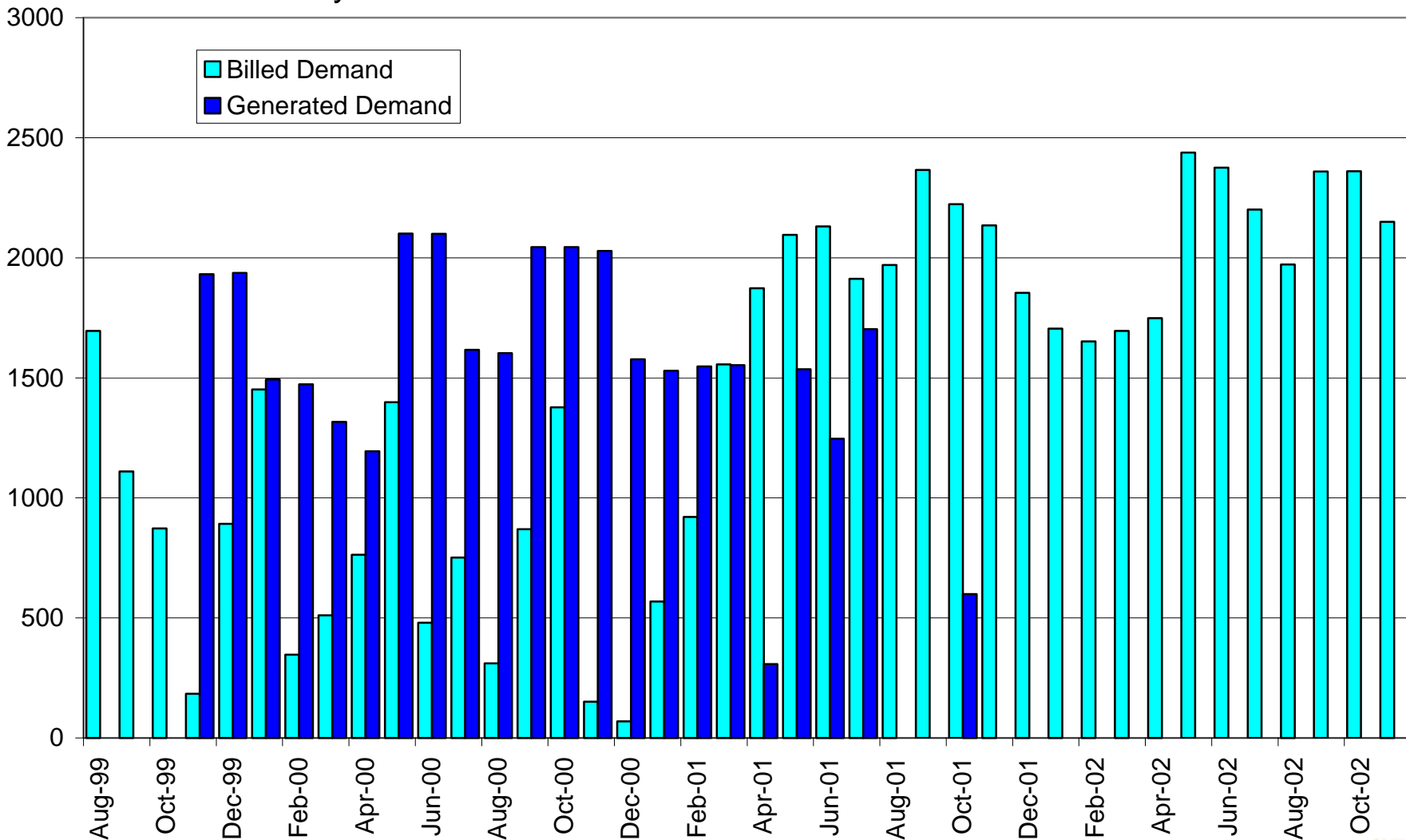
Electric Consumption and Source

Energy Consumption and Source



Electric Demand

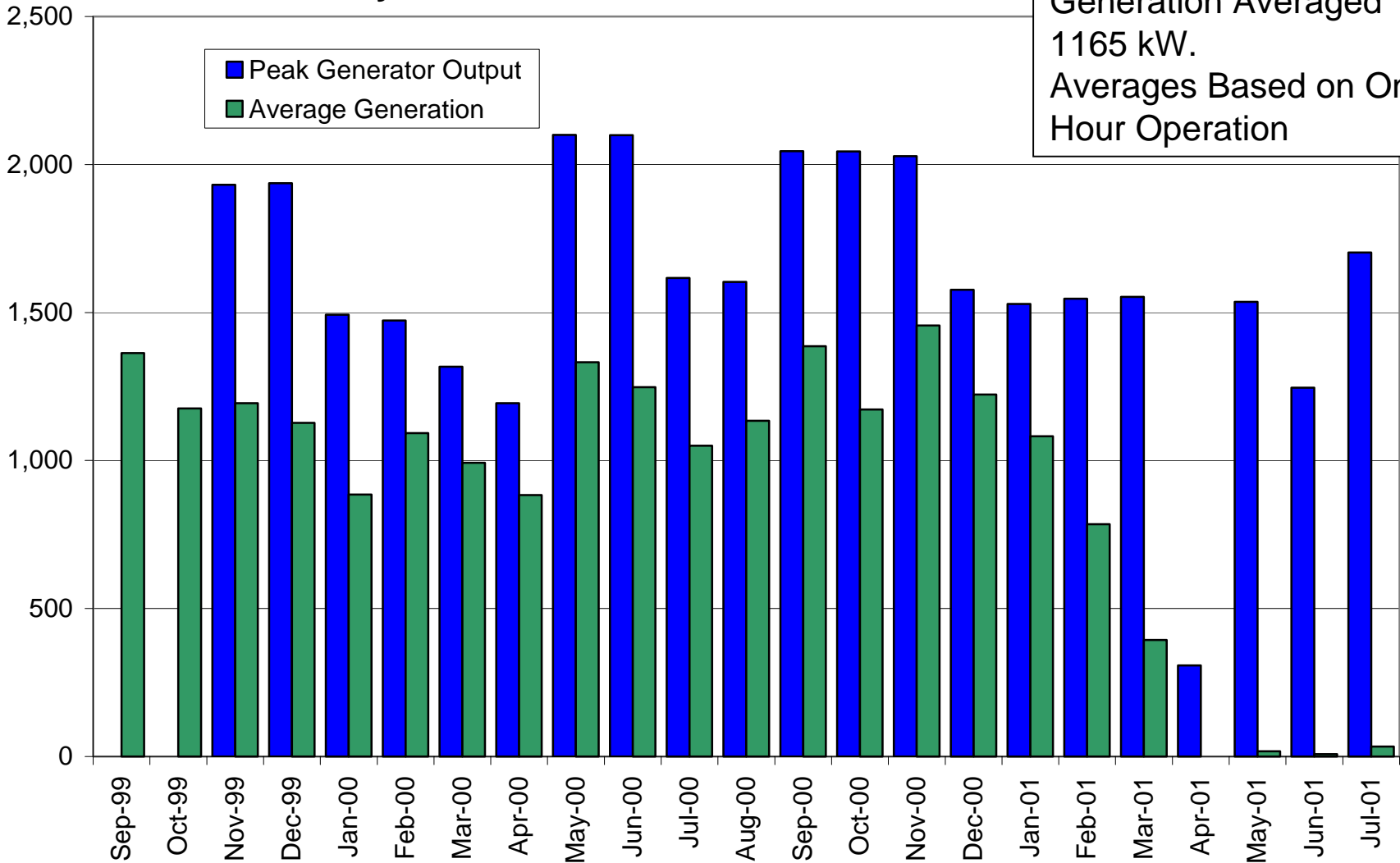
Demand History - kW



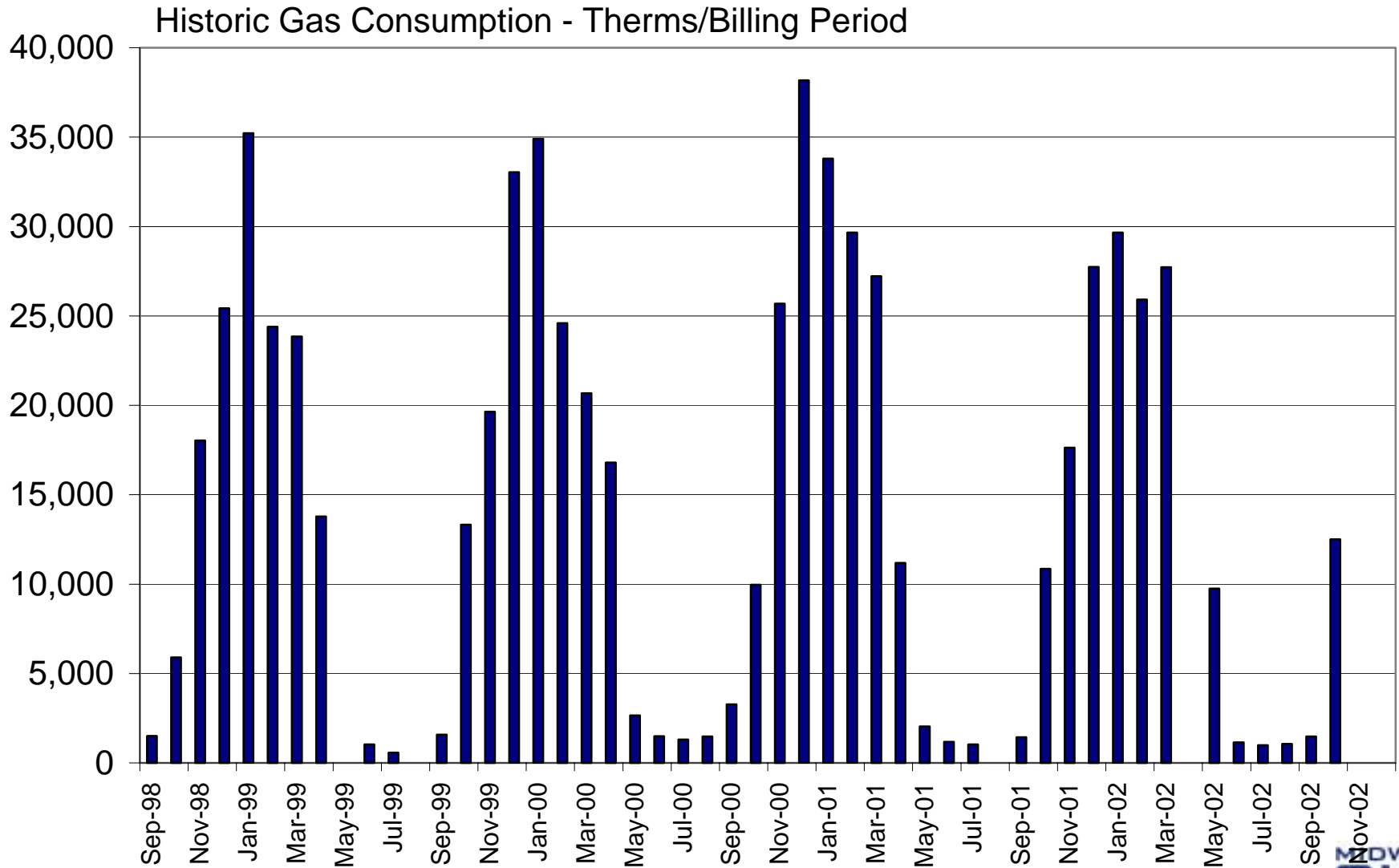
Generation History

Generator History kW

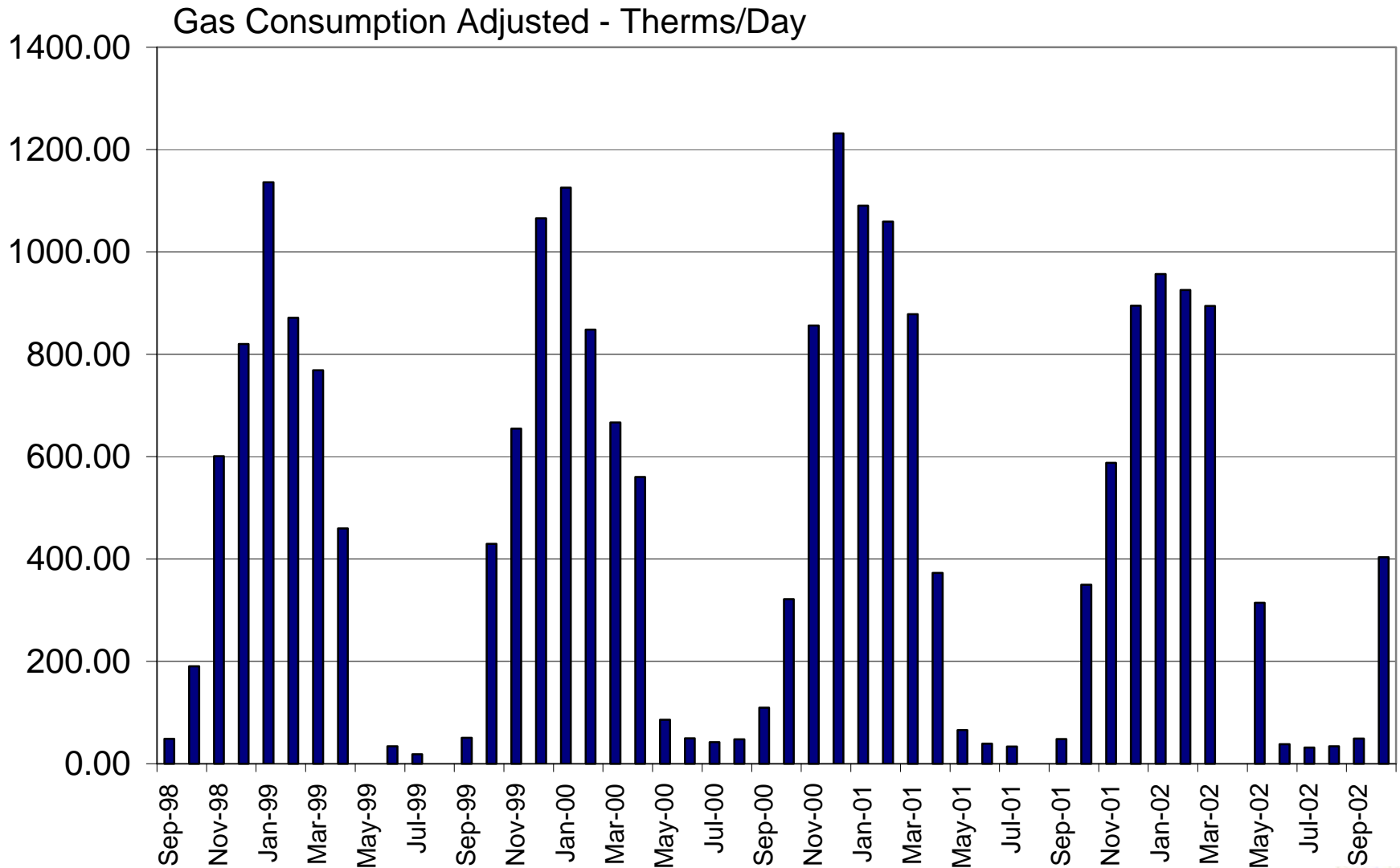
Generation Averaged
1165 kW.
Averages Based on On-Peak
Hour Operation



Gas Consumption for East Wing



Normalizing for Differing Length of Month



Need to Separate Usages

- Estimate Shower Loads
- Estimate Pool Loads
- Net Shower and Pool Loads Out of Total Gas Usage
- Net is the Space Heating Load

Shower Heating Estimate

Attendance	2,500	People
Assumed Gym Classes/Week	3	
School Day	7	hrs
Showers/Week	7,500	
Shower Duration	5	Min
Shower Flow	2	GPM
Shower Temp	110	F
Cold Water Temp	45	F
Water Heating Load	4,862	Btu/Shower
Thermal Use Per Day	5,209	MBtu/Day

