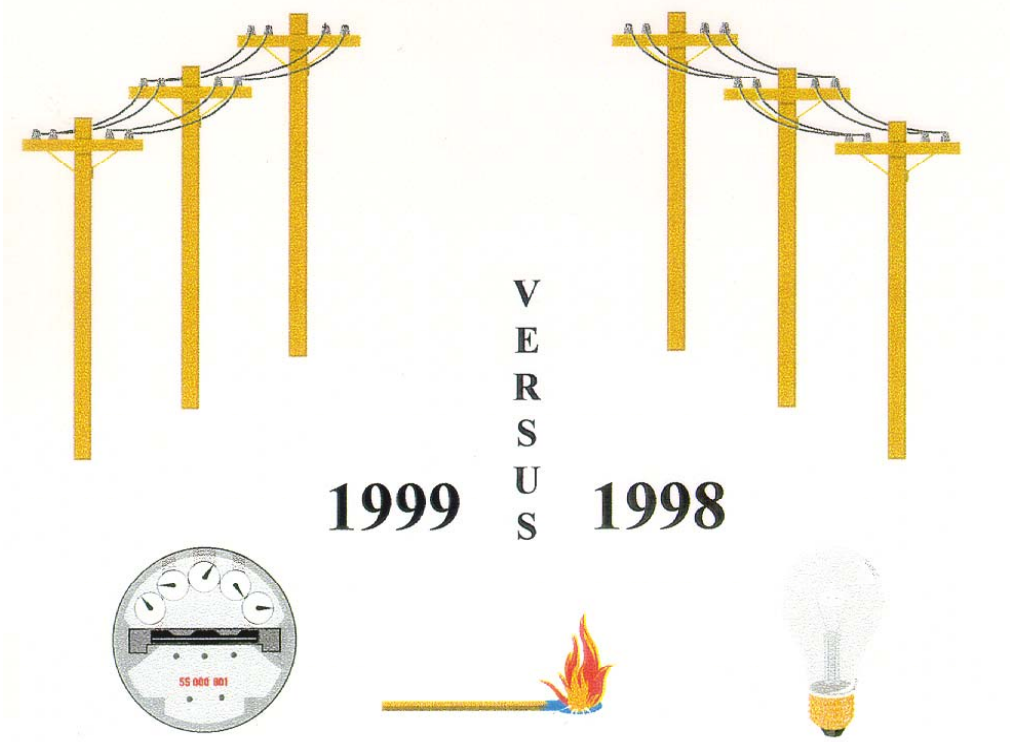
Energy Conservation Program Presentation
For Department of Electrical Engineering
Silesian Technical University, Gliwice



Building Energy Auditing

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Manczyk Energy Consulting

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Energy Management Program In Facilities

- An Energy Management Program is a systematic approach for controlling a building's energy utilization so as to reduce energy waste to the absolute minimum without adversely affecting the building's functional requirements.

- For a municipality to have a successful energy management program, it must create an environment of established goals to prevent waste and protect the assets of facilities; management must understand and support the importance of energy efficiency, environmental quality, and the programming of energy improvements; and a significant portion of energy savings must be reinvested in the energy management program.

Goals and Objectives

- Audit the energy consumption of selected buildings to determine which types of energy are used and the amount of each.
- Analyze which operations/processes consume extensive amounts of energy in each building
- Plan measures by which individual building can conserve energy used in their high-energy using operations/processes.
- Provide consultation to managers of buildings that were audited in an attempt to reduce the consumption of energy in their facility.
- Provide a pathway to benchmark energy conservation methods that can be used in other buildings and facilities.
- Identify the major construction, maintenance and design features that make building energy efficient.

Strategies of Energy Savings Program - "1"

1. **Evaluate Your Facilities to Identify Potential Energy Savings Measures**

a. Perform energy accounting audit of facilities, compare results to industry standards.
b. Assess potential energy savings opportunities in each facility, including building envelope as well as mechanical and engineering systems based on energy audit results by means of a "walk-through audit."
c. Inventory mechanical and electrical systems and their operating schedules.
d. Identify existing monitoring and metering equipment.
e. Interview facilities' users about operating and comfort needs.
f. Evaluate the facility operating schedule and the operating and maintenance practices of current operation and maintenance staff.
g. Develop a "potential energy savings opportunity checklist" for each facility.
h. Select, evaluate the feasibility of and design new, energy-efficient systems and equipment that may be implemented in each facility.

Consider such measures:

(1) Computerized energy management systems for automated equipment operation and monitoring and performance and energy consumption;
(2) Additional monitoring and metering equipment;
(3) Integration of innovative technologies.

Strategies of Energy Savings Program - “2”

2. Examine Your Regulatory and Rate/Cost Environment

a. Determine whether and how local utility or energy supply costs vary with time of use, season of use, peak usage, etc.

b. Identify sources for lowest cost purchase of fuels and electricity.

c. Identify relevant local standards for indoor air quality, environmental emissions, etc. that apply to your facilities.

Strategies of Energy Savings Program - “3”

3. Examine Financial Opportunities

a. Identify grants, incentives, etc., available from local, national, and international sources that may apply to your facilities.

b. Consider potential collaborations and partnerships with other local industries, utilities, governmental facilities, etc.

Strategies of Energy Savings Program - "4"

4. Analyze the economics and feasibility of opportunities for Energy Savings measures identified above including potential savings, long-term cost avoidance, and payback periods

a. Determine implementation schedule, costs, and payback period for each measure.
b. Identify and implement measures that you can finance from your current operating budget by applying savings from current cost reductions (these will generally be low-cost/no-cost measures).
c. Project the cost savings and cost avoidance value of all measures for a 3-5 year period beyond your current budget year.
d. Program standards:
   (1) The first program implemented in a conventional facility should yield up to a 40% energy consumption reduction.
   (2) Subsequent programs implemented should maintain or reduce the accomplished levels of energy consumption.
   (3) Measures should result in:
      a) longer service lives of building systems;
      b) environmental improvements; and,
      c) maintain comfort levels and other services provided for building occupants.

Why Should You Have An Energy Accounting Audit

You can't manage what you don't measure!

Purposes:

- Track utility costs
- Account for current energy consumption and cost
- Identify areas where opportunities for savings may exist
- Justify capital investment decisions
- Identify and correct consumption problems
- Pinpoint billing errors

Building Energy Accounting Audit

- Identify relationships between energy use and factors such as occupancy and outdoor temperatures.

- Once patterns are established, potential problems such as equipment malfunctions can be identified and corrected.

Information Gathering - 1

- Assemble copies of all monthly utility bills.
- Characterize utility bills either by building or by meter, and organize them into 12-month blocks using the meter-read dates.
- Familiarize yourself with all meters and sub-meters. If several meters are used, it is helpful to clearly label them on a blueprint for each facility being monitored.
- Determine which facility or space is being served by each meter.

Information Gathering - 2

- Obtain historical energy data to establish a base year. If you don't have this information in your files, it can be obtained from your local utility company.

- Obtain degree-day data. This information may be obtained from your utility company, National Oceanic and Atmospheric Administration, or your local weather stations.

Purpose Of The Audit

- **The building energy accounting audit provides a detailed weather-adjusted evaluation of the historical energy utility (electric, natural gas, oil, and steam) usage and costs for the facility that was audited.**

An Audit Will Assist In:

- The initial stages of project development;
- The ongoing monitoring and verification of a specific facility's project savings; and,
- Identifying facilities to target conservation project efforts supported by an energy audit and complete economic analysis.

