IMPROVING PROFIT IN THE SMALL/MEDIUM SIZED MOTEL THROUGH ENERGY MANAGEMENT

By

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SIZED MOTEL THROUGH ENERGY

MANAGEMENT

This individual research investigation, INDEN 5350 - Industrial Engineering Problems, is accepted and approved as partial fulfillment of the requirements for the degree of Master of Science.

APPROVED____________________________ DATE_______________________

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ABSTRACT

One of the problems facing motels in the USA, is a lack of knowledge about energy management resulting in higher costs and waste. Energy cost is almost always the most rapidly rising element of operating cost. However, energy costs can usually be reduced significantly through a well-funded energy management program, directed and supported by management. A key element in an effective energy management program is the energy audit.

This paper examines motel energy management. Specifically, an energy audit was conducted for El Sol Motel in Stillwater, Oklahoma. Twelve opportunities were uncovered yielding a savings of $10,470.16. This represents 46% of total energy consumed.

CHAPTER I

INTRODUCTION

The energy situation is a multi-dimensional problem that does not lend itself readily to easily implemented solutions. Many factors exist that contribute to the overall problem and tend to make its ultimate resolution seem all the more unlikely.

The ultimate solution to our present energy situation, like the problem itself, will not be singular in nature. Rather, the solution, if one exists, must encompass the effective and efficient utilization of all of our energy resources (foreign, domestic, renewable, and nonrenewable). This perspective, in combination with sound energy management practices and energy planning, will aid significantly in our continuing efforts to overcome the energy problem.

The purpose of this paper is not to lament the causes of the energy problem or to admonish our society for its continued utilization of vast amounts of nonrenewable energy resources. The purpose is to stress the necessity for managers to become knowledgeable in energy management. Second, the author's purpose is to reduce the energy cost of the El Sol Motel.

Equally so, it is not the intention of this study to promote the utilization of one particular energy source over another, or for that matter, to advocate the establishment or adherence to a particular national energy policy. The point to be made here is that regardless of the form of energy which we have available to us, it is our responsibility, or better yet, our obligation to seek the most efficient manner in which to utilize that energy. Energy management is a prime profit improvement technique for motels and other industries.

CHAPTER II

STATEMENT OF THE PROBLEM

In a small to medium sized motel, one of the big problems is rising utility costs, so efficient energy utilization is of considerable importance. Typical medium sized motels have about $30,000-40,000 energy costs, which is about 15% of their total income. There is a possibility of a substantial amount of savings, but most managers are not aware of such savings. In a survey of 24 motels, 20 in Oklahoma and four in Texas (size varied from 40-70 units), the following points emerged:

Five managers have tried to reduce energy cost;

Eight managers have not thought about it;

Six managers know but do not want to do anything;

Two managers do not know what to do; and

Three managers gave no answers.

From the above survey, it is found that managers do not understand how to utilize energy resources for profit improvement. An energy management program needs to be designed in such a way that it gives management an in-depth look at various types of energy audits, management strategies and new techniques which are being successfully used to eliminate unnecessary expenditures from inefficient energy usages. This report considers the El Sol Motel as a typical medium sized motel for this study.

The El Sol Motel, owned and operated by the United Six, Inc., is located at the corner of Highway 51 and Western Street in Stillwater, Oklahoma. The motel was built in 1960. It has 60 rooms varied in sizes: singles, doubles, and suites. The facility also includes a Mexican restaurant, a cantina, and a meeting room. The air-conditioning and the heating system are individually controlled in each room. The motel structure is shown in Figures 1 through 4.

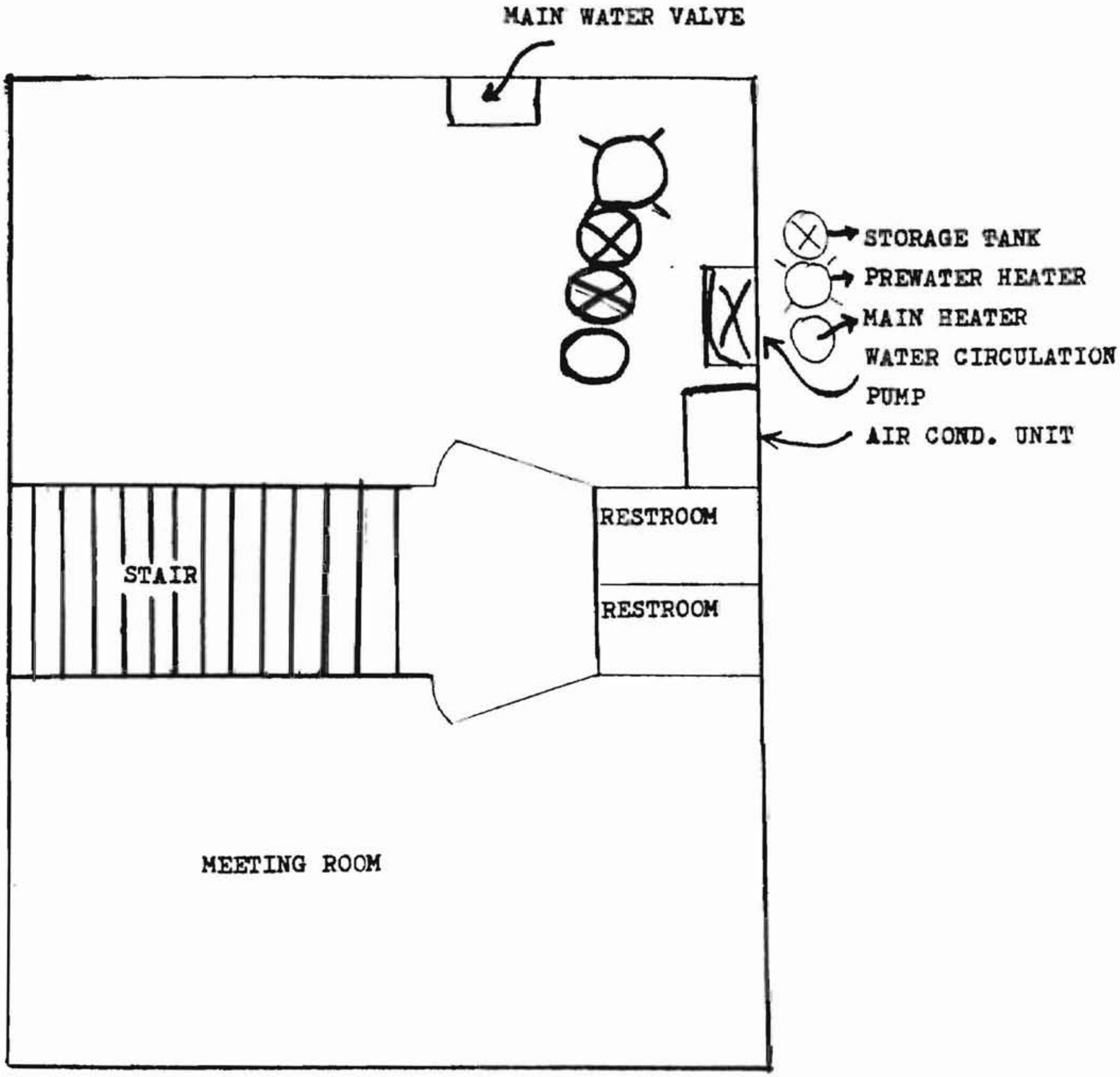
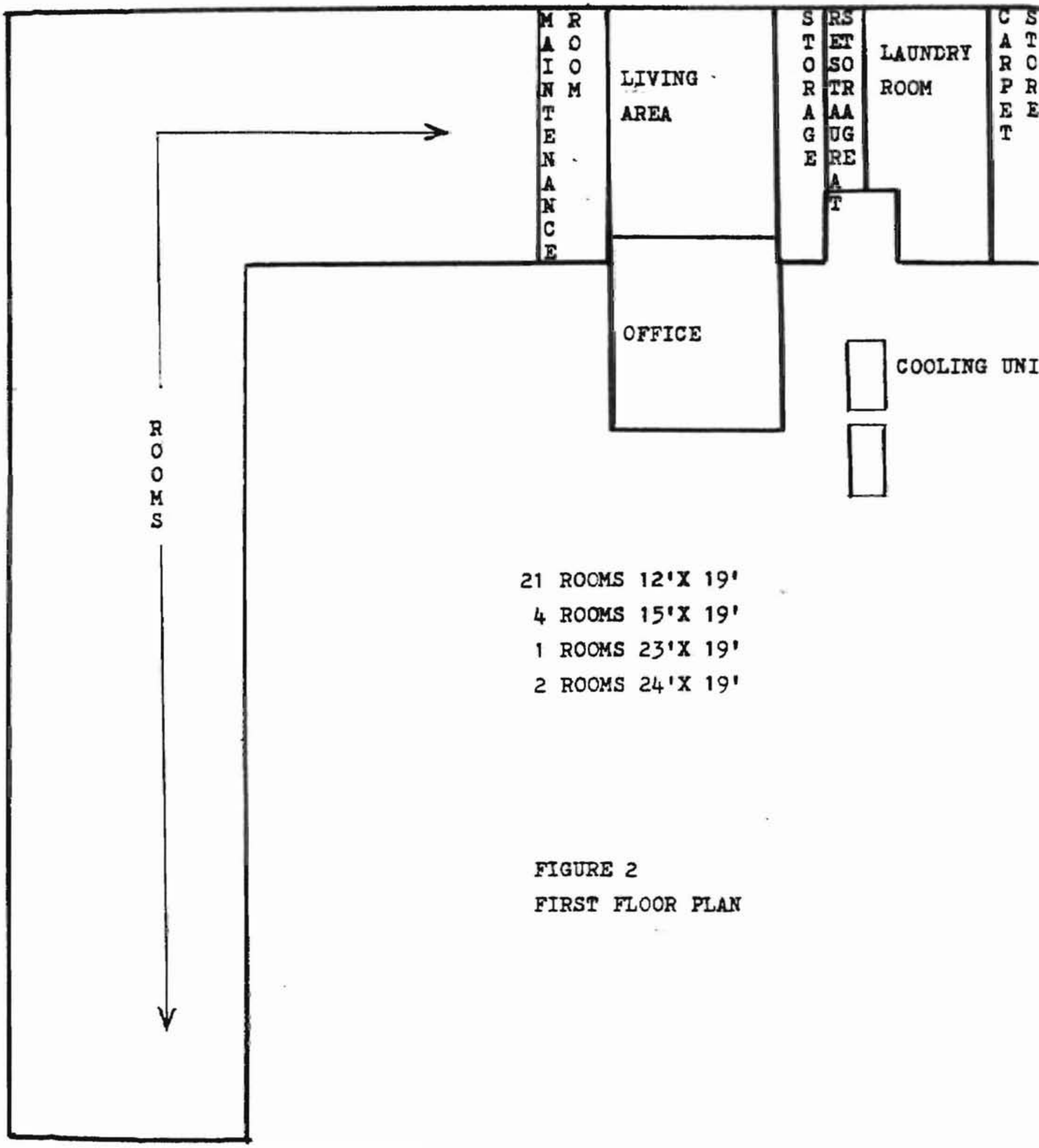
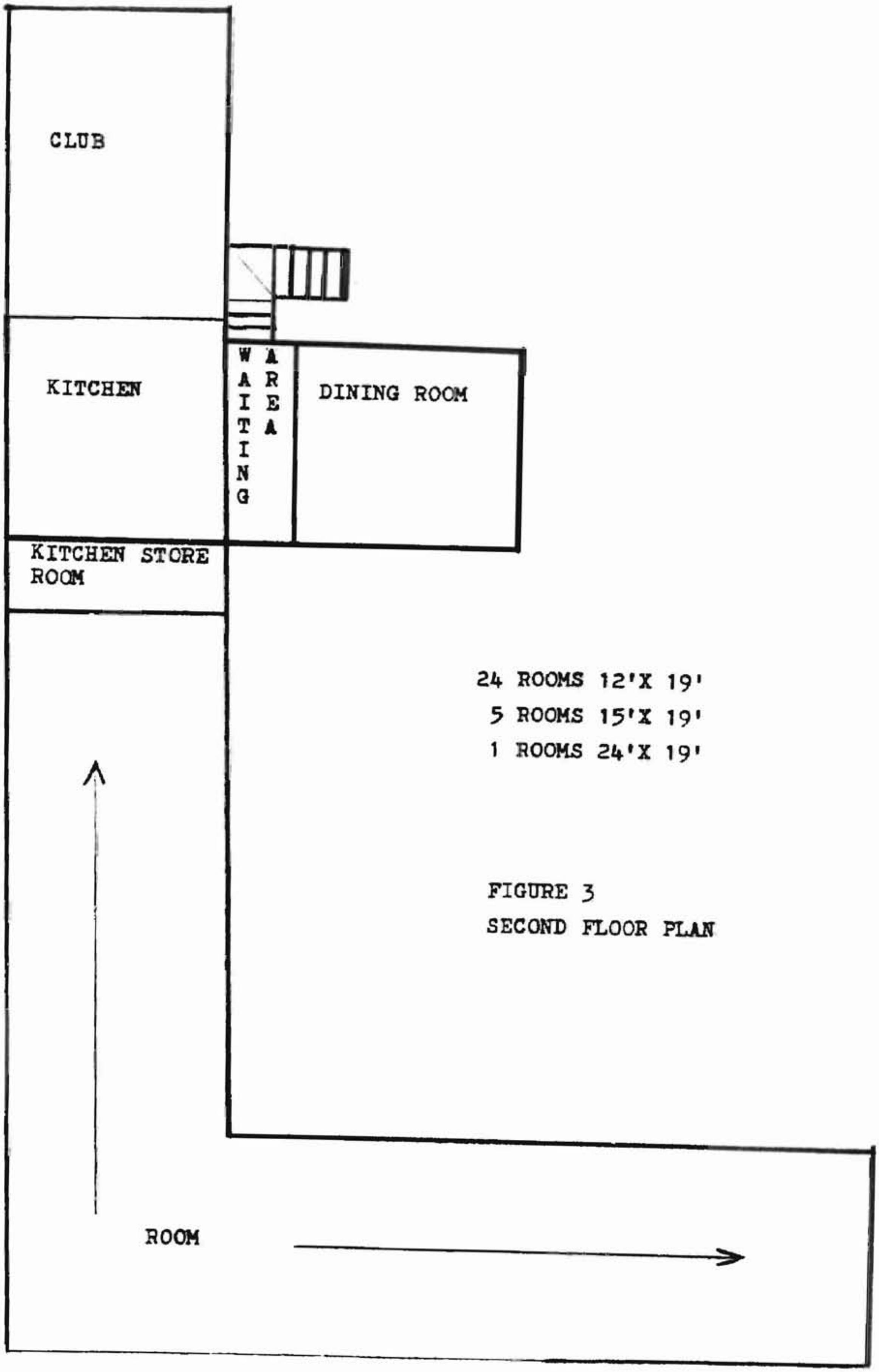