Pool Heating Estimate

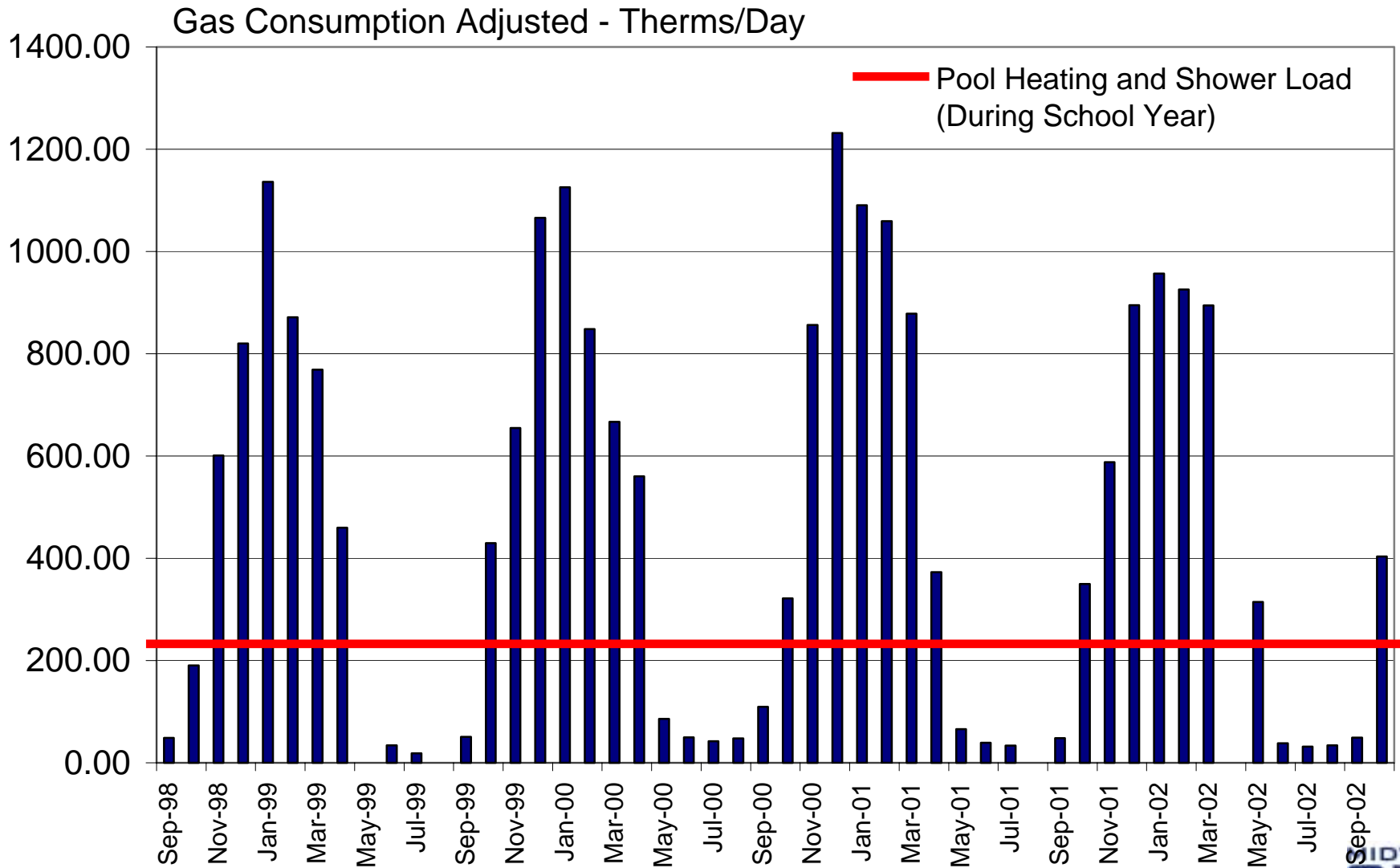
<u>Continuous Pool Heating Load</u>			
Pool Length		164	Ft
Pool Width		50	Ft
Pool Size		8,200	SF
Heat Loss Coefficient		11	Btu/hr/F
Pool Temp		80	F
Room Temp		72	F
Indoor/Outdoor Factor		1	
Heat Loss Load		516,600	Btu/Hr
Daily Heat Loss		12,398	MBtu/Day