Comparative Energy Consumption

Apollo Office Building

Comparative Energy Usage

1999 vs 1998

	Non-Weather Related Energy				Weather Related Energy					
	Electric Consumption, KWH		Electric Costs		Steam Consumption, M-Lbs		Steam Costs		Degree Days	
	1998	1999	1998	1999	1998	1999	1998	1999	1998 D.D.	1999 D.D.
Jan	227,418	203,383	$22,421.60	$19,952.37	527.3	919.7	$4,603.33	$7,449.57	1,033	1,295
Feb	208,619	179,951	$20,776.34	$18,078.52	448.2	657.2	$3,912.79	$5,323.32	900	952
Mar	202,848	185,158	$20,306.09	$18,415.97	488.6	742.2	$4,265.48	$6,011.82	837	1056
Apr	227,492	186,749	$22,859.58	$18,937.53	213.1	215.5	$1,860.36	$1,745.55	507	585
May	220,125	178,854	$22,688.75	$19,208.25	26.5	20.2	$231.35	$163.62	114	194
Jun	222,917	202,773	$23,063.63	$21,504.25	0	0	$0.00	$0.00	114	57
Jul	245,599	226,457	$24,702.13	$23,127.21	0	0	$0.00	$0.00	4	2
Aug	219,681	213,470	$22,755.12	$19,629.41	0	0	$0.00	$0.00	11	25
Sep	210,197	196,599	$21,852.04	$18,061.44	0	0	$0.00	$0.00	115	93
Oct	183,938	172,914	$19,615.44	$16,242.93	139.9	212.9	$1,133.19	$1,728.75	425	431
Nov	163,117	160,089	$16,779.54	$15,386.82	461	426.5	$3,734.10	$3,463.18	686	584
Dec	165,758	164,589	$17,009.35	$14,978.76	457.1	483.3	$3,702.51	$3,924.40	929	1012
Total	2,497,709	2,270,986	$254,829.61	$223,523.46	2,762	3,678	$23,443.10	$29,810.20	5,675	6,286

Energy Performance Indicators Current Year Versus Prior Year

Apollo Office Building

MONTH		ELECTRIC CONSUMPTION	ELECTRIC COST	STEAM CONSUMPTION	STEAM COST	DEGREE DAYS
Jan-	98	227,418.00	$22,421.60	527.30	$4,271.13	1,033
Jan-	99	203,383.00	$19,952.37	919.70	$7,449.57	1,295
Feb-	98	208,619.00	$20,776.34	448.20	$3,630.42	900
Feb-	99	179,951.00	$18,078.52	657.20	$5,323.32	952
Mar-	98	202,848.00	$20,306.09	488.60	$3,957.66	837
Mar-	99	185,158.00	$18,415.97	742.20	$6,011.82	1,056
Apr-	98	227,492.00	$22,859.58	213.10	$1,726.11	507
Apr-	99	186,749.00	$18,937.53	215.50	$1,745.55	585
May-	98	220,125.00	$22,688.75	26.50	$214.65	114
May-	99	178,854.00	$19,208.25	20.20	$163.62	194
Jun-	98	222,917.00	$23,063.63	0.00	$0.00	114
Jun-	99	202,773.00	$21,504.25	0.00	$0.00	57
Jul-	98	245,599.00	$24,702.13	0.00	$0.00	4
Jul-	99	226,457.00	$23,127.21	0.00	$0.00	2
Aug-	98	219,681.00	$22,755.12	0.00	$0.00	11
Aug-	99	213,470.00	$19,629.41	0.00	$0.00	25
Sep-	98	210,197.00	$21,852.04	0.00	$0.00	115
Sep-	99	196,599.00	$18,061.44	0.00	$0.00	93
Oct-	98	183,938.00	$19,615.44	139.90	$1,133.19	425
Oct-	99	172,914.00	$16,242.93	212.90	$1,724.49	431
Nov-	98	163,117.00	$16,779.54	461.00	$3,734.10	686
Nov-	99	160,089.00	$15,386.82	426.50	$3,454.65	584
Dec-	98	165,758.00	$17,009.35	457.10	$3,702.51	929
Dec-	99	164,589.00	$14,978.76	483.30	$3,914.73	1,012
TOTAL	98	2,497,709.00	$254,829.61	2,761.70	$22,369.77	5,675
TOTAL	99	2,270,986.00	$223,523.46	3,677.50	$29,787.75	6,286

CURRENT SQUARE FOOTAGE: 167,212

MMBTU	Electric	Steam
1998	8,523	3,284
1999	7,749	4,373

BTU/(SF*DD)

1998	12.44
1999	11.53

REDUCTION 7.31%

BTU/SF

1998	70,606
1999	72,492

REDUCTION (2.67%)

COST/SF

1998	1.66
1999	1.51

Total Cost Avoidance: $17,305.84

Steam

Cost Avoidance: *CURRENT* [$/UNIT]*(*BASE* [CONS/DD]-*CURRENT* [CONS/DD])* *CURRENT* [DD] = Cost Avoidance

8.10 | 0.49 | 0.59 | 6,286 | ($5,009.53)

Electric

Cost Avoidance: *CURRENT* [$/KWH] * (*BASE* CONS - *CURRENT* CONS) = Cost Avoidance

0.098426 | 2,497,709 | 2,270,986 | $22,315.38

Energy Performance Indicators Current Year Versus Base Year

Apollo Office Building											
		ELECTRIC		STEAM		DEGREE					
MONTH		CONSUMPTION	COST	CONSUMPTION	COST	DAYS		CURRENT SQUARE FOOTAGE:			167,212
Jan-	87	315,218.00	$22,681.60	861.00	$6,974.10	1,223					
Jan-	99	203,383.00	$19,952.37	919.70	$7,449.57	1,295					
Feb-	87	295,181.00	$21,732.38	945.50	$7,658.55	1,153					
Feb-	99	179,951.00	$18,078.52	657.20	$5,323.32	952		MMBTU	Electric	Steam	
								1987	12,828	4,310	
Mar-	87	301,336.00	$20,502.85	577.50	$4,677.75	858		1999	7,749	4,373	
Mar-	99	185,158.00	$18,415.97	742.20	$6,011.82	1,056					
Apr-	87	293,368.00	$17,854.20	236.40	$1,914.84	454		BTU/(SF*DD)			
Apr-	99	186,749.00	$18,937.53	215.50	$1,745.55	585		1987	15.96		
								1999	11.53		
May-	87	295,532.00	$18,607.15	67.50	$546.75	234					
May-	99	178,854.00	$19,208.25	20.20	$163.62	194					
								REDUCTION			27.73%
Jun-	87	315,342.00	$23,077.63	69.10	$559.71	39					
Jun-	99	202,773.00	$21,504.25	0.00	$0.00	57					
								BTU/SF			
Jul-	87	365,532.00	$30,557.59	60.20	$487.62	7		1987	102,490		
Jul-	99	226,457.00	$23,127.21	0.00	$0.00	2		1999	72,492		
Aug-	87	361,236.00	$32,034.78	40.10	$324.81	50					
Aug-	99	213,470.00	$19,629.41	0.00	$0.00	25		REDUCTION			29.27%
				12.00							
Sep-	87	336,537.00	$30,314.40	40.10	$324.81	139					
Sep-	99	196,599.00	$18,061.44	0.00	$0.00	93		COST/SF			
								1987	1.83		
Oct-	87	288,328.00	$21,697.39	134.40	$1,088.64	547		1999	1.51		
Oct-	99	172,914.00	$16,242.93	212.90	$1,724.49	431					
Nov-	87	291,872.00	$18,179.10	273.30	$2,213.73	722					
Nov-	99	160,089.00	$15,386.82	426.50	$3,454.65	584		Total Cost Avoidance:			
Dec-	87	300,049.00	$19,790.21	319.40	$2,587.14	997			$145,455.63		
Dec-	99	164,589.00	$14,978.76	483.30	$3,914.73	1,012					
TOTAL	87	3,759,531.00	$277,029.28	3,624.50	$29,358.45	6,423					
TOTAL	99	2,270,986.00	$223,523.46	3,677.50	$29,787.75	6,286					
Steam											
Cost Avoidance:			*CURRENT* [$/UNIT]*(*BASE* [CONS/DD]-*CURRENT* [CONS/DD])* *CURRENT* [DD] =					Cost Avoidance			
			8.10	0.56	0.59		6,286	($1,055.50)			
Electric											
Cost Avoidance:			*CURRENT* [$/KWH] * (*BASE* CONS - *CURRENT* CONS) =					Cost Avoidance			
			0.098426	3,759,531	2,270,986			$146,511.13			

Cost Avoidance/Savings Calculations

COST AVOIDANCE/SAVINGS

1999 vs 1987

Building Number:

Building Name: Apollo Office Building **Gross Area:** 167,212 Ft^2

HEATING: WEATHER RELATED

	COST CONSUMPTION	CONSUMPTION DEGREE DAYS	CONSUMPTION DEGREE DAYS	DEGREE DAYS	$
STEAM:	$29,787.75 / 3,677.50	3,624.50 / 6,423	3,677.50 / 6,286	6,286	$ (1,055.50)
GAS:	$0.00 / 0.00	0.00 / 0	0.00 / 0	0	$ 0.00
OIL:	$0.00 / 0	0 / 0	0 / 0	0	$ 0.00

ELECTRICAL: NON-WEATHER RELATED

	COST CONSUMPTION	CONSUMPTION -	CONSUMPTION		$
ELECTRICAL:	$223,523.46 / 2,270,986.00	3,759,531.00	2,270,986.00		$ 146,511.13

HEATING:

		1987	1999
MMBTUS x 1000 / SQ. FT.	=	102.49	72.49
MMBTUS x 10^6 / SQ. FT. x D.D.	=	15.96	11.53
COST / SQ. FT.	=	1.83	1.51
DEGREE DAYS	=	6,423	6,286