FIGURE 1
BASEMENT PLAN
OF EL SOL MOTEL



21 ROOMS 12'X 19'
4 ROOMS 15'X 19'
1 ROOMS 23'X 19'
2 ROOMS 24'X 19'

FIGURE 2
FIRST FLOOR PLAN



24 ROOMS 12'X 19'
5 ROOMS 15'X 19'
1 ROOMS 24'X 19'

FIGURE 3
SECOND FLOOR PLAN

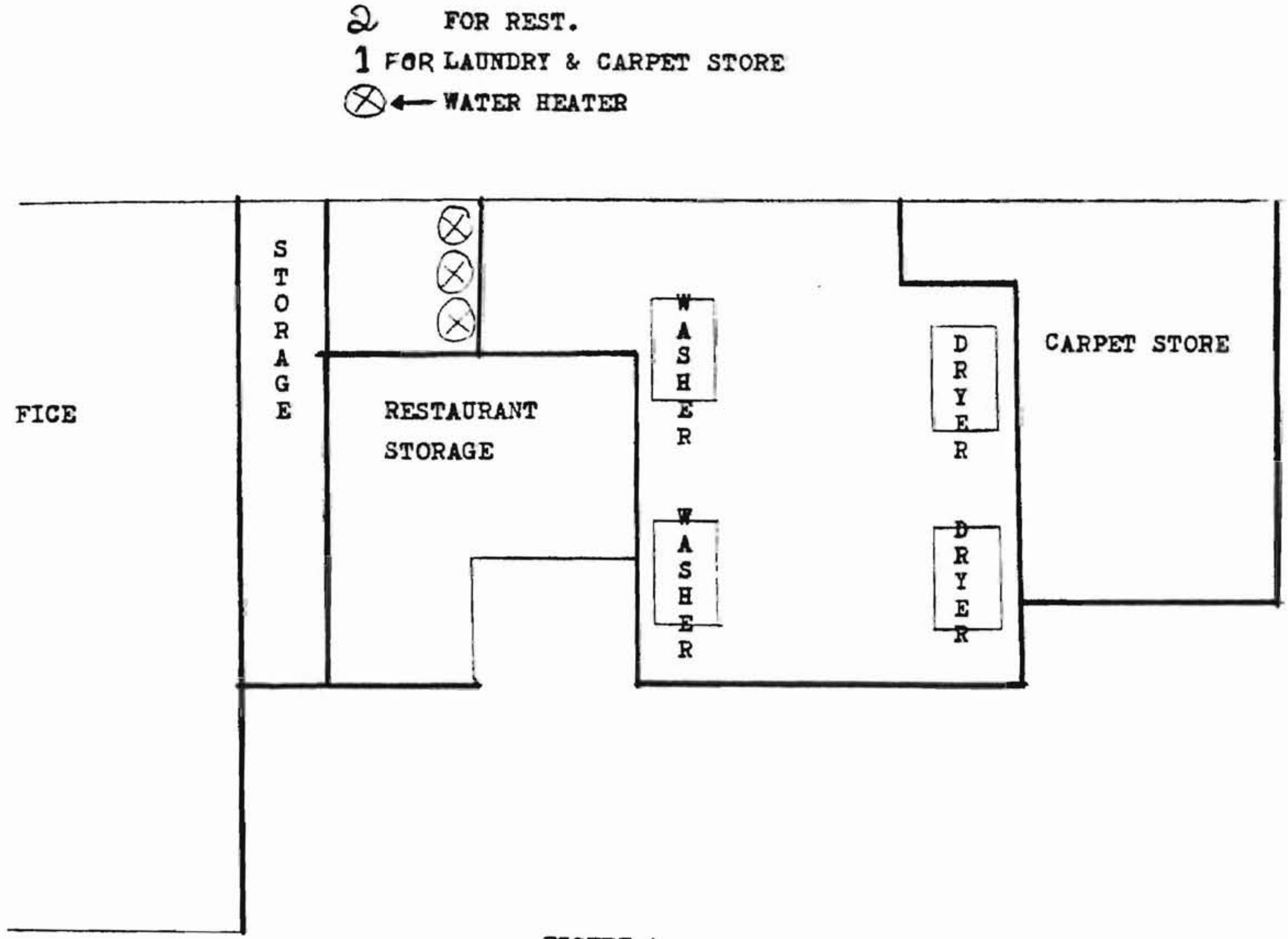


FIGURE 4
FIRST FLOOR SOUTH & END DETAIL

CHAPTER III

ENERGY MANAGEMENT APPLICATION

(EL SOL MOTEL)

Executive Summary

Energy consumption at the El Sol Motel, for the 12 month period from January 1982 through December 1982, was 236067 KWH of electricity and 3667 MCF of natural gas. Total energy costs for the period were $32,257.00. The energy conservation opportunities (ECO's) contained in this report will save an estimated 2149.19 million BTU's each year, or 46% of the total usage (see Table I).

Total energy savings are very high because:

1. Solar water heater does not need any gas consumption. Actually it is not energy conservation, but we used a different source (sun), which is free, so those BTU's were shown as being saved.
2. Heat recovery from chilling equipment will save most of the gas consumption presently used for water heating.
3. All ECO's are calculated based on current rate schedules (power-electric). One of the proposed ECO's is to change rate schedules. If this is

done first, the saving for some of the ECO's will change slightly (usually lower). Also, there is significant overlap for several of the ECO's, so to figure savings by adding all individual savings overestimates the total.

TABLE I

SUMMARY OF ECO'S

ECO	Description	Implementation Cost	First Year Savings	Undiscounted Payback in years
1	Switch outside room bug lights from 60W to 25W	1.95	331.32	0.0058
2	Use higher efficiency, lower wattage fluorescent lamps in the existing fixtures	77.45	84.19	0.92
3	Switch outdoor Parking lot floodlights ~~fixture~~ to high pressure sodium. ~~light fixture~~	650.00	240.30	2.70
4	Switch rate schedule from PL1 to commercial rate	0.00	484.67	Immediate
5	Place photosensors on outside security lights and motel sign	105.00	215.54	0.49
6	Use solar water heater with exchanger	3120.00	4149.36	0.75
7	Use flow restrictor for showerheads	54.00	538.19	0.10
8	Reduce temperature of hot water heater in rooms	0.00	214.65	Immediate

TABLE I (Continued)

ECO	Description	Implement-tation Cost	First Year Savings	Undis-counted Payback in years
9	Install weatherstripping on doors	232.00	228.41	1.02
10	Thermal insulate ~~hot~~ water heater storage tank and pipeline	151.49	281.06	0.54
11	Night setback for lounge and dining room area	625.00	672.35	0.93
12	Heat recovery from chilling equipment	1654.00	1893.15	0.88
13	Remove existing motel sign and install new energy efficient sign	3275.25	731.20	4.48
14	Use of energy management system to turn off and on air conditioning	21,000.00	1493.28	14.06
		TOTAL	11358.07	