Adjustment for Pool and Shower Heating

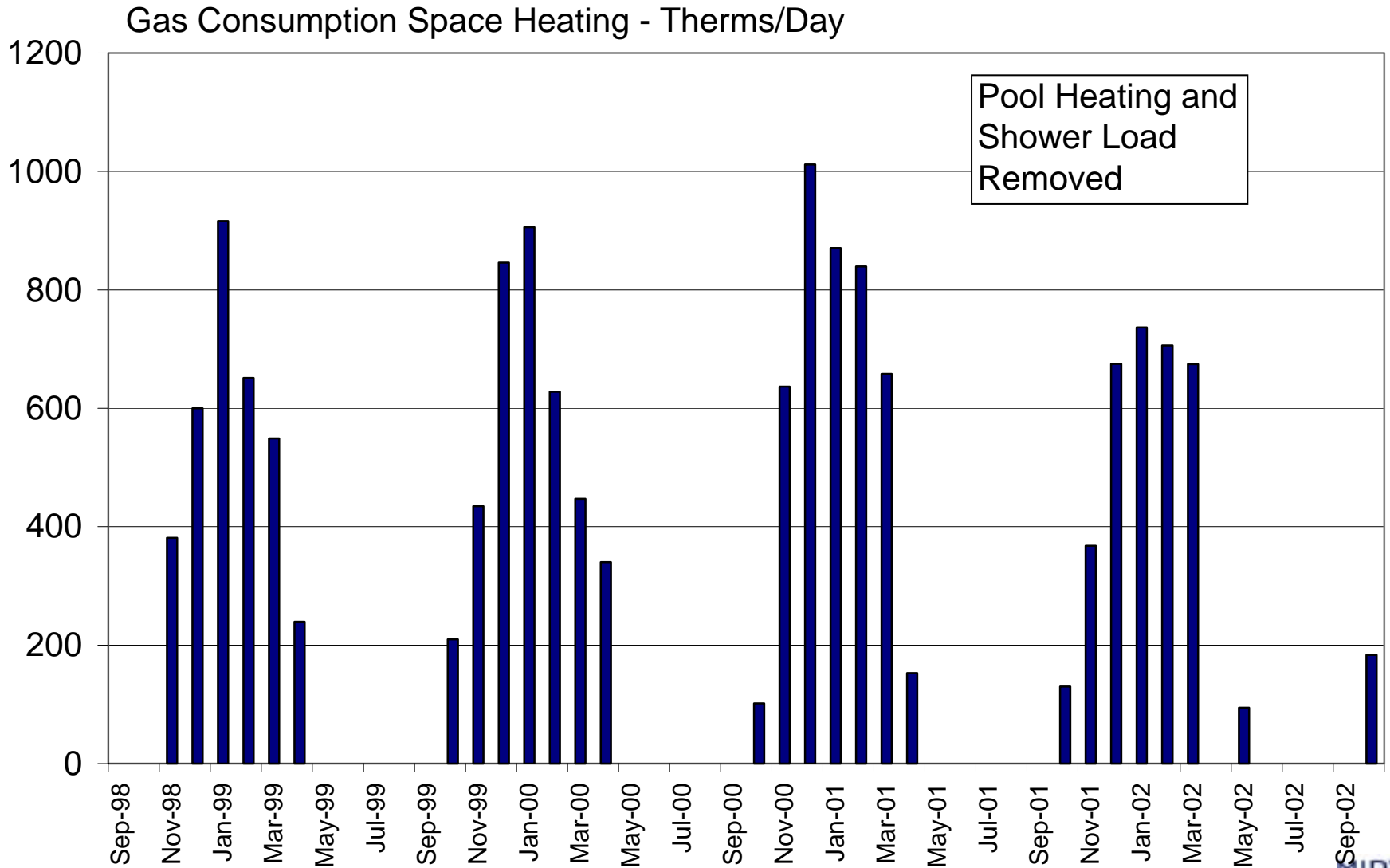
Normalizing Loads to Extract Heating Loads		
Daily Pool Load	12,398	MBtu/Day
Daily Shower Load	5,209	MBtu/Day
Effect on Gas Bills	220	Therms Day

- Loads Based on School Year Usage and Occupation
- Summer Gas Bills Indicate Loads is Much Lower in Summer Month
- Subtracting 220 Therms from Gas Bills and Correcting for Boiler Efficiency Gives an Approximate Heating Load
- Shower Load is Only During School Hours on Weekday.
- Pool Loads are Continuous