TOTAL COST AVOIDANCE $ 145,455.63

no sign is a savings

minus sign is a loss

Energy Utilization Index: 1999 Versus 1998 Versus 1987 Base Year

ENERGY UTILIZATION INDEX						
January - December						
BUILDING:	Apollo Office Building			**SQUARE FEET:**		167,212
YEAR 1999				DEGREE DAYS:		6,286
2,270,986.00	KWH x 3,413 =	7.75E+09	BTU'S	COST:		$223,523.46
3,677.50	M-LBS x 1,189,000 =	4.37E+09	BTU'S	COST:		$29,787.75
0.00	THERMS x 100,000 =	0.00E+00	BTU'S	COST:		$0.00
0.00	GALS x 138700 =	0.00E+00	BTU'S	COST:		$0.00
	TOTAL =	1.21E+10	BTU'S	COST:		$253,311.21
BTU / Ft^2 - D.D. =	1.15E+07					
YEAR 1998				DEGREE DAYS:		5,675
2,497,709	KWH x 3,413 =	8.52E+09	BTU'S	COST:		$254,829.61
2,761.70	M-LBS x 1,189,000 =	3.28E+09	BTU'S	COST:		$22,369.77
0.00	THERMS x 100,000 =	0.00E+00	BTU'S	COST:		$0.00
0.00	GALS x 138,700 =	0.00E+00	BTU'S	COST:		$0.00
	TOTAL =	1.18E+10	BTU'S	COST:		$277,199.38
BTU / Ft^2 - D.D. =	1.24E+07					
YEAR 1987				DEGREE DAYS:		6,423
3,759,531.00	KWH x 3,413 =	1.28E+10	BTU'S	COST:		$277,029.28
3,624.50	M-LBS x 1,189,000 =	4.31E+09	BTU'S	COST:		$29,358.45
0.00	THERMS x 100,000 =	0.00E+00	BTU'S	COST:		$0.00
0.00	GALS x 100,000 =	0.00E+00	BTU'S	COST:		$0.00
	TOTAL =	1.71E+10	BTU'S	COST:		$306,387.73
BTU / Ft^2 - D.D. =	1.60E+07					

Steam Consumption & Demand And Its Associated Costs

Apollo Office Building
Energy Accounting

Apollo Office Building

Steam Usage Data & Demand

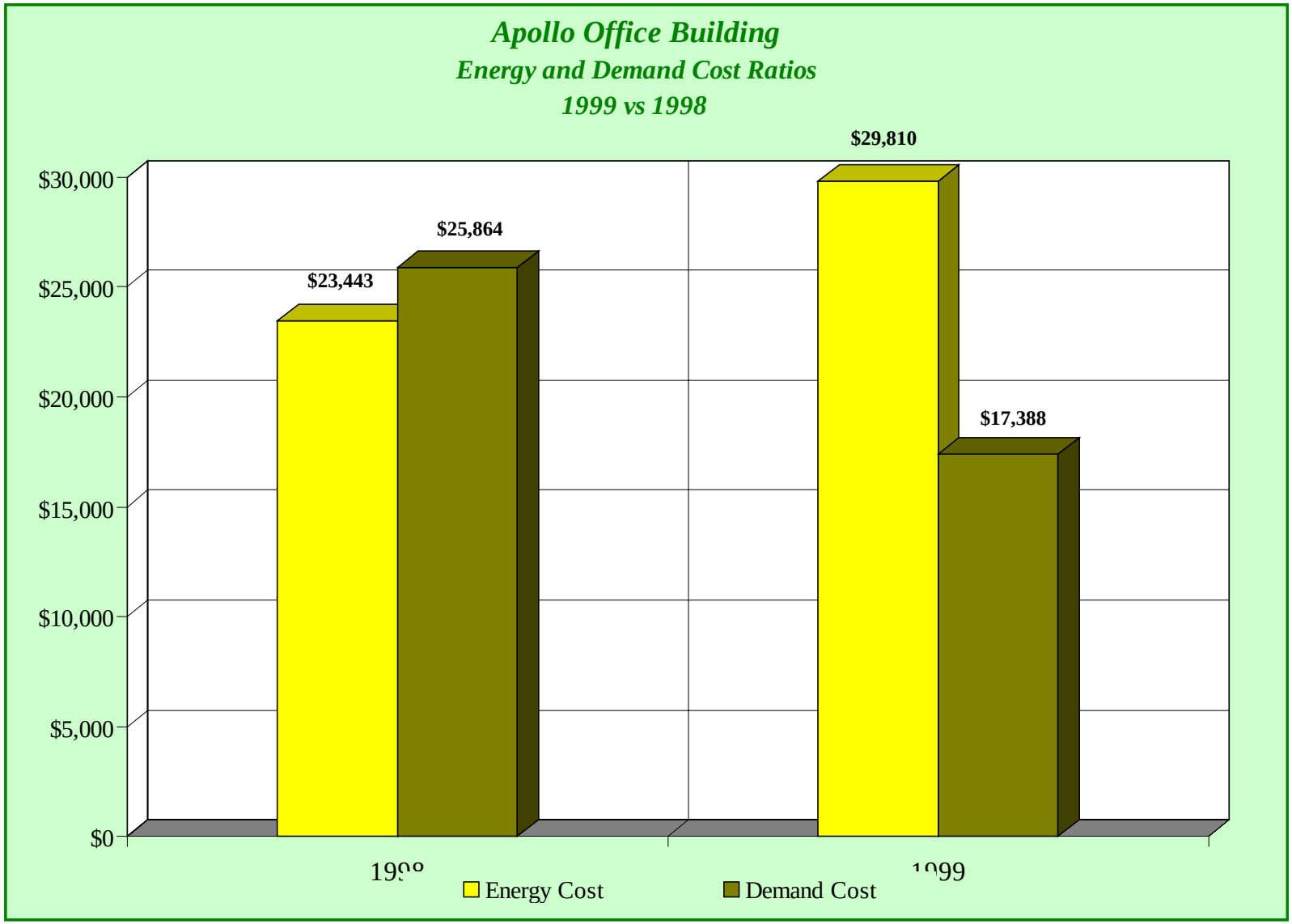
1998

	Consumption M-Lbs	Rate ($/unit)	Energy Cost ($)	Demand Cost ($)	Total Energy Costs ($)
Jan	527.3	$8.73	$4,603.33	$2,578.00	$7,181.33
Feb	448.2	$8.73	$3,912.79	$2,578.00	$6,490.79
Mar	488.6	$8.73	$4,265.48	$2,578.00	$6,843.48
Apr	213.1	$8.73	$1,860.36	$2,578.00	$4,438.36
May	26.5	$8.73	$231.35	$2,578.00	$2,809.35
Jun	0	$8.73	$0.00	$2,578.00	$2,578.00
Jul	0	$8.73	$0.00	$2,578.00	$2,578.00
Aug	0	$8.73	$0.00	$2,578.00	$2,578.00
Sep	0	$8.10	$0.00	$1,310.00	$1,310.00
Oct	139.9	$8.10	$1,133.19	$1,310.00	$2,443.19
Nov	461	$8.10	$3,734.10	$1,310.00	$5,044.10
Dec	457.1	$8.10	$3,702.51	$1,310.00	$5,012.51
TOTAL	2761.7	$8.49	$23,443.10	$25,864.00	$49,307.10