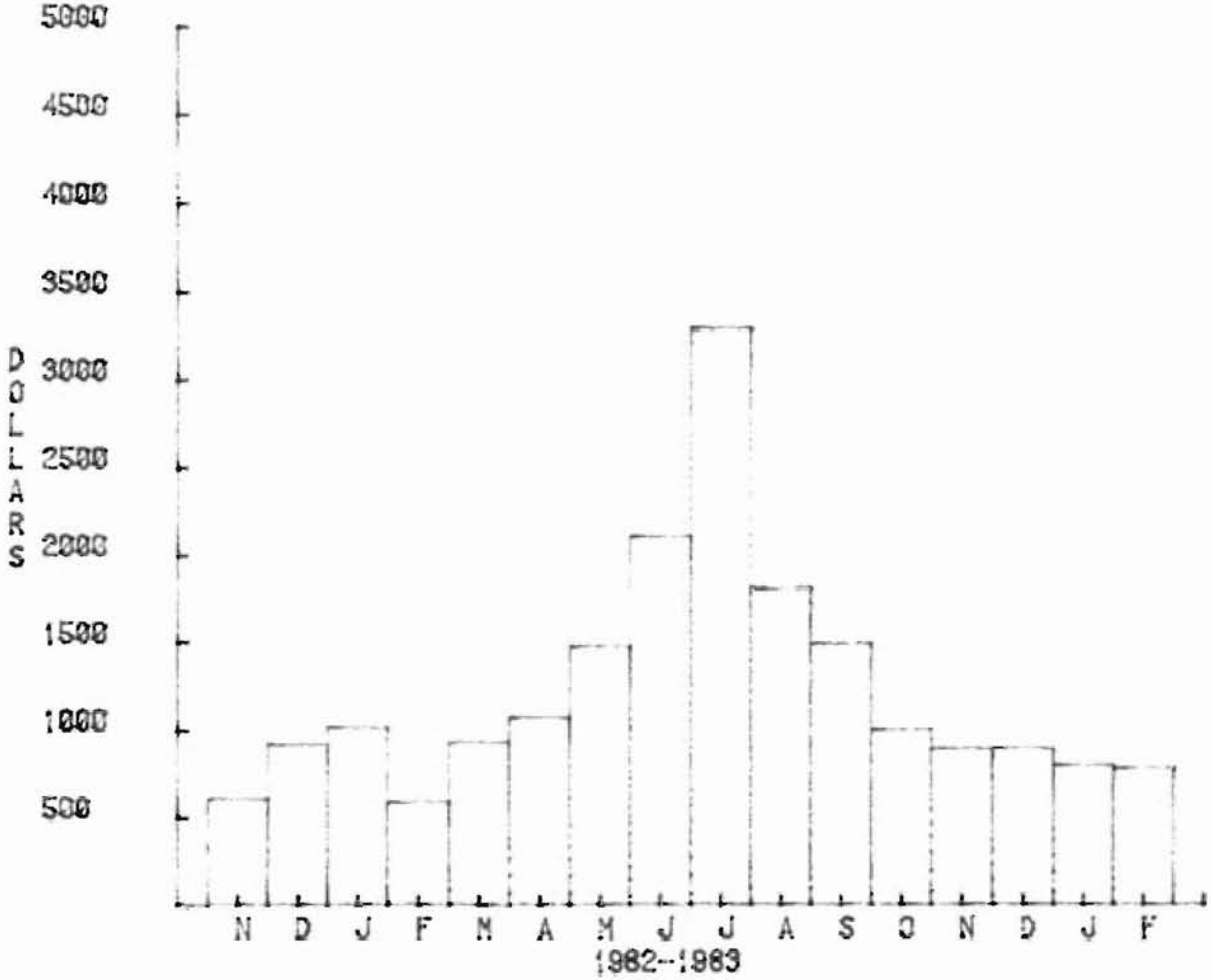
Details of Energy Audit Survey

Energy management is the judicious and effective use of energy to improve profits (reduced cost) and enhance competitive positions. Enlightened management in energy intensive plants will take the requisite action to provide the necessary organization, funding and environment with which energy waste can be identified and minimized, energy related costs can be reduced, and energy resources can be managed, all in a cost effective manner.

An energy audit was done at the El Sol Motel on September 1, 1983. In this survey, potential energy conservation opportunities (ECO's) were listed and reviewed by the team, prior to any detail analysis. For those ECO calculations, all utility bills and other fuel bills for the previous year (1982), weather data for the same period, occupancy rate, number of available rooms, record of space occupancy, sizes of different types of rooms, and facility as built drawings were collected.

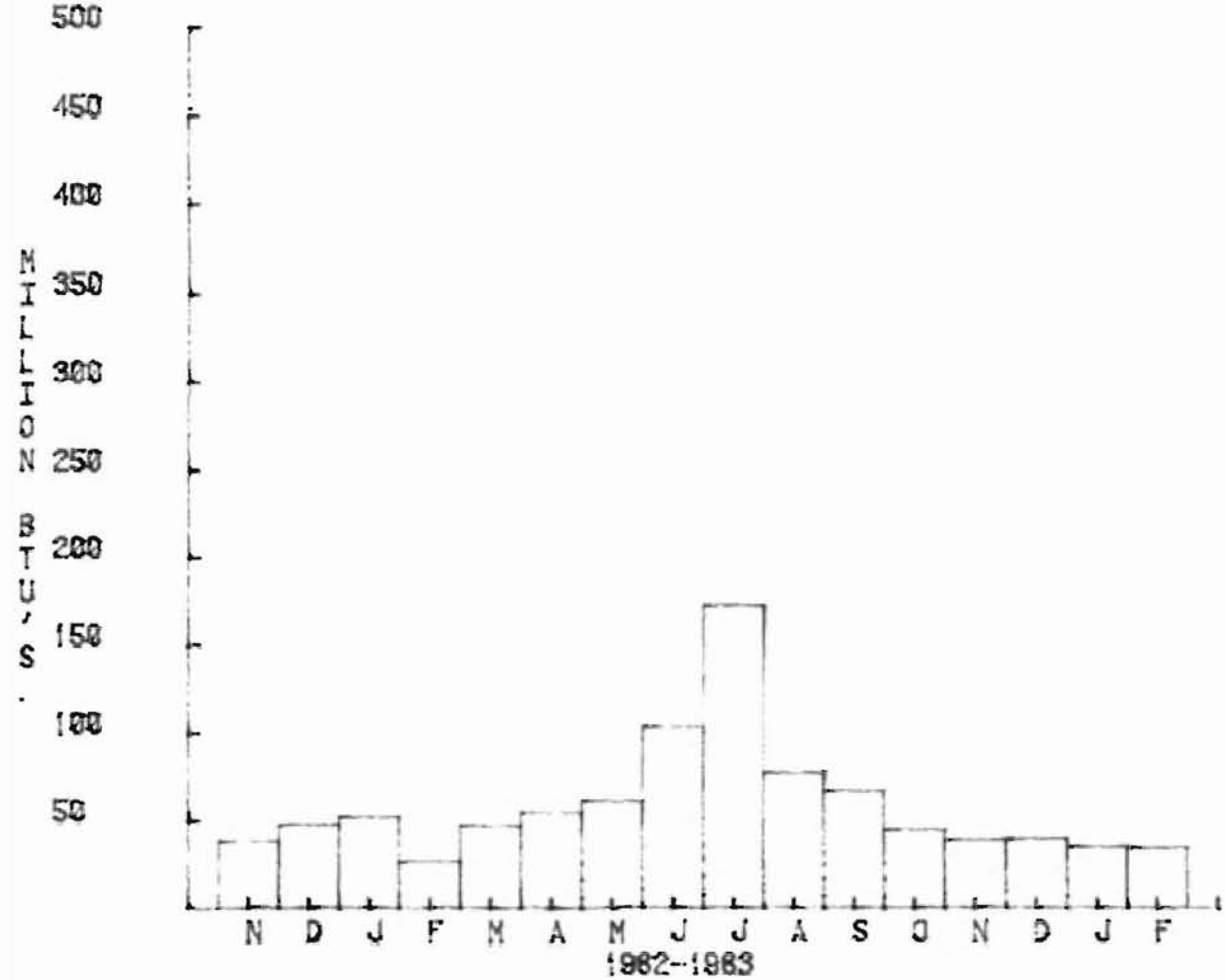
Team members studied the as built drawings to thoroughly familiarize themselves with the motel, and plot the energy consumption records of the electrical cost, electrical consumption, natural gas cost, natural gas consumption, total energy consumption, and total energy cost (Figures 5 through 10, respectively). Table II shows the energy consumption and cost.

In the following, the results of the analysis are presented. First, a summary of the results is shown. Then each ECO is presented with the necessary data and analysis.