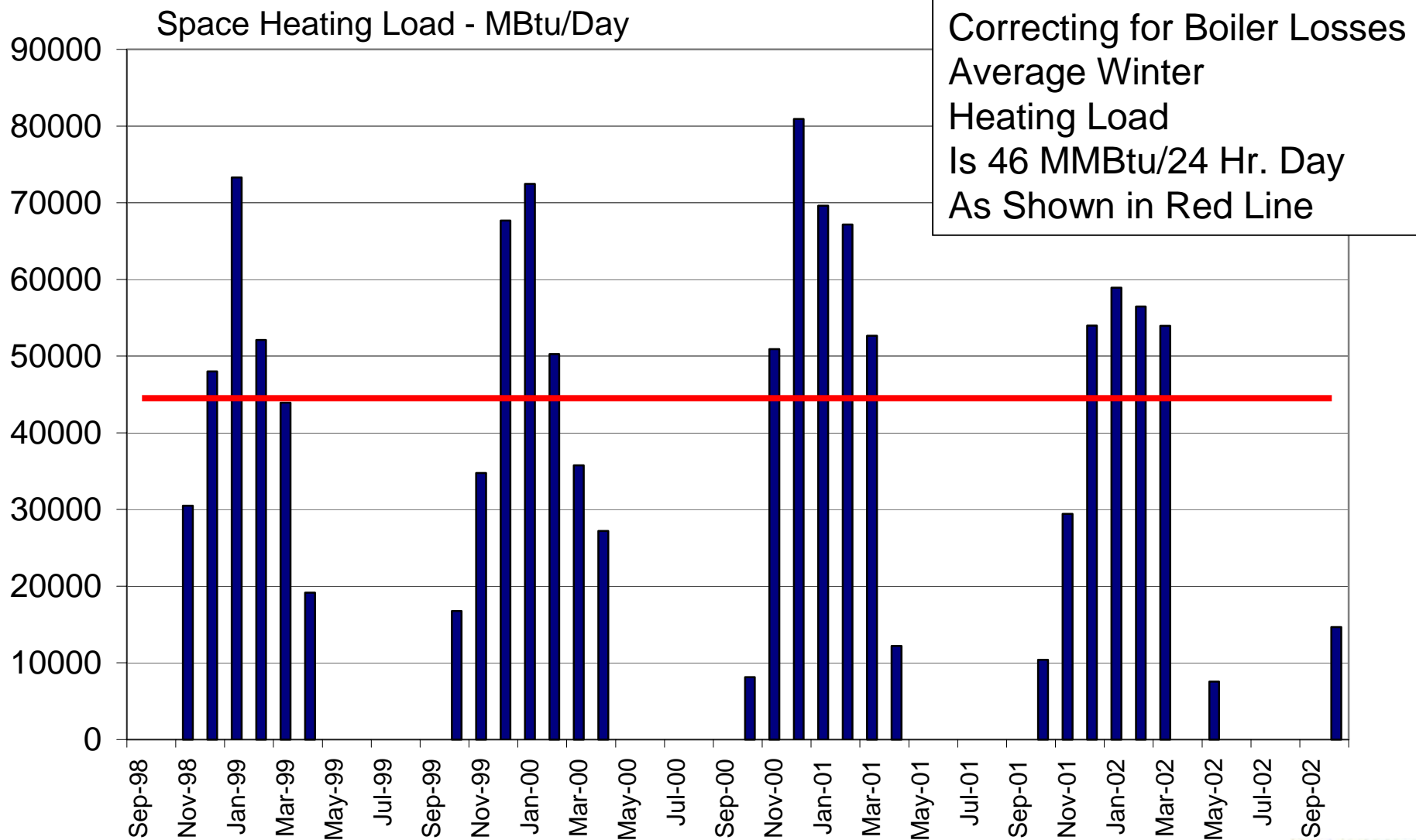
East Wing Gas Consumption



Gas Used for Space Heating Only



East Wing Heating Load



Heating Loads

	Average Month	Maximum Month	
Heating Load	46	80	MMBtu/Day
Heating Gas Load	58	100	Gas MMBtu/Day
13 Hr On-Peak Daytime Allocation	40%	40%	
13 Hr On-Peak Daytime Allocation	18	32	MMBtu Heating /On-Peak Period
13 Hr On-Peak Daytime Allocation	1,415	2,462	MBH Heating /On- Peak Period

Average Heating Load During On-Peak Per.

Continuous Pool Load	517	517	MBH
Shower Load - On Peak Hours	561	561	MBH
Winter Heat Load	1,415	2,462	MBH
Total	2,493	3,539	MBH
Generator Recoverable at 1800 kW	9,215	9,215	MBH
Generator Recoverable at 1165 kW	5,964	5,964	MBH

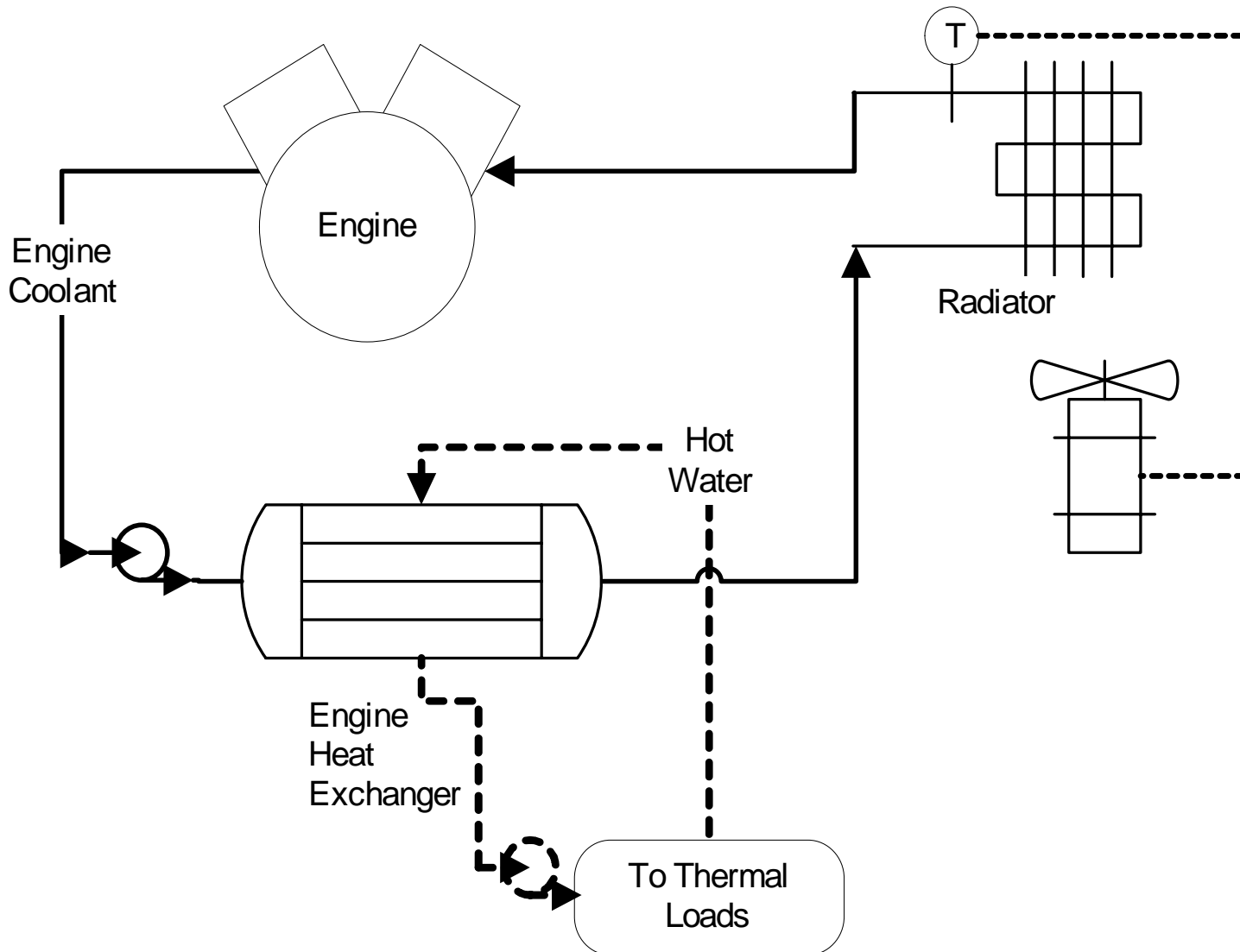
- The Generator Heat Rejection Tends to Exceed the Average Daytime Heating Loads on Even the Worst Months