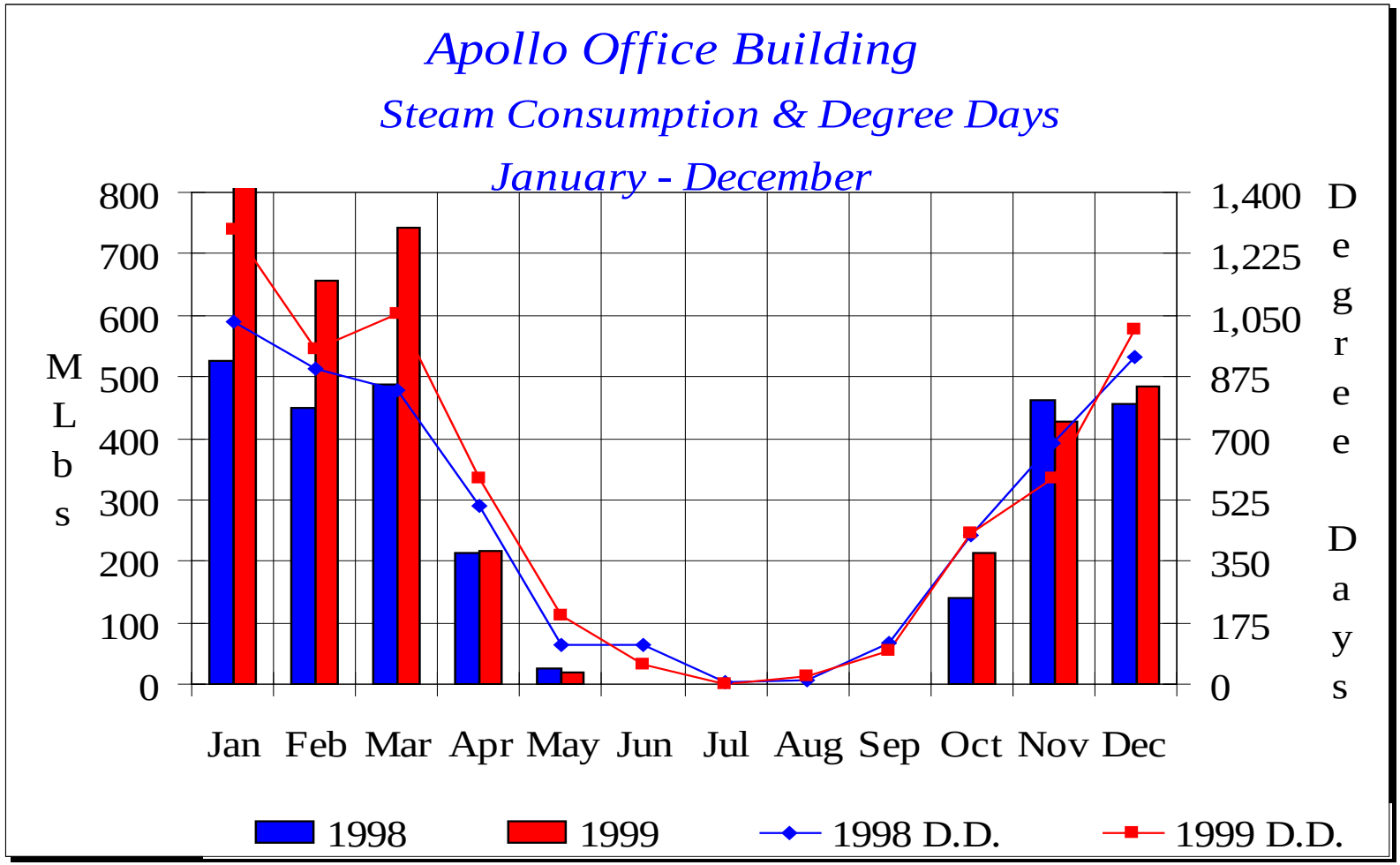
1999

	Consumption M-Lbs	Rate ($)	Energy Cost ($)	Demand Cost ($)	Total Energy Costs ($)
Jan	919.7	$8.10	$7,449.57	$1,310.00	$8,759.57
Feb	657.2	$8.10	$5,323.32	$1,310.00	$6,633.32
Mar	742.2	$8.10	$6,011.82	$1,310.00	$7,321.82
Apr	215.5	$8.10	$1,745.55	$1,310.00	$3,055.55
May	20.2	$8.10	$163.62	$1,310.00	$1,473.62
Jun	0	$8.10	$0.00	$1,310.00	$1,310.00
Jul	0	$8.10	$0.00	$1,310.00	$1,310.00
Aug	0	$8.10	$0.00	$1,310.00	$1,310.00
Sep	0	$8.10	$0.00	$1,727.00	$1,727.00
Oct	212.9	$8.12	$1,728.75	$1,727.00	$3,455.75
Nov	426.5	$8.12	$3,463.18	$1,727.00	$5,190.18
Dec	483.3	$8.12	$3,924.40	$1,727.00	$5,651.40
TOTAL	3677.5	$8.11	$29,810.20	$17,388.00	$47,198.20