ELECTRICALOCOST

Figure 5



ELECTRICAL CONSUMPTION

Figure 6

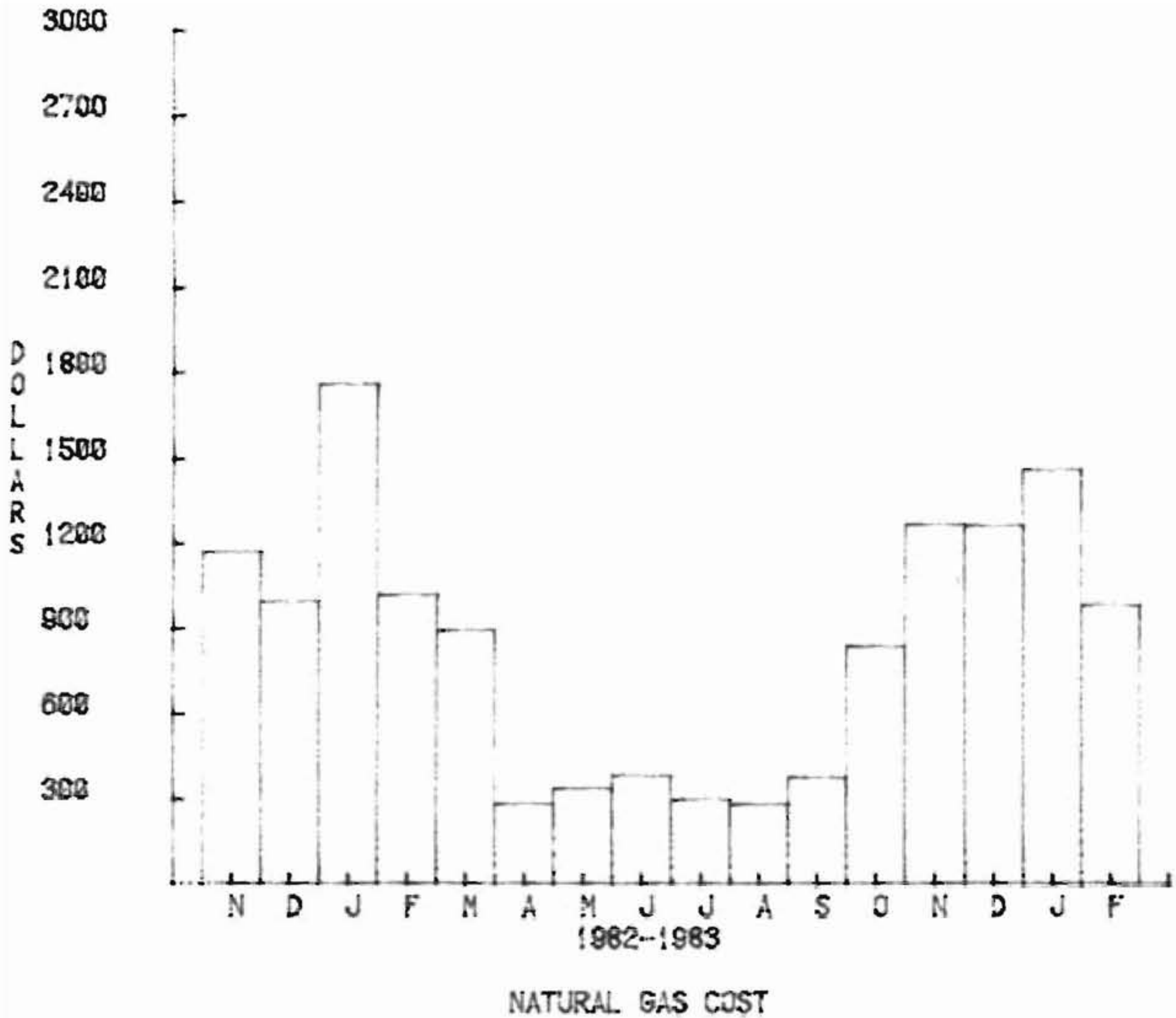

3000
2700
2400
2100
1800
1500
1200
900
600
300
DOLLARS
N D J F M A M J J A S O N D J F
1982--1983
NATURAL GAS COST

Figure 7

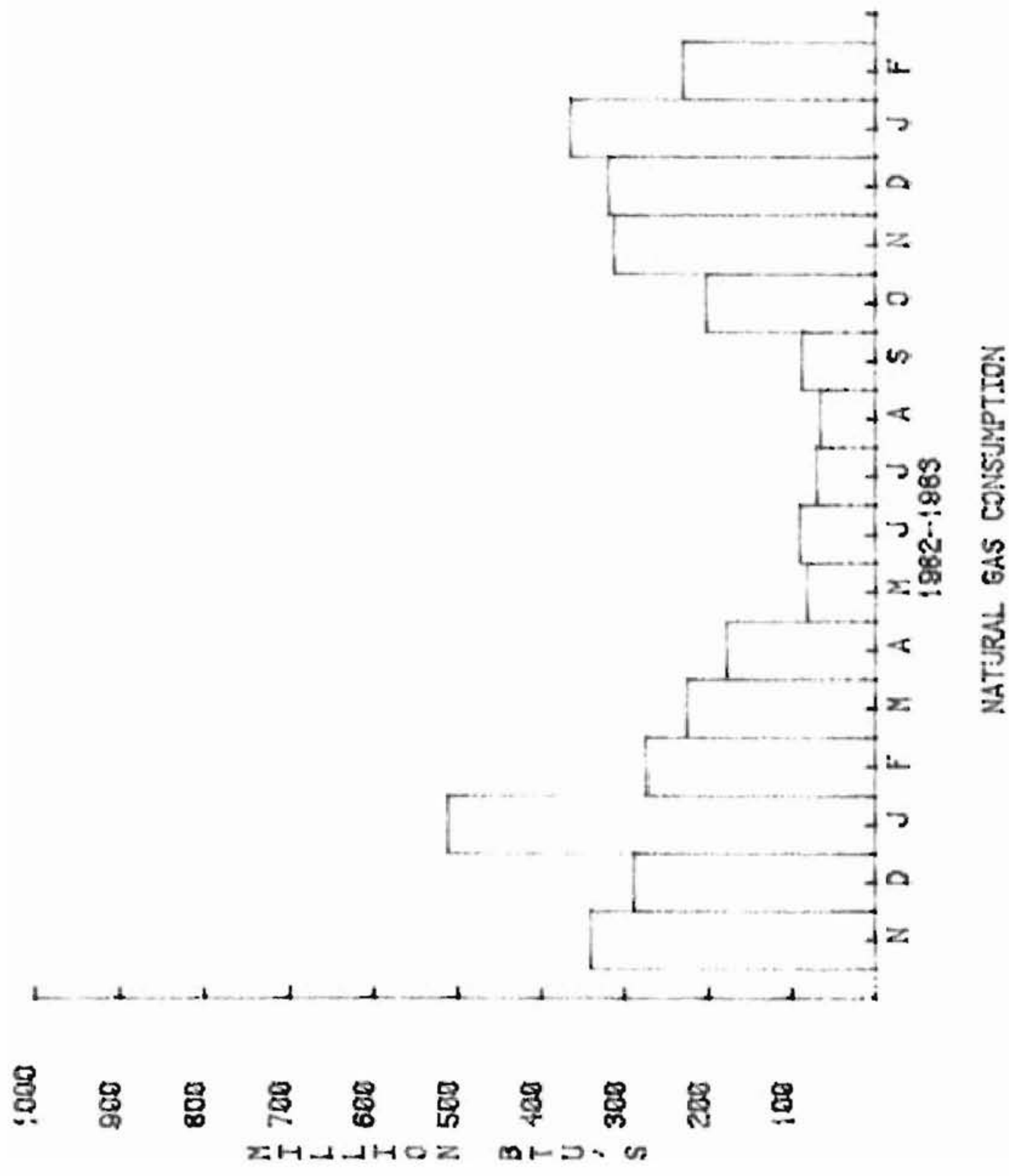
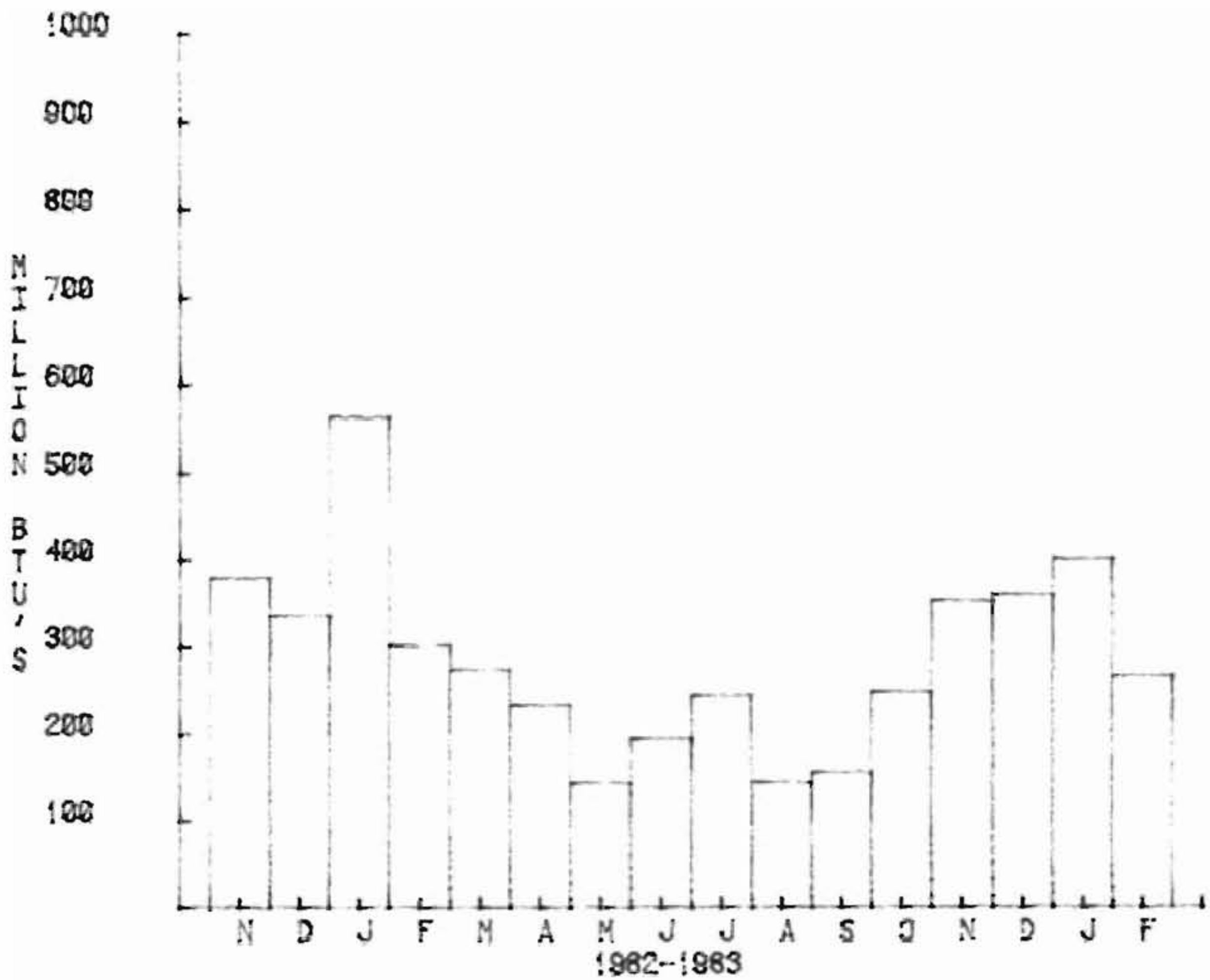