Savings Controlled by What Can Be USED

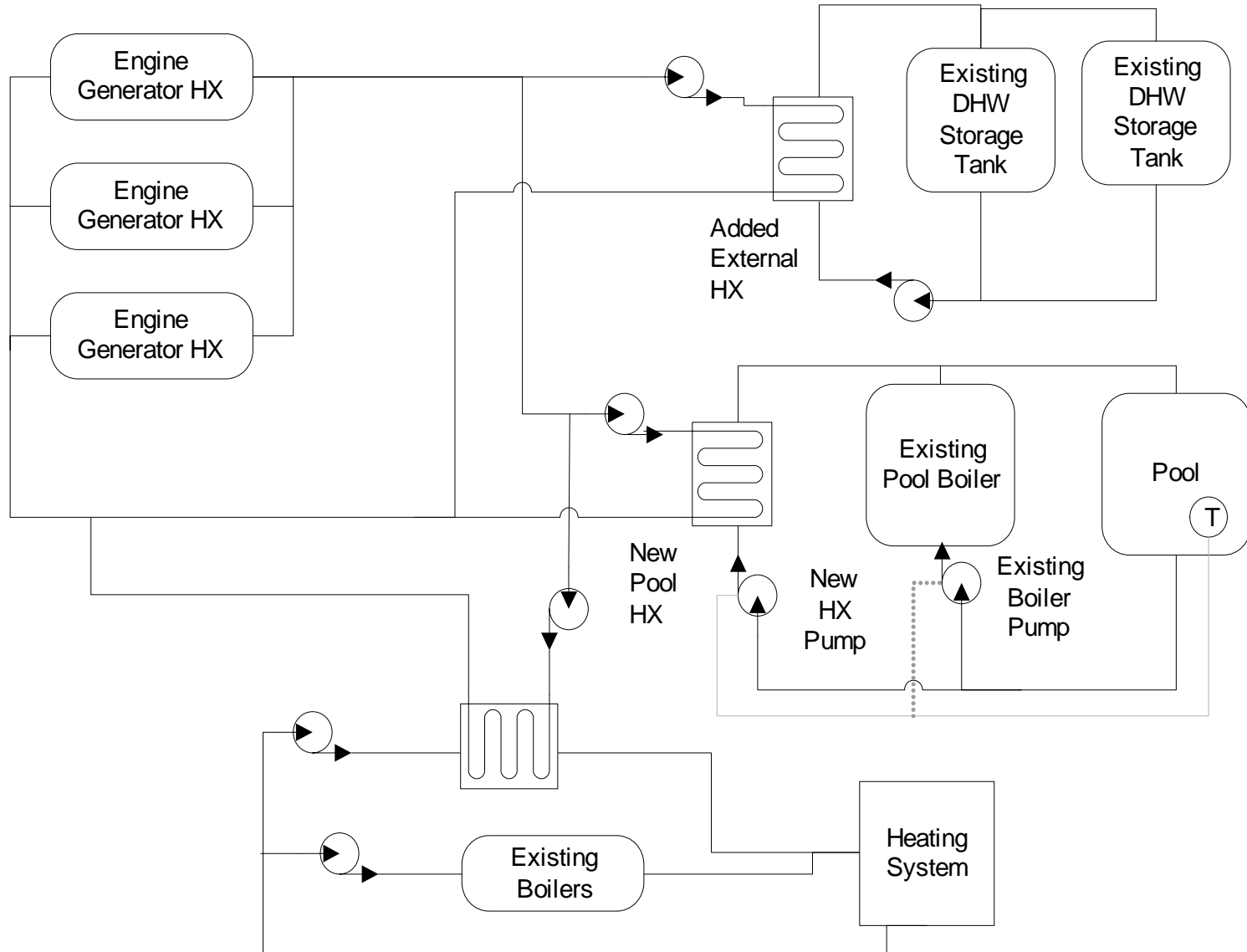
Heating Savings Calculation		
Average Daytime Heat Load	2.493	MMBtu/Hr.
Days/Week	5	
Hours /Week	65	
Weeks in 6 Month Heating Season	26	
Total Heat Savings	4,213	MMBtu/Yr
Total Gas Savings	5,266	MMBtu/Yr Gas
Gas Cost	\$5.400	MMBtu
Savings	\$28,439	Per Year