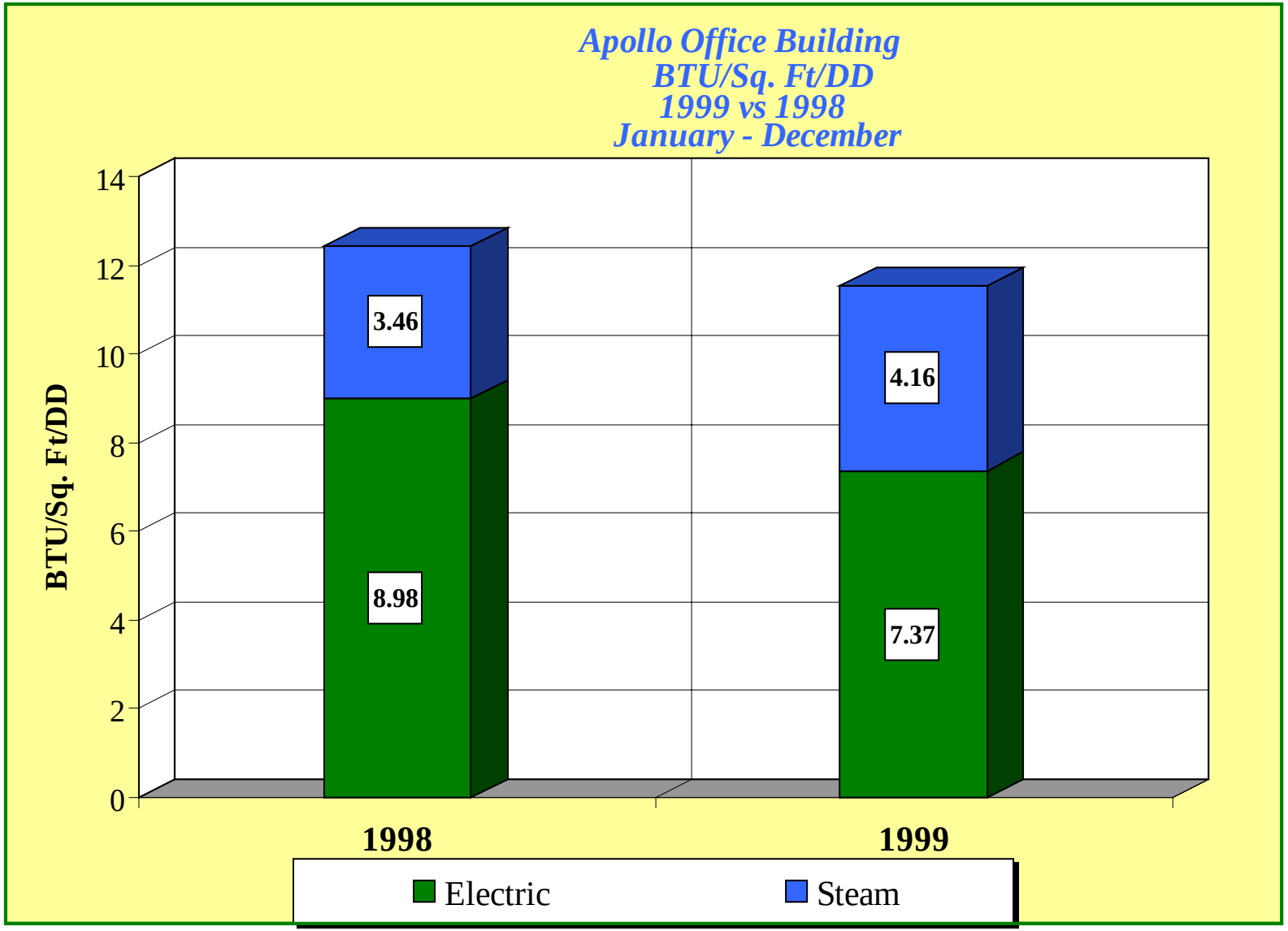
Energy and Demand Cost Ratios



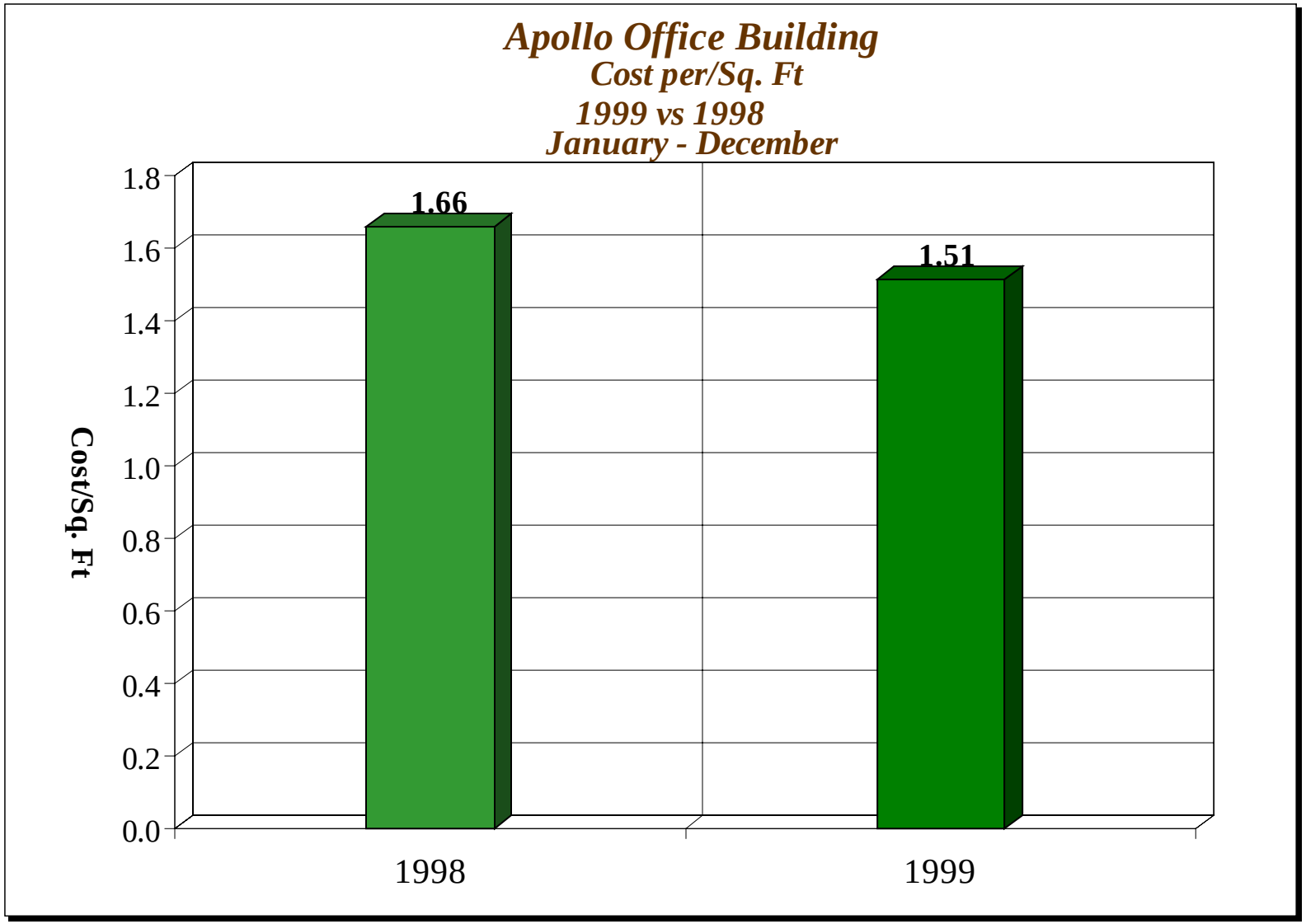
Steam Consumption & Degree Days Relationship