1000
900
800
700
600
500
400
300
200
100
MILLION BTU'S
N D J F M A M J J A S O N D J F
NATURAL GAS CONSUMPTION
1982-1983

Figure 8



TOTAL ENERGY CONSUMPTION

Figure 9

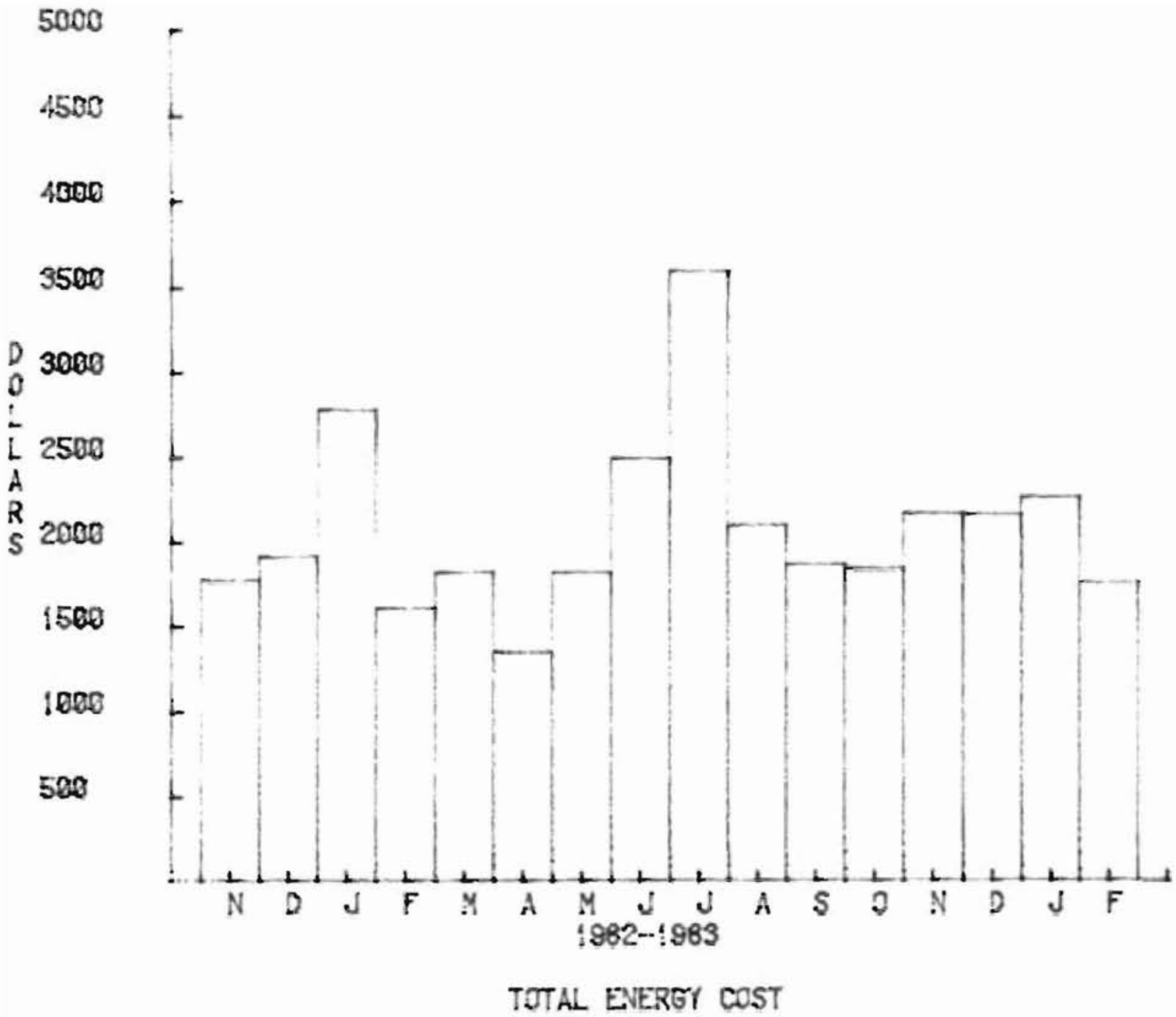

5000
4500
4000
3500
3000
2500
2000
1500
1000
500
DOLLARS
N D J F M A M J J A S O N D J F
1982--1983
TOTAL ENERGY COST

Figure 10

TABLE II

ENERGY CONSUMPTION AND COST

Mo.	Gas MMBTU	Elect. MMBTU	Gas Cost	Elect. Cost	Total MMBTU	Total Cost
N	340.30	38.48	1171.72	609.85	378.78	1781.57
D	289.20	47.68	995.77	921.05	336.88	1916.82
J	511.30	52.83	1760.50	1021.04	564.13	2781.54
F	275.40	27.18	1018.81	592.32	302.58	1610.93
M	226.30	47.40	682.80	932.84	273.70	1825.64
A	179.10	54.64	282.00	1075.25	233.74	1357.25
M	82.30	61.88	340.36	1481.80	144.18	1822.16
J	90.90	104.31	385.76	2109.09	195.21	2494.85
J	71.90	173.09	300.84	3304.02	244.99	3604.86
A	66.70	78.10	283.14	1820.95	144.80	2104.09
S	88.50	67.65	377.83	1495.50	156.15	1873.33
O	204.20	44.81	840.40	1008.75	249.11	1849.15
N	314.10	39.54	1272.90	901.75	353.64	2174.65
D	320.60	39.87	1270.05	900.92	360.47	2170.97
J	366.60	35.65	1466.42	799.41	402.25	2265.83
F	232.20	34.98	985.75	784.20	267.18	1769.95

ECO #1

TITLE: Switch bug light from 60W to 25W.

EXECUTIVE SUMMARY:

25W bug light bulbs are available as replacements for the 60W bulbs. They consume considerably less energy and yield the required light levels. The 25W bug light bulbs are direct replacements and need no modification or adjustment in fixtures. This ECO can be easily implemented by replacing regular 25W bulbs at the end of their life by equivalent energy efficient ones. The payback period is short.

REQUIRED DATA:

1.	cost of electricity	$0.03255/KWH
2.	fuel adjustment factor	$0.00388/KWH
3.	operation hours	3650hrs/yr
4.	conversion factor	3412 BTU/KWH
5.	sales tax	5%
6.	surcharge tax	6%

<u>Type of lighting source</u>: bug light bulbs

	Present System	Proposed System
No. of lamps in use	65	65
Wattage per lamp	60	25
Life/lamp	3500 hrs.	3500 hrs.
Cost/lamp	$1.27	$1.27

CALCULATIONS (for energy & $ saving):

1. Effective cost of electricity:

   = 1.10 (cost of electricity) + 1.05 (cost of fuel adjustment factor change)

   = $0.03580 + $0.00408

   = $0.0399/KWH

2. Saving in energy charge:

   = [(no. of lamps in use)(existing watts/lamp - proposed watts/lamp) x (1 KW/1000 watts)] (hours of operation/yr)

   = 8,303.75 KWH/yr

3. Dollar saving:

   = (saving in energy charge)(effective cost of electricity)

   = (8,303.75 KWH/yr)($0.0399/KWH)

   = $331.32/yr

4. Saving in energy (BTU's)

   = (saving in energy KWH/hr)(conversion factor)

   = (8,303.75 KWH/yr)(3,413 BTU/KWH)

   = 28.34 X 10^6 BTU/yr

IMPLEMENTATION COST:

1. Incremental annual cost for lamp replacement:

   Management can take care of this by ordering 25 watt lamps instead of the 60 watt lamps as existing bulbs fail and need replacement. Therefore, the total incremental cost of replacement

   = (no. of lamps in use)(cost/proposed lamp - cost/existing lamp)

   = (65 lamps)($1.27/lamp - $1.30/lamp)

   = $1.95

PAYBACK PERIOD:

Simple Payback:

= (total incremental cost of replacement)/(total $ savings/yr)

= $1.95/$331.32

= 0.0058 yrs

= 3 days

Note: It is worth mentioning that cleaning dirt off the lamps increases the lighting level.

ECO #2

TITLE: Use higher efficiency, lower wattage fluorescent lamps in the existing fixtures.

EXECUTIVE SUMMARY:

Energy efficient fluorescent bulbs are available as replacements for the standard bulbs. They consume considerably less energy, but yield approximately the same light level. The energy efficient lamps are direct replacements and need no modification of adjustment in fixtures. This ECO can be easily implemented by replacing your regular fluorescent lamps at the end of their life by their equivalent energy efficient ones. The incremental costs of buying the new ones are not at all high, but the savings in energy and dollars are quite attractive. The payback period is short.

REQUIRED DATA:

Present system of regular fluorescent lighting:

F40/CW (40 watts)	F96/T12/CW (75 watts)
Total number - 85	Total Number - 24
Life - 20,000 hrs	Life - 12,000 hrs
Lumens/lamp - 3,150	Lumens/lamp - 6,300
Cost/lamp - $1.73	Cost/lamp - $4.25

Proposed system of energy efficient fluorescent lighting:

F40/CW/RS/SS (35 watts)	F96/T12/CW/SS (60 watts)
Total number - 85	Total Number - 24
Life - 20,000 hrs	Life - 12,000 hrs
Lumens/lamp - 2,850	Lumens/lamp - 5,600
Cost/lamp - $2.50	Cost/lamp - $4.75

Cost of electricity $0.03255/KWH

Fuel cost adjustment factor charge $0.00388/KWH

Operating hours:

for 40 watts bulb = 2,500 hrs/yr

for 75 watts bulb = 3,000 hrs/yr

Average occupancy rate (assumed) - 70%

CALCULATIONS:

1. Effective cost of electricity:

= 1.11 (KWH consumption charge) + 1.05 (fuel cost adjustment factor charge)

= 1.11($0.03255/KWH) + 1.05($0.00388 KWH)

= $0.0399 KWH

2. Saving in energy change:

= [(no. of lamps in use)(existing watts/lamp - proposed watts/lamp) X (1 KW/1000 watts)] (hours of operation)

= [(85 lamps X 0.80*)(40 watts/lamp - 35 watts/lamp)(1 KW/1000 watts)](2,500 hrs/yr) + [(24 lamps)(75 watts/lamp - 60 watts/lamp) (1 KW/1000 watts)(3,500 hrs/yr)]

= [(850 KWH/yr) + (1,260 KWH/yr)]

= 2,110 KWH/yr

3. Dollar saving:

= (saving in energy change)(effective cost of electricity)

= (2,110 KWH/yr)($0.0399/KWH)

= $84.19/yr

*Includes average occupancy rate plus some bulbs run for longer periods.

4. Savings in BTU's

= (KWH saving/yr)(conversion factor)

= (2,110 KWH/yr)(3,412 BTU/KWH)

= 7.2×10^6 BTU/yr

IMPLEMENTATION COST:

The implementation cost for this ECO is based on incremental cost basis. Energy efficient lights can be used as existing bulbs fail and need replacement. Therefore, total incremental cost of replacement:

= (no. of lamps in use)(cost/proposed lamp - cost/existing lamp)

= [(85 lamps)($2.50/lamp - $1.73/lamp)] + [(24 lamps)($4.75/lamp - $4.25/lamp)]

= 65.45 + 12

= $77.45

PAYBACK PERIOD:

Simple Payback:

= (total incremental cost of replacement)/(total $ savings/yr)

= $77.45/$84.19

= 0.92 years

Note: Management could initiate lamp maintenance program. It is worth mentioning that cleaning dirt off the light lamps increases the lighting level from 5-10%.

ECO #3

TITLE: Switch outdoor floodlight fixture to high pressure sodium light fixture

EXECUTIVE SUMMARY:

Switching from one light source to a more efficient source is always recommended if economically justified because this results in large energy savings in addition to improved general lighting condition. Table III gives a comparative pictorial of the most commonly used light sources and their various characteristics. These factors do enter into consideration whenever a decision is made to switch from one source of light to a more efficient one. The high pressure sodium lamps have a high lamp efficiency and also have excellent lumen maintenance over life.

REQUIRED DATA:

cost of electricity	\$0.03255/KWH
fuel adjustment factor	\$0.00388/KWH
operation hours	3650hrs/yr

Present system of lighting:

type of light source in use	floodlight
wattage/lamp	150 watts
number of lamps	16
number of fixtures	8
lumens/watt	19.2
life/lamp	2000 hrs
cost/lamp	\$5.95

Proposed system of lighting:

type of light source in use	HPS 150W
wattage/lamp	150 watts
number of lamps	5
lumens/watt	80
life/lamp	20,000 hrs
cost/lamp	$150

CALCULATIONS:

1. Effective cost of electricity:

   = 1.11 (KWH consumption charge) + 1.05 (fuel cost adjustment factor charge)

   = 1.11($0.03255/KWH) + 1.05($0.00388 KWH)

   = $0.0399 KWH

2. Saving in energy change:

   = (existing KW - proposed KW)(operation hours)

   = [(no. of lamps in use)(watts/lamp) (1 KW/1000 watts) - (no. of lamps proposed) (watts/lamp)(1 KW/1000 watts)](operation hr/yr)

   = [(16)(150 watts/lamps)(1 KW/1000 watts) - (5) (150 watts/lamp)(1 KW/1000 watts)(3650 hrs/yr)

   = 6022.5 KWH/yr

3. Dollar saving:

   = (saving in energy change)(effective cost of electricity)

   = (6022.5 KWH/yr)($0.0399/KWH)

   = $240.30/yr

4. Saving in energy (BTU's)

   = (saving in energy KWH/yr)(conversion factor)

   = (5840 KWH/yr)(3412 BTU/KWH)

$= 19.93 \times 10^6$ BTU/yr

IMPLEMENTATION COST:

1. Labor cost = $102.00

2. Replacement cost:

   = (no. of lamps in use)($ cost/lamp)

   = (4 lamps)($137/lamp)

   = $548.00

PAYBACK PERIOD:

Simple Payback:

   = total cost of replacement/(total $ savings/yr)

   = ($548 + $102)/($240.30/yr)

   = $650/$240.30

   = 2.70 years

TABLE III

LIGHT SOURCE CHARACTERISTICS

	Incandescent, Including Tungsten Halogen	Fluorescent	High-Intensity Discharge: Mercury Vapor (Self-Ballasted)	High-Intensity Discharge: Metal Halide	High-Intensity Discharge: High-Pressure Sodium (Improved Color)	Low-Pressure Sodium
Wattages (lamp only)	15–1500	15–219	40–1000	175–1000	70–1000	35–180
Life[a] (hr)	750–12,000	7500–24,000	16,000–15,000	1500–15,000	24,000 (10,000)	18,000
Efficacy[a] (lumens/W) lamp only	15–25	55–100	50–60 (20–25)	80–100	75–140 (67–112	Up to 180
Lumen maintenance	Fair to excellent	Fair to excellent	Very good (good)	Good	Excellent	Excellent
Color rendition	Excellent	Good to excellent	Poor to excellent	Very good	Fair (very good)	Poor
Light direction control	Very good to excellent	Fair	Very good	Very good	Very good	Fair
Source size	Compact	Extended	Compact	Compact	Compact	Extended
Relight time	Immediate	Immediate	3–10 min	10–20 min	Less than 1 min	Immediate
Comparative fixture cost	Low; simple fixtures	Moderate	Higher than incandescent and fluorescent	Generally higher than mercury	High	High
Comparative operating cost	High; short life and low efficacy	Lower than incandescent	Lower than incandescent	Lower than mercury	Lowest of HID types	Low
Auxiliary equipment needed	Not needed	Needed; medium cost	Needed; high cost	Needed; high cost	Needed; high cost	Needed; high cost

[a] Life and efficacy ratings subject to revision. Check manufacturers' data for latest information.

ECO #4

TITLE: Switch rate schedules from PL1 to commercial rates

EXECUTIVE SUMMARY:

Although this ECO saves no electricity, there is substantial opportunity for dollar savings. Approximately 12 months ago, the company was switched from commercial to PL1. The commercial rate has no demand charge, but the energy charge ($ KWH) is 80% higher than the energy charge of PL1. The best historical data was used, but it should be understood that the audit team could only assume that these conditions would prevail in the future.

REQUIRED DATA:

Power electric rate schedule:

cost of electricity	$0.02765/KWH
fuel adjustment charge	$0.00388/KWH

Demand charge:

on peak:	$449 for first 75 KW + $4.97/additional KW
off peak:	$283 for first 75 KW + $3.29/additional KW

Customer charge:	$115.00
Surcharge:	6% of demand and consumption
Tax:	5%

Commercial rate schedule:

	On Peak	Off Peak
First 2000 KWH/month	$0.07729	$0.06716
All additional KWH	$0.06312	$0.0518
Monthly charge	$6.20	$6.20
Surcharge	6%	6%
Sales tax	5%	5%

CALCULATIONS:

During Peak Season:

High peak month = August

Consumption = 24,400 KWH

Demand = 46.8 KW/month

1. Power Electric Rate Calculation:

a) Customer charge = $115.00

b) Demand charge = $449.00

c) Consumption charge

= (consumption/month)($0.02765/KWH)

= (24,400 KWH/month)($).02765 KWH)

= $674.66/month

d) Fuel adjustment charge

= (fuel adjustment factor)(KWH/month)

= ($0.00388/KWH)(24,400 KWH/month)

= $94.67/month

e) Surcharge cost

= (surcharge factor)($ amount of consumption/month + $ amount of demand/ month)

= (0.06)($674.66/month + $449.00/month)

= \$67.42

f) Tax

= (0.05)(customer charge + consumption cost + demand cost + surcharge cost + fuel adjustment cost)

= (0.05)(\$115.00 + \$674.66 + \$449.00 + \$67.42 + \$94.67)

= \$70.03

g) Total cost/month

= customer charge + demand charge + consumption charge + surcharge + FA cost + tax

= (\$115.00 + \$449.00 + \$674.66 + \$67.42 + \$94.67 + \$70.03)

= \$1470.78/month

h) for off peak calculation, we have to use off peak rate schedule

2. Commercial electric rate calculation:

a) Fuel adjustment cost

= (fuel adjustment charge)(consumption/month)

= (\$0.00388/KWH)(24,400 KWH/month)

= \$94.67/month

b) Consumption charge

= first (2000 KWH)(\$0.07729) = \$154.58
+ next (22,400 KWH)(\$0.06312) = \$1413.89

= \$1568.47

c) Surcharge cost

= (surcharge factor)(consumption charge)

= (0.06)(\$1568.47)

= \$94.11

d) Tax

= (tax rate)(consumption charge + FA charge + surcharge + min. charge)

= (0.05)($1568.47 + $94.67 + $94.11 + $6.20)

= $88.17

e) Total charge

= (consumption charge + FA charge + surcharge cost + tax + min. charge)

= ($1568.47 + $94.67 + $94.11 + $88.17 + $6.20)

= $1851.62

3. Difference between power electric and commercial rate:

= PL1 rate cost - commercial rate cost

= $1470.78 - $1851.62

= -$380.84

4. Total savings per year (see Table IV)

IMPLEMENTATION COST:

There is no cost because the management can change rate schedules anytime for at least a 12 month period.

PAYBACK:

Since there is no implementation cost, payback is immediate.

TABLE IV

COMPARISON OF PL1 AND COMMERCIAL RATE FOR EL SOL MOTEL

Consumption in KWH	Month	PL1	Commercial	Savings
12,200	June 1982	1011.29	910.44	100.85
18,000	July	1177.53	1305.70	-128.17
24,400	August	1470.78	1851.62	-380.84
12,800	September	1043.28	966.09	77.19
11,200	October	990.65	850.38	140.27
10,400	November	794.56	679.08	115.48
10,200	December	782.67	688.11	94.56
11,600	January 1983	825.58	742.36	83.22
10,200	February	780.28	685.83	94.45
10,200	March	783.53	688.93	94.60
13,600	April	920.07	890.92	29.15
8,600	May	741.02	577.15	163.87
TOTAL SAVINGS				$484.67

Figure 11. Electrical Rate Schedules

ELECTRICAL RATE EFFECTIVE ON ALL BILLINGS AFTER MAY 19, 1982

Commercial GS - 1

(A) ON PEAK:

#1 First 2000 KWH per month - Multiply KWH x .07729¢
#2 All additional KWH per month - Multiply KWH x .06312¢
#3 Multiply total of line #1 and #2 x 1.06 (6% surcharge)
#4 Multiply total KWH x fuel adjustment
#5 Add monthly charge of $6.20
#6 Multiply total of Lines #3, #4, and #5 x 1.05 (5% tax)

(B) OFF PEAK:

#1 First 2000 KWH per month -- Multiply KWH x .06716¢
#2 All additional KWH per month -- Multiply KWH x .05180¢
#3 Multiply total of lines #1 and #2 x 1.06 (6% surcharge)
#4 Multiply total KWH x fuel adjustment
#5 Add monthly charge of $6.20
#6 Multiply total of Lines #3, #4, and #5 x 1.05 (5% tax)

OKLAHOMA GAS AND ELECTRIC COMPANY — OKLAHOMA DIVISION

STANDARD RATE SCHEDULE GS-1 CODE NO 06

General Service Rate GS

EFFECTIVE IN: All territory served.

AVAILABILITY: Alternating current for use other than a residential dwelling unit. Service will be rendered at one location at one voltage. For service at transmission voltage, see Power and Light Rate schedule. *applicable to loads up to 75kw —(*

No resale, breakdown, auxiliary or supplementary service permitted. Where commercial and residential service are served through one meter, the General Service Rate shall apply to the entire load.

RATE:

Customer Charge: $6.20 per bill per month.

Energy Charge: On-Peak Season (OG&E revenue months of June through October of any year.)

First 2000 kWh per month @7.729¢ per kWh
All Additional kWh per month @6.312¢ per kWh

Energy Charge: Off-Peak Season (OG&E revenue months of November of any year through May of the succeeding year.)

First 2000 kWh per month @6.716¢ per kWh
All Additional kWh per month @5.180¢ per kWh

LATE PAYMENT CHARGE: A late payment charge in an amount equal to one and one-half per cent (1 1/2%) of the total amount due on each monthly bill as calculated under the above rate will be added if the bill is not paid on or before the due date stated on the bill. The due date shall be twenty (20) days after the bill is mailed.

MINIMUM BILL: The minimum monthly bill shall be the Customer Charge.

The Company shall specify a larger minimum monthly bill, calculated in accordance with the Company's Allowable Expenditure Formula in its Terms and Conditions of Service on file with and approved by the Commission, when necessary to justify the investment required to provide service.

(Continued)

Issued March 16 1982 (Month Day Year) — Effective Bills rendered on and after March 17 1982 (Month Day Year)

Rates Authorized by Oklahoma Corporation Commission Order dated: 210919 (Order No.) 27275 (J.E.No.) (Cause No.) 3/16/82 (Date of Letter)

Issued by J. G. Harlow, Jr., Chairman of the Board and President
(Name of Officer) (Title)
Oklahoma City, Oklahoma
(Address of Officer)

STANDARD RATE SHEET

Original SHEET NO. 10.1 OF OCE CO NO. 9
SHEET NO. OF OGE CO NO.

OKLAHOMA GAS AND ELECTRIC COMPANY OKLAHOMA DIVISION

STANDARD RATE SCHEDULE GS-1 CODE NO 06

General Service Rate GS

(Continued)

FUEL COST ADJUSTMENT: The rate as stated above is based upon an average cost of $1.60 per million Btu for the cost of fuel burned at the Company's thermal generating plants. The monthly bill as calculated under the above rate shall be increased or decreased for each kWh consumed by an amount computed in accordance with the following formula:

$$F.A. = A \times \frac{B}{10^6} \times C + \frac{P}{S}$$

Where F.A. = The fuel cost adjustment factor (expressed in dollars per kWh) to be applied per kWh consumed.

A = The weighted average Btu/kWh for net generation from the Company's thermal plants during the second calendar month preceding the end of the billing period for which the kWh usage is billed.

B = The amount by which the average cost of fuel per million Btu during the second calendar month preceding the end of the billing period for which the kWh usage is billed exceeds or is less than $1.60 per million Btu. Any credits, refunds or allowances on previously purchased fuel, received by the Company from any source shall be deducted from the cost of fuel before calculating "B" each month.

C = The ratio (expressed decimally) of the total net generation from all the Company's thermal plants during the second calendar month preceding the end of the billing period for which the kWh usage is billed to the total net generation from all the Company's plants including hydro generation owned by the Company, or kWh produced by hydro generation and purchased by the Company, during the same period.