- As a Comparison – Annual Gas Use is ~ 15 MMBtu/Yr.
- At a Cost of \$92,000
 - All 2001 Values

Typical Engine Heat Recovery System

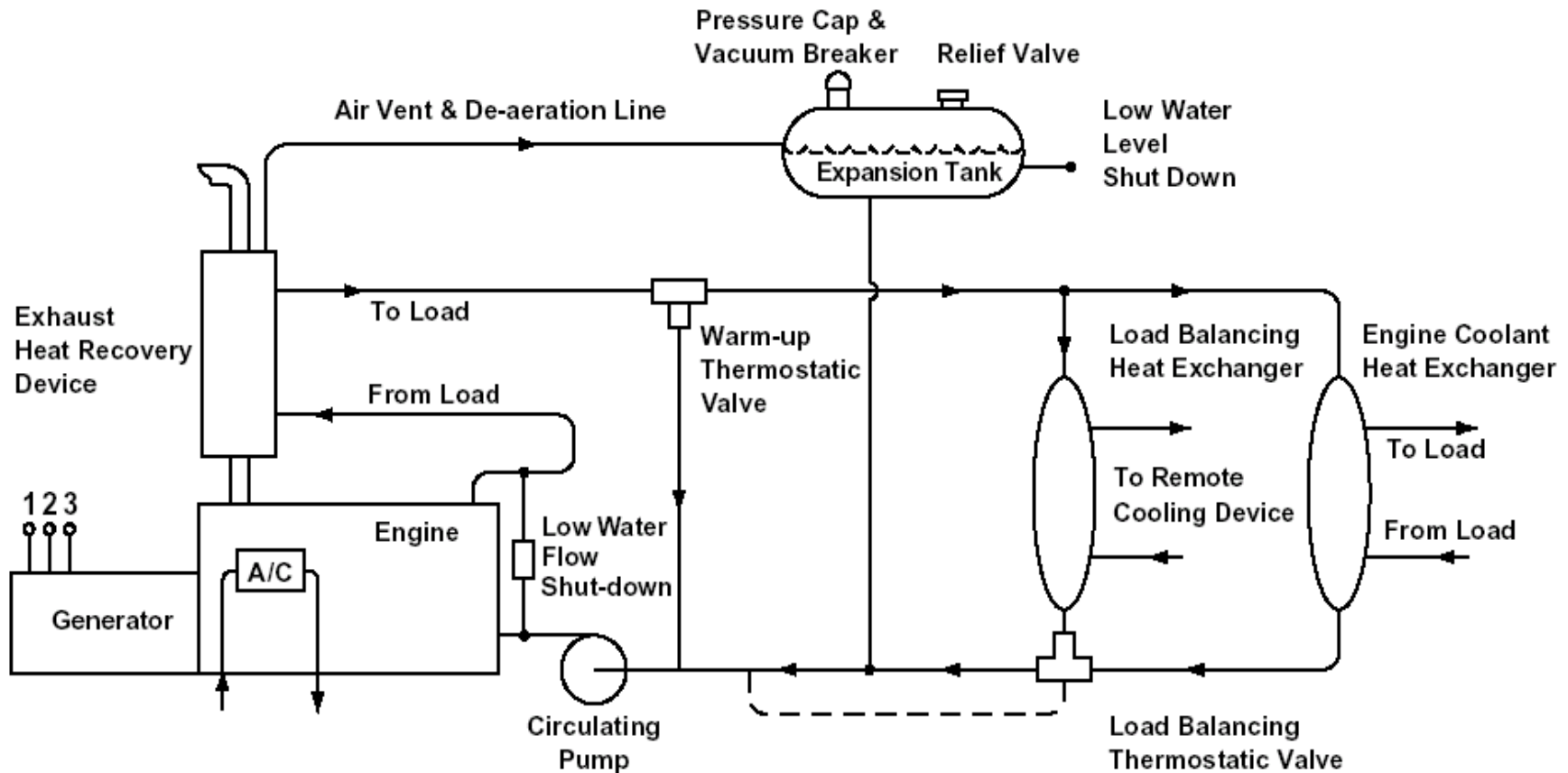


Possible Heat Recovery Piping to Loads



Caterpillar Layout with Jacket and Exh. Recovery (Recovery System < 100°C)

Standard Temperature Water System



Summary

- Recover Heat from All Engines at
 - Total Plant Operates at 1,800 kW (Aver) During the On-peak Period (9AM-10PM)
 - 13 Hrs/Day, 5 Day/Wk. Total of 65 Hr./Wk.
- Available Heat Exceeds the Needed Heat for This Wing
 - Average Winter Load 2.5 MMBH
 - Even at 1160 kW Gen Output, Heat Available is ~ 6 MMBH

Summary

- Recover Heat for Winter Heating
 - \$28,400 in Annual Savings
 - Equipment Needed
 - 3 Heat Recovery Heat Exchangers
 - Piping to Heating Equipment Mezzanine
 - Tie in with Separate Space, Pool, and DHW Heating Systems
 - Controls