Electric & Steam Consumption In Relation To The Weather



Energy Cost/Sq.Ft Budget



Load Factor Data

Apollo Office Building
Energy Accounting

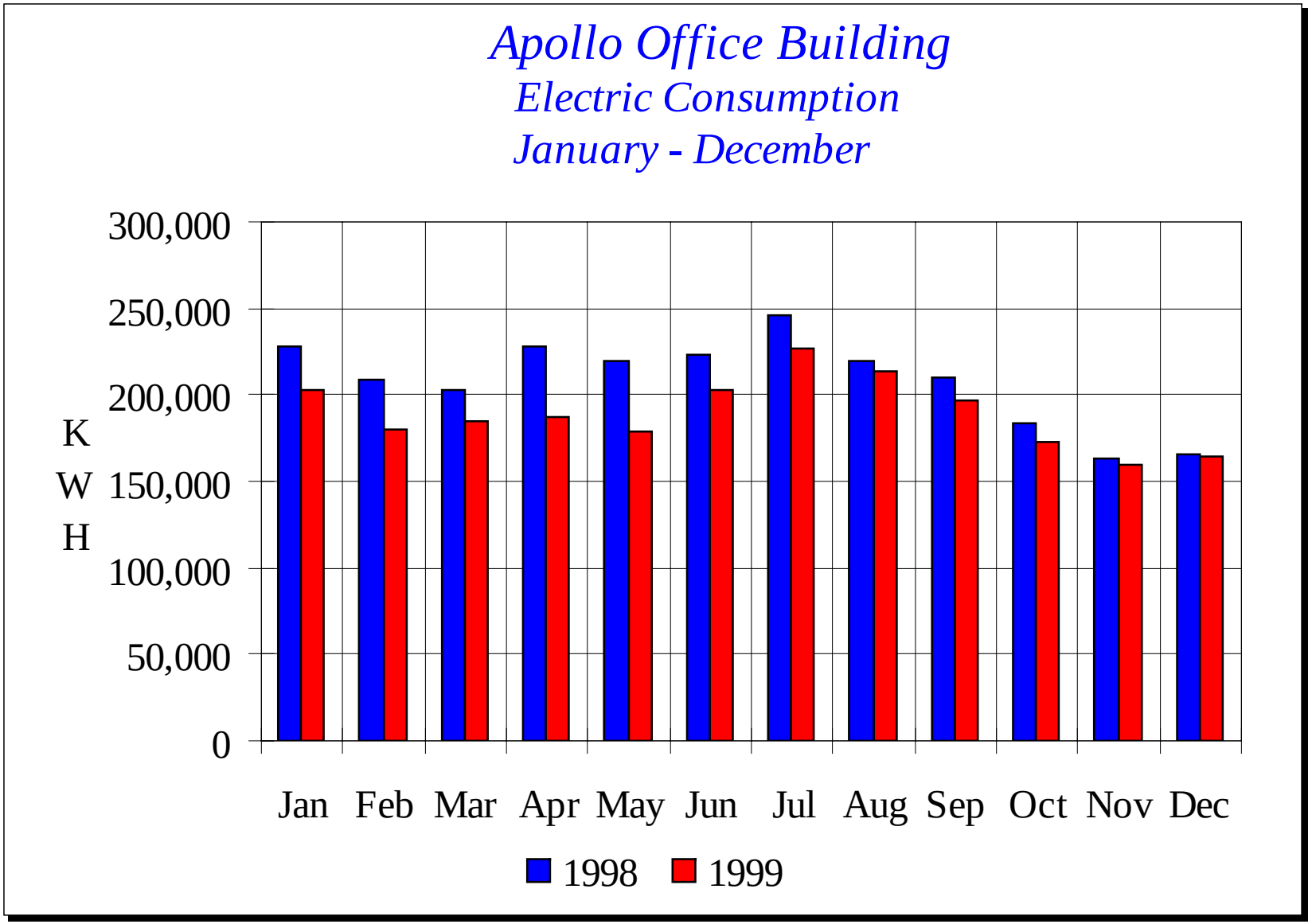
Apollo Office Building

Electrical Usage & Load Factor

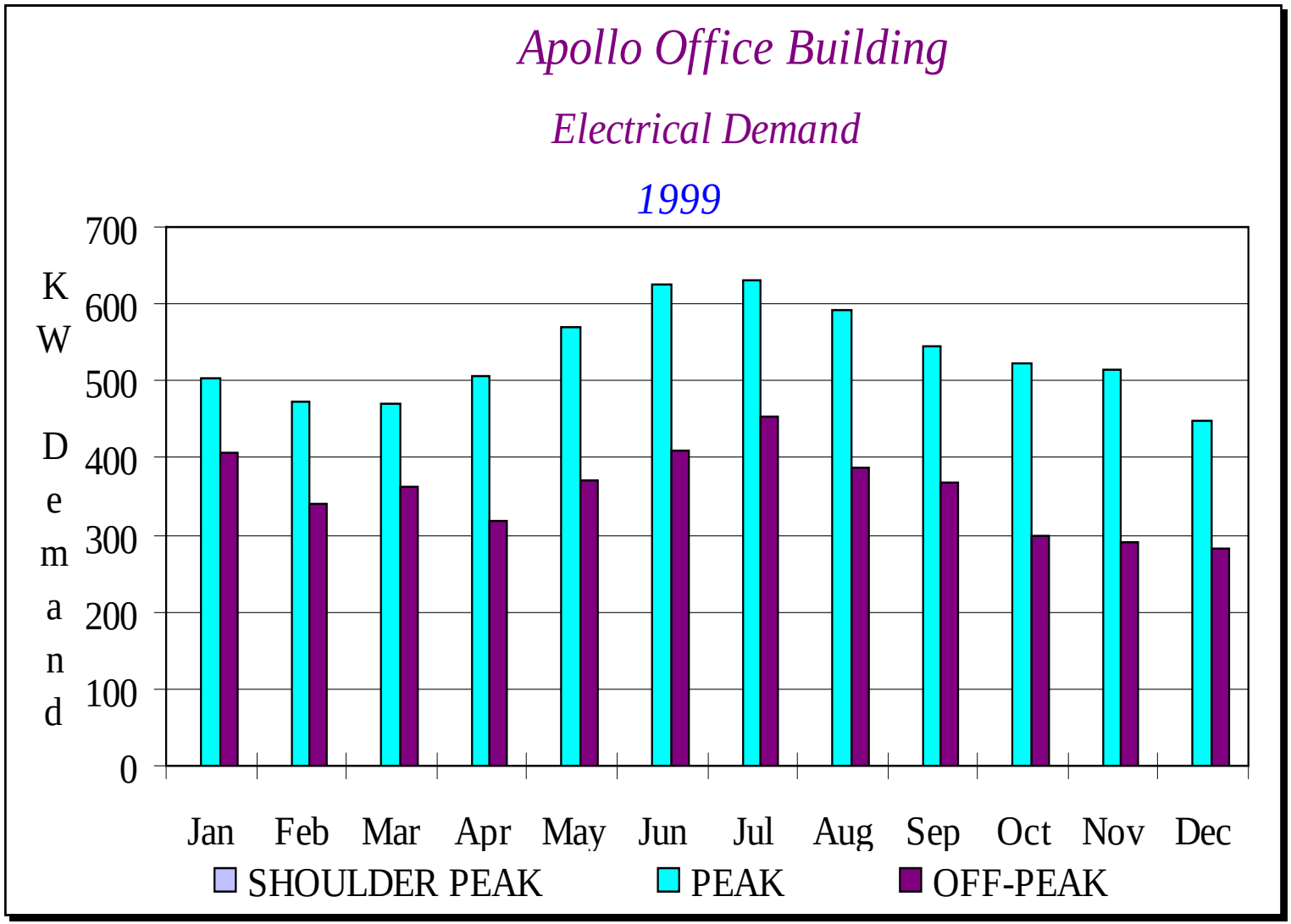
	1998		
	Total KWH	Maximum Demand KW	Load Factor, %
Jan	227,418	556.80	56.73%
Feb	208,619	524.40	55.25%
Mar	202,848	514.80	54.73%
Apr	227,492	586.80	53.84%
May	220,125	608.40	50.25%
Jun	222,917	620.40	49.90%
Jul	245,599	633.60	53.84%
Aug	219,681	621.60	49.09%
Sep	210,197	601.20	48.56%
Oct	183,938	583.20	43.80%
Nov	163,117	458.40	49.42%
Dec	165,758	464.40	49.57%
TOTAL	2,497,709	6,774.00	51.21%

	1999		
	Total KWH	Maximum Demand KW	Load Factor, %
Jan	203,383	502.80	56.18%
Feb	179,951	472.80	52.86%
Mar	185,158	470.40	54.67%
Apr	186,749	505.20	51.34%
May	178,854	568.80	43.67%
Jun	202,773	624.00	45.13%
Jul	226,457	631.20	49.83%
Aug	213,470	592.80	50.01%
Sep	196,599	546.00	50.01%
Oct	172,914	522.00	46.01%
Nov	160,089	514.80	43.19%
Dec	164,589	448.80	50.93%
TOTAL	2,270,986	6,399.60	49.29%