(Continued)

Bills rendered on and after

Issued March 16 1982 Effective March 17 1982
Month Day Year Month Day Year

Oklahoma Corporation Commission Order dated
Rates Authorized by 210919 27275 3/16/82
(Order No.) (J.E.No.) (Cause No.) (Date of Letter)

Issued by J. G. Harlow, Jr., Chairman of the Board and President
(Name of Officer) (Title)

(Continued)

P = Cost of power purchased by the Company from a cogeneration or small power production facility calculated on the basis of the "buy-back" rate established and approved by the Commission times the total kWh purchased from such facility or facilities during the second calendar month preceding the end of the billing period for which the kWh usage is billed.

S = Total kWh sales by the Company during the second calendar month preceding the end of the billing period for which the kWh usage is billed.

FRANCHISE PAYMENT: Pursuant to Order No. 110730 and Rule 54(a) of Order No. 104932 of the Corporation Commission of Oklahoma, franchise taxes or payments (based upon a per cent of gross revenue) in excess of 2% required by a franchise or other ordinance approved by the qualified electors of a municipality, to be paid by the Company to the municipality, will be added pro rata as a percentage of charges for electric service, as a separate item, to the bills of all consumers receiving service from the Company within the corporate limits of the municipality exacting the said tax or payment.

TERM: Open order. Seasonal changes to other rate schedules are prohibited. The Company may require a contract for a year or longer, subject also to special minimum guarantees, which may be necessary in cases warranted by special circumstances or unusually large investments by the Company. Such special minimum guarantees shall be calculated in accordance with the Company's Allowable Expenditure Formula in its Terms and Conditions of Service filed with and approved by the Commission.

Issued March 16 1982 (Month Day Year) — Effective Bills rendered on and after March 17 1982 (Month Day Year)

Rates Authorized by Oklahoma Corporation Commission: 210919 (Order No.) (J.E. No.) 27275 (Cause No.) Order dated 3/16/82 (Date of Letter)

Issued by J. G. Harlow, Jr. (Name of Officer), Chairman of the Board and President (Title)

Oklahoma City, Oklahoma (Address of Officer)

ECO #5

TITLE: Place photosensors on outside security lights and motel sign

EXECUTIVE SUMMARY:

The security lights on the outside of the building and motel sign are on 10-12 hours a day. Photosensors placed on these lights turn them off at daybreak and turn them on again at dusk. This will reduce the consumption cost and maybe the demand cost depending on when the peak occurs.

REQUIRED DATA:

number of security lights	16
size of security lights (high pressure sodium)	150 watts
average hours saved per day	2 hours
size of motel sign	5000 watts
cost of electricity	$0.03255/KWH
fuel adjustment charge	$0.00388/KWH
cost of photosensor	$20.00

CALCULATIONS:

1. Effective cost of electricity

   = 1.10(cost of electricity) + 1.05(cost of fuel adjustment factor charge)

   = 1.10($0.03255/KWH) + 1.05($0.00388/KWH)

   = $0.0399/KWH

2. Saving in KW:

= (no. of security lights)(power consumed) + (no. of motel signs)(power consumed)

= (16)(150/1000 KW) + (1)(5000/1000 KW)

= 7.4 KW

3. Saving in KWH:

= (saving in KW)(hours/day)(days/year)

= (7.40)(2 hrs/day)(365 days/yr)

= 5402 KWH/yr

4. Saving in BTU's:

= (saving in KWH)(conversion factor)

= (5402 KWH/yr)(3413 BTU/KWH)

= 18.44 X 10^6 BTU/yr

5. Dollar saving in consumption:

= (saving in KWH)(effective cost of electricity)

= (5402 KWH/yr)($0.0399/KWH)

= $215.54*

*If peaking occurs before the signs are turned on, there would be some demand savings, also.

IMPLEMENTATION COST:

An arrangement that allows the eight light fixtures to be banked together into the photosensor and one for photosensor for motel sign. Therefore, implementation cost

= (no. of photosensors)(cost of photosensor) + (no. of sensor)(average hrs to install) (cost/hr labor)

= (3)($20.00) + (3)(1 hr)($15.00/hr)

= $60.00 + $45.00

= $105.00

PAYBACK:

Payback period:

$$= (cost)/(savings/yr)$$

$$= \$105/\$215.54$$

$$= 0.49 \text{ years}$$

ECO #6

TITLE: Use of solar water heaters with heat exchangers

EXECUTIVE SUMMARY:

Solar water heaters are available in different sizes. This saves direct gas consumption. However, solar water heaters are expensive. For El Sol, storage tanks are available, so payback will be faster. Also, there is a 30% savings due to an investment tax credit on solar water heaters.

REQUIRED DATA:

average hot water consumption	15 gal/day/person
current gas consumption per year	1080 X 10^6 BTU
hours of operation	8760 hours/year
natural gas cost	\$3.842/MCF
electricity cost for cold days (assumed)	\$1000/year
investment tax credit	30%

CALCULATIONS:

1. Gas consumption charge:

   = (gas consumption/year)(natural gas cost)

   = (1080 X 10^6 BTU/year)(\$3.842/10^6 BTU)

   = \$4149.36

2. Dollars saved by installing solar water heater

   = gas consumption charge - electricity charge for cloudy days*

*There is a possibility of savings in electricity cost since gas heaters are available at El Sol which could be used for cloudy days.

= $4149.36 - $1000

= $3149.36

3. Number of gallons of hot water used per year

= (no. of gal/person-day)(no. of people/yr)

= (15 gal/person)(17,885 people/yr)

= 268,275 gallons/year

IMPLEMENTATION COST:

solar collectors with two panels	$900.00
two storage tanks (used current ones)	0.00
two glass-lined tanks (SUN-100)	$800.00
3" insulation cost	$70.00
copper absorbency tube and black chrome surface	$350.00
TOTAL MATERIAL COST	$2120.00

Total implementation cost

= material cost + installation cost

= $2120.00 + $1000.00

= $3120.00

PAYBACK:

= cost of solar heater/($ saving/yr + $ saved due to tax credit)

= $3120.00/[$3149.36/yr + (0.30)($3120.00)

= $3120/($3149.36 + $936.00)

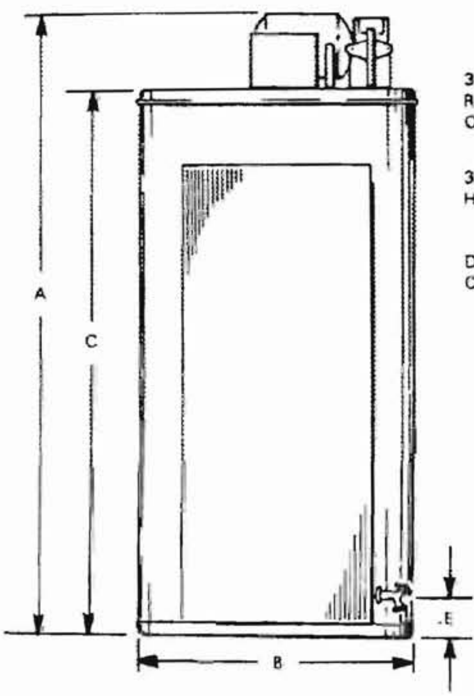
= 0.764 years

Figure 12. Details for Solar Water Heaters With Heat Exchangers

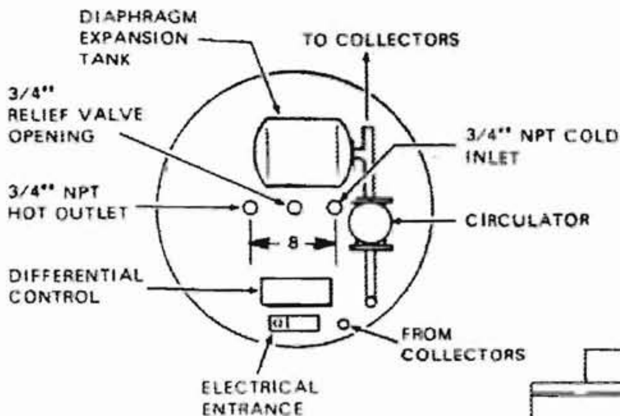
HERE'S HOW THE A. O SMITH CONSERVATIONIST solar system works:

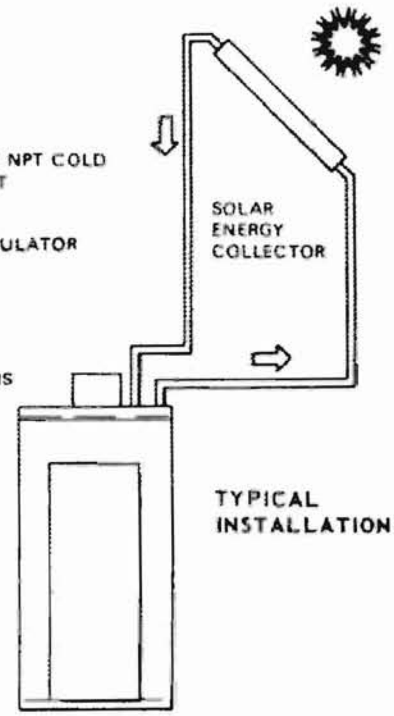
- The hot sun rays are absorbed by roof-mounted collector panels to heat special anti-freeze fluid that is circulating through integral copper channels.
- A. O. Smith utilizes a closed-loop system for transfer of heated solution and return. Ethylene glycol eliminates any worries of freezing.
- Heater-mounted differential controller has modulating output with two-speed pump to collect maximum amount of available heat from collector panels, even on cloudy days. Pump has all stainless steel internal parts; adjustable for flow with a restrictor that makes the A. O. Smith CONSERVATIONIST solar system flexible for various installations.
- Two high density magnesium anodes protect ta against corrosion.
- 3-inch double efficiency blanket of high density i sulation surrounds tank to keep in more heat.
- Tank is isolated from the jacket to prevent conducti heat loss.
- 30 psi Relief Valve.

FRONT VIEW



TOP VIEW



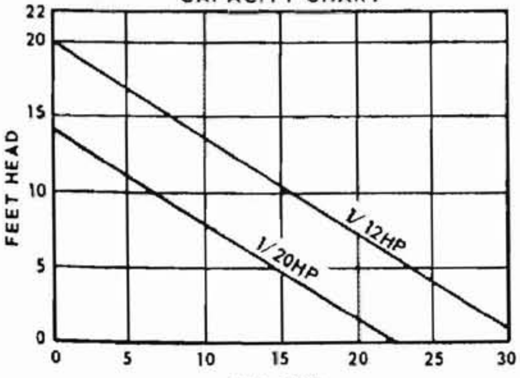


TYPICAL INSTALLATION

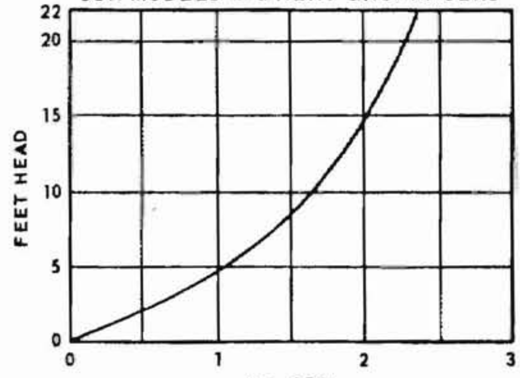
ALL DIMENSIONS IN INCHES

MODEL	CAPACITY U.S. GALLONS	A	B	C	E	APPROX. SHIP. WT. (LBS.)
SUN-82	82	56	28	48	4 1/4	235
SUN-100	100	65 7/8	28	57 7/8	4 1/4	250
SUN-120	120	69	30	61	5 3/4	340

CIRCULATOR CAPACITY CHART



PRESSURE DROP SUN MODELS W/2 HEAT EXCHANGERS



A.O. SMITH

SOLAR WATER HEATERS WITH EXCHANGERS

Nos. SUN-82, 100, 120

).Smith Conservationist Solar electric water heaters h heat exchangers are designed to provide the ulti- e in storage for your water heating system. Energy ing features of the A. O. Smith CONSERVATIONIST ™ er heaters are incorporated into these models to imize efficiencies.