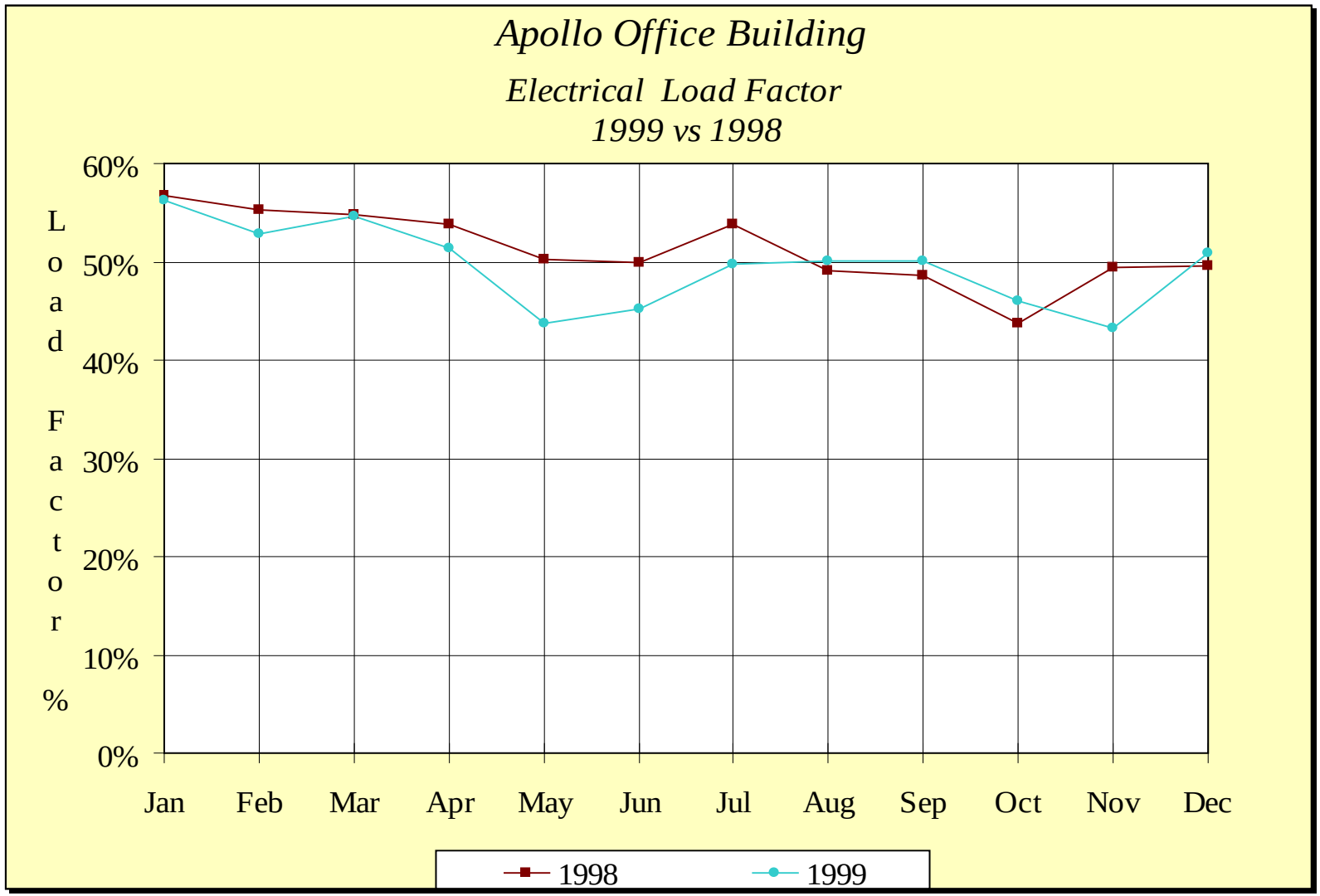
Electric Consumption



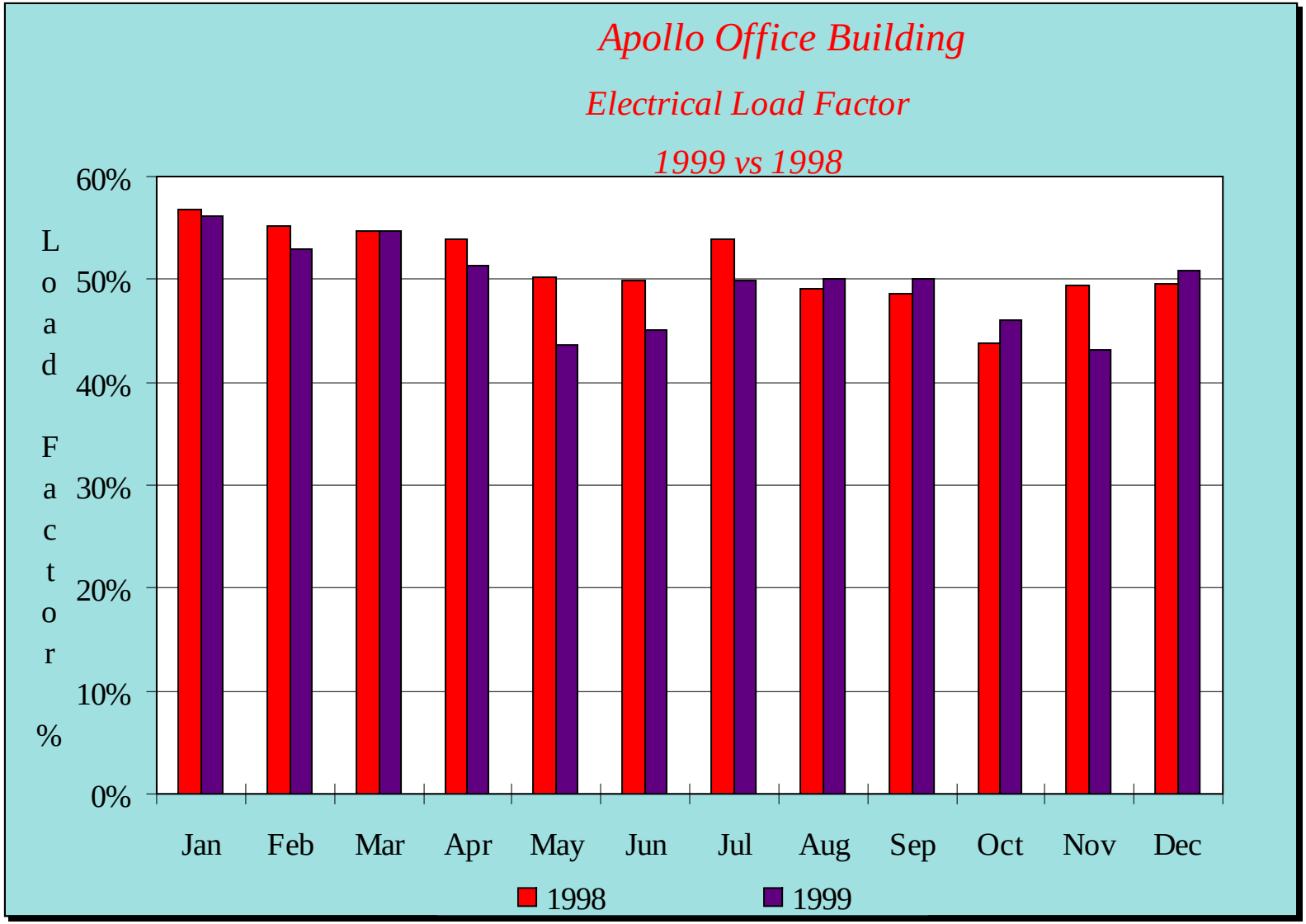
Electrical Demand Data



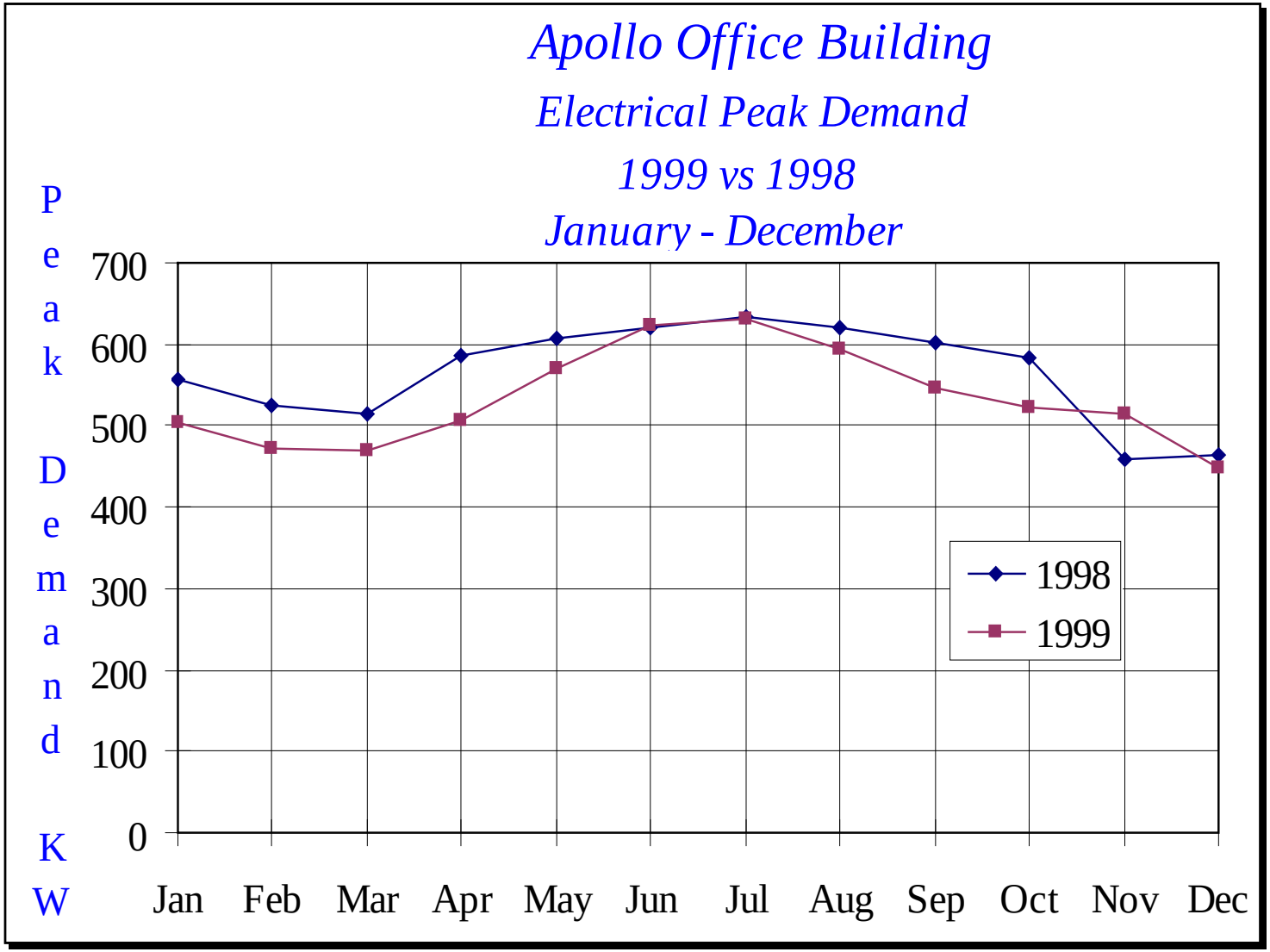
Electric Load Factor Illustrated Graphically



Electric Load Factors Comparison



Electric Peak Demand - 1999 Versus 1998



Energy Consumption Characteristics In Buildings

BUILDING ENERGY CONSUMPTION CHARACTERISTICS

On a national basis, the systems in buildings which will consume the most energy are, in descending order:

1. Heating and Ventilating
2. Lighting
3. Cooling and Ventilating
4. Domestic Hot Water

The amount of energy consumed in a given building depends upon climate, building construction, use and type of operation, control and efficiency of the mechanical and electrical equipment.

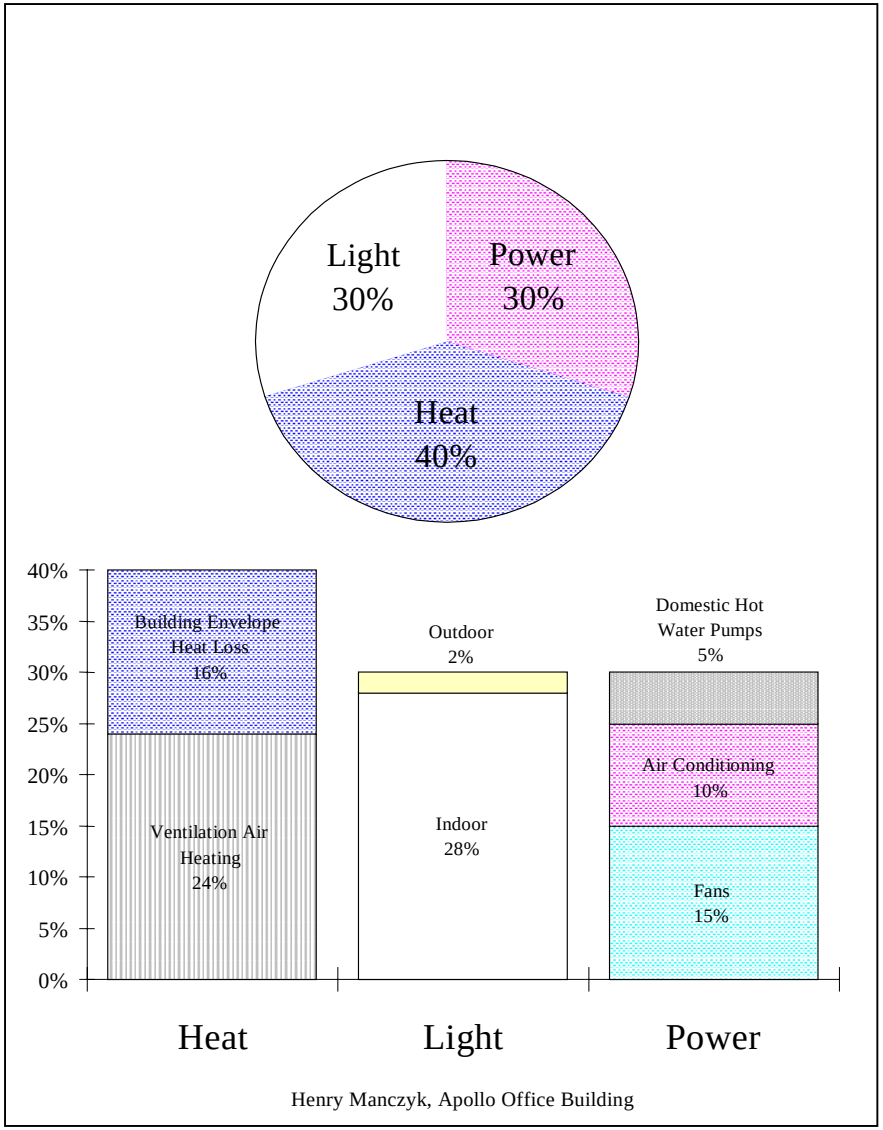
Climate conditions generally are considered to be the most important of all conditions affecting energy consumption.

BUILDING LOADS

Energy consumption can be divided between two types of loads: Weather-Dependent Load and Base-Load. The weather-dependent load is self descriptive. It includes the heating, ventilating and air conditioning loads.

Base-Load consists of systems that are not affected by weather or, if they are, just slightly. For example, the lighting load is affected very little by weather, unless you are somehow relying on natural daylight. Elevator load is not affected by weather, except to the extent that it may receive less use when fewer people come in due to extremely inclement conditions.

Typical Commercial Building Energy Usage



Degree Days & BTU Definitions

DEGREE DAYS DEFINITION

Outdoor air temperature is a major climatic variable affecting energy use. The temperature is usually discussed in terms of "degree days' - heating degree days and cooling degree days. The number of heating degree days in a regular 24-hour day is determined as the difference between 65°F and the average of the high and low temperature for a specific day in question. For example, if the low temperature on a particular day is 35°F, and the high is 55°F, this day would have 20 heating degree days derived as follows:

High Temperature:	55°F
Low Temperature:	35°F

Average of High and Low 55 + 35 = 45°F

Heating Degree Days = 65°F - Average of high and low temperature = 65°F - 45°F = 20 degree days for that specific day.

Adding all degree days each day represents a total degree day per year.

Rochester's rated heating degree days per year is 6719.

Cooling degree days are determined in a similar manner, except that 65°F is subtracted from the average.

BTU DEFINITION

Btu is short for British Thermal Unit, which is the amount of heat needed to raise one pound of water 1F. It is also equivalent to the energy produced by one kitchen match.

Energy Utilization Index Computation Based On Its Btu's Value, Square Foot & Degree Days

TO COMPUTE THE ENERGY UTILIZATION INDEX (EUI), THE FOLLOWING IS DONE:					
	Total Electricity Used in KWH x 3.413	=		BTUs	
	Total Gas Used in Therms x 100,000	=		BTUs	
	Total #2 Oil Used in Gallons x 138,700	=		BTUs	
	Total #6 Oil Used in Gallons x 146,000	=		BTUs	
	Total Steam Used in Lbs x 1,189	=		BTUs	
	Total Coal Used in Short Tons x 26 x 106	=		BTUs	
	Total BTUs	=		BTUs	
	Total Degree Days	=			
	Gross Conditioned Area	=		Square Feet	
	EUI = BTUs / (Gross Conditioned Area x Degree Days)				
Therefore, EUI =		BTUs/Sq.Ft./D.D.			

Energy Cost Avoidance Equations

Energy Cost Avoidance

Equation Related With Heating

$$C.A. = \left[\left(\text{Base Year Consumption} \right) \left(\frac{\text{Current Year Cost}}{\text{Current Year Consumption}} \right) \left(\frac{\text{Current Year DD}}{\text{Base Year DD}} \right) \right] - \left(\text{Current Cost} \right)$$

C.A. =	Cost Avoidance in $	Bc =	Current year consumption
Bb =	Base year consumption	Ddc =	Current year degree days
Cc =	Current year cost	Ddb =	Base year degree days

$$C\ .A\ .\ = \left[\left(B\ b \right) \left(\frac{C\ c}{B\ c} \right) \left(\frac{D\ D\ c}{D\ D\ b} \right) \right] - \left(C\ c \right)$$

Equation Non-Weather Related

$$C.A. = \left[\left(\text{Base Year Consumption} \right) \left(\frac{\text{Current Year Cost}}{\text{Current Year Consumption}} \right) \right] - \left(\text{Current Cost} \right)$$

$$C\ .A\ .\ = \left[\left(B\ b \right) \left(\frac{C\ c}{B\ c} \right) \right] - \left(C\ c \right)$$

Energy Values, Definitions & Equations

DEFINITIONS AND FORMULAS

1 KWH	= 3,413 BTUs
1 Therm	= 100,000 BTUs
1 Lb. of St	= 1,189 BTUs
1 BTU	= Amount of Heat Needed to Raise 1 Pound of Water 1 oF
1 M-Lb	= 1,000 Lbs of Steam
D.D.	= Degree Days (See Attached Explanation)

FORMULA

1. $$BTU / Sq.Ft / D.D. = \frac{Total\ BTUs}{Sq.Ft \times D.D.}$$

2. $$BTU / Sq.Ft = \frac{Total\ BTUs}{Sq.Ft}$$

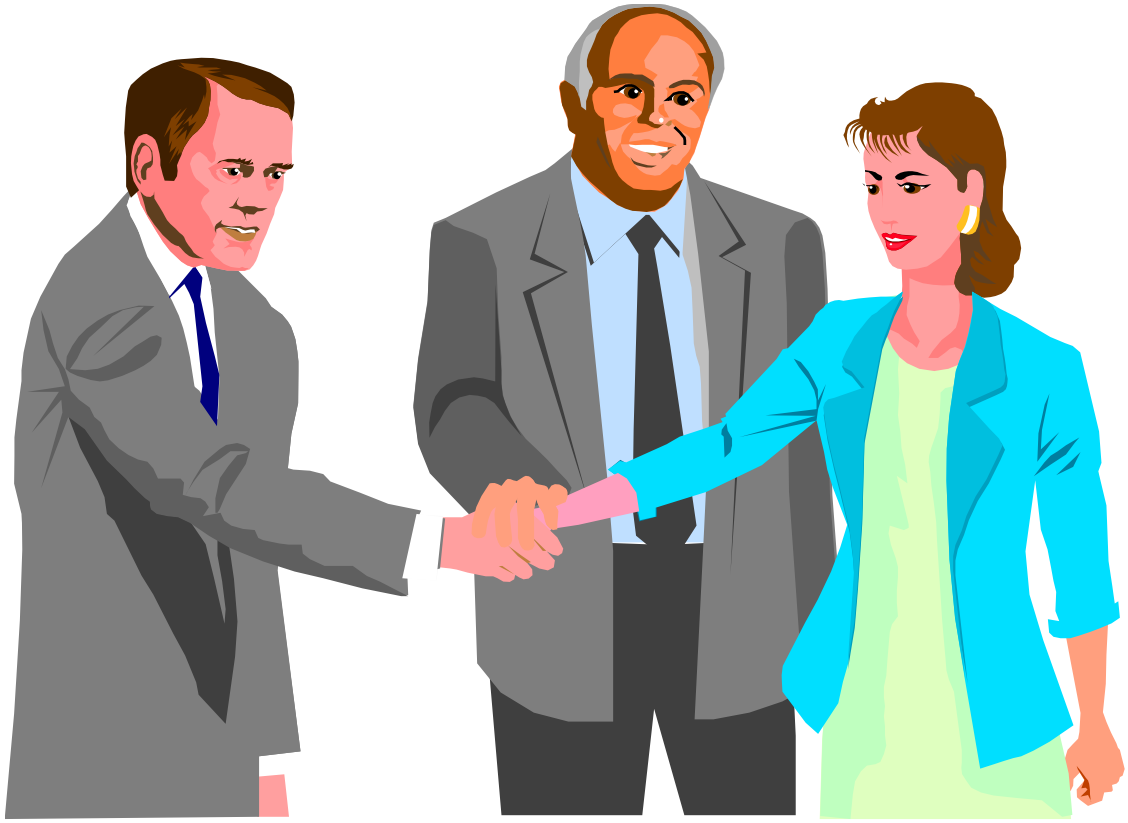
3. $$\%\ in\ Dollar = \frac{Dollar\ Savings}{(Total\ Present\ Cost + Dollar\ Savings)} \times 100$$

Example:

$$\%\ in\ Dollar\ Savings = \frac{200}{(1{,}000 + 200)} = 16.6\%$$

BTU/Sq.Ft. - Energy Consumed For a Given Area

BTU/Sq.Ft./D.D. = Energy Consumed For a Given Area at a Given Weather Condition



THANK YOU