ATURES

ISS-LINED TANK - Available in three sizes, 82, and 120 gallon capacity. All internal surfaces coated with glass especially developed for water ter use. Tanks have working pressure of 150 psi; t pressure 300 psi.

IONA ™ HEAT EXCHANGER - Type L copper tub- is used in a tube within tube design providing the ble wall type exchanger required by solar codes n a non-potable solution is used as heat transfer d, while maintaining the excellent heat transfer racteristics of copper. The heat exchangers are of immersion type and replaceable for maximum heat sfer and ease of maintenance. Two heat exchang- are standard; two additional heat exchangers are ional.

FERENTIAL CONTROL - Provides control of circu- r, turning on circulator when temperature difference veen panel temperature and tank temperature exceed F and turning off circulator when temperature differ- al is less than 3° F. Control is factory mounted to cover and pre-wired to circulator and tank sensor.

)ENIX ™ ELEMENT - Incoloy sheath combined with amic terminal block and highest quality nichrome provide the ultimate in electrical heating of do- tic hot water. The element is located in upper d of tank to provide reserve capacity of heated er for cloudy days.

RGY SAVING INSULATION - Tank is insulated with same high density insulation used in the A. O. th CONSERVATIONIST ™ water heaters. Stand-by ciency has been further improved through the use an extra thick blanket of fiberglass insulation - 3 hes - which surrounds the tank. Stored heat energy obtained longer and wasteful loss of heat to the n is reduced. The R-factor is 12.

PHRAGM EXPANSION TANK - Provided to handle ex- sion of heat transfer fluid in closed loop circula- line. Tank is factory mounted on top of heater. k is precharged to 12 psi; maximum working pres- e - 75 psi; test pressure - 150 psi.

CULATOR - Variable head, water lubricated, 1/20 circulator factory mounted and wired to differential trol. Isolation valves provided standard for ease of vice, 1/12 HP circulator optional.

CORONA ™
HEAT
EXCHANGER

A. O. Smith CONSERVATIONIST ™ models bear this label:

A representative product sample of this model, has been tested in accordance with ASHRAE Standard 90-75.

OTHER STANDARD FEATURES

• Jacket has baked enamel finish over galvanized undercoat • Color coded circuitry for ease of maintenance. Adjustable thermostat, UL rated for 100,000 cycling - check valve • Two magnesium anodes • Brass drain valve

OPTIONAL

- Two additional Corona heat exchangers
- 1/12 HP circulator

LIMITED WARRANTY OUTLINE

If the tank should leak any time during the first five years, under the terms of the warranty, A. O. Smith will furnish a replacement equivalent model; installation, labor, handling and local delivery extra. When used commercially, warranty is for one year. This outline is not a warranty. For complete information, consult the written warranty or A. O. Smith Consumer Products Division.

Prices subject to change without notice.

Figure 13. Details for Solar Collectors

SOLAR COLLECTOR
NSC-186

COVER - Single glazing: special low iron glass, 1/8 inches empered. Transmissivity: 90.5 percent.

ABSORBER CONTAINER - Sides, aluminum extrusion; ear aluminum sheet.

AIR SPACE BETWEEN COVER AND ABSORBER - Ap- roximately 1 inch.

WEATHERPROOFING - This module can be placed out in he weather without need for further weatherproofing.

FINISH ON ALUMINUM SIDES OF CONTAINER - tandard mill finish.

DIMENSIONS OF SURFACE-MOUNTED MODULE - Outside dimensions overall: 35 inches wide X 77 inches ong X 4 1/2 inches thick. Gross collector area = 18.6 $Ft.^2$

ABSORBER - Copper sheet: 0.032 inches thick. Selective lack chrome surface. Durable to 400°F. Copper tubes: /4 inch nominal, 5 1/2 inches on center. Tube pattern: rid. Tubes are inflated under pressure into single, solid heet of copper. Manifolds: 1/2 inch nominal. (5/8 in I.D.) Connection to external piping: 1/2 inch. Manifold/ ubes pressure tested before leaving factory to 150 psig. 5 psig working pressure.

INSULATION BEHIND ABSORBER - 3 1/2 inch thick- igh temperature glass fiber (compressed). R = 10.2 $t^2 \cdot °F \cdot Hr/Btu$.

METHOD OF ANCHORING - Model NSC-186 CON- ERVATIONIST collectors are offered with a choice of o mounting systems:

Integral flange for installing the collector to a roof which has the correct tilt angle. The collector is positioned vertically with the long dimension at a right angle to the mounting surface.

Adjustable position for installing the collector on a surface which does not have the correct tilt angle. This includes sloped or flat roofs and on-ground installations. The long or short collector dimension may be installed at the right angle to the mounting surface. The parts are made of aluminum or stainless steel.

PERFORMANCE FACTORS - Based on Gross Area of 18.6 $Ft.^2$.

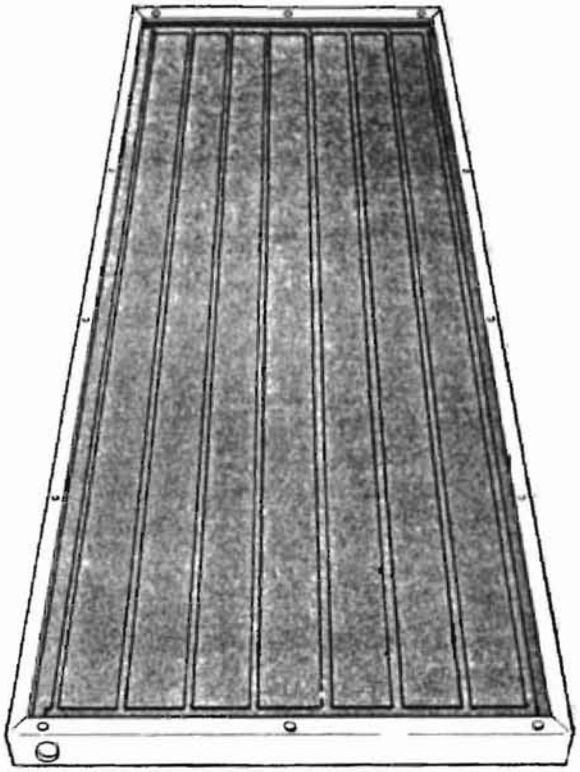
tercept, $F_R(\tau\alpha) = 0.718$

ss Coefficient, $F_R U_L = 0.849$

ident Angle Modifier, $K_{\alpha\tau} = 1.014 - 0.092\left[\frac{1}{\cos\theta} - 1\right]$

al ASHRAE 93-77 Analysis of the efficiency data re- ted in the following second order equation:

$$= 0.710 - 0.664\left[\frac{T_i - T_a}{I_T}\right] - 0.422\left[\frac{T_i - T_a}{I_T}\right]^2$$



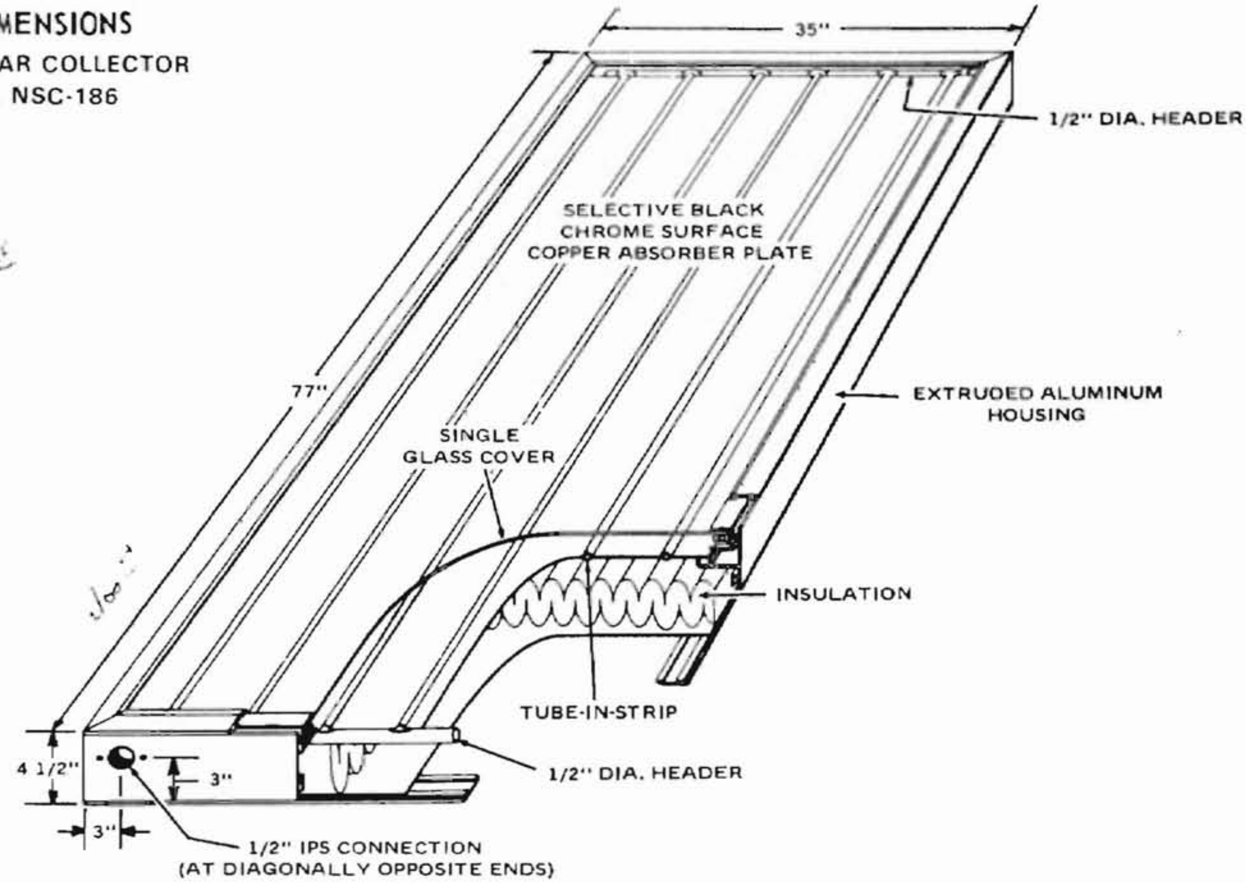
WEIGHT PER MODULE - 90 pounds, filled; 88 pounds, empty. (NOTE: The liquid in the collector is equal to 0.28 gallons or 2.33 pounds).

COLLECTOR COOLANT - Coolant should be water/ propylene glycol mixture. It is important that the pH be controlled between 6.5 and 9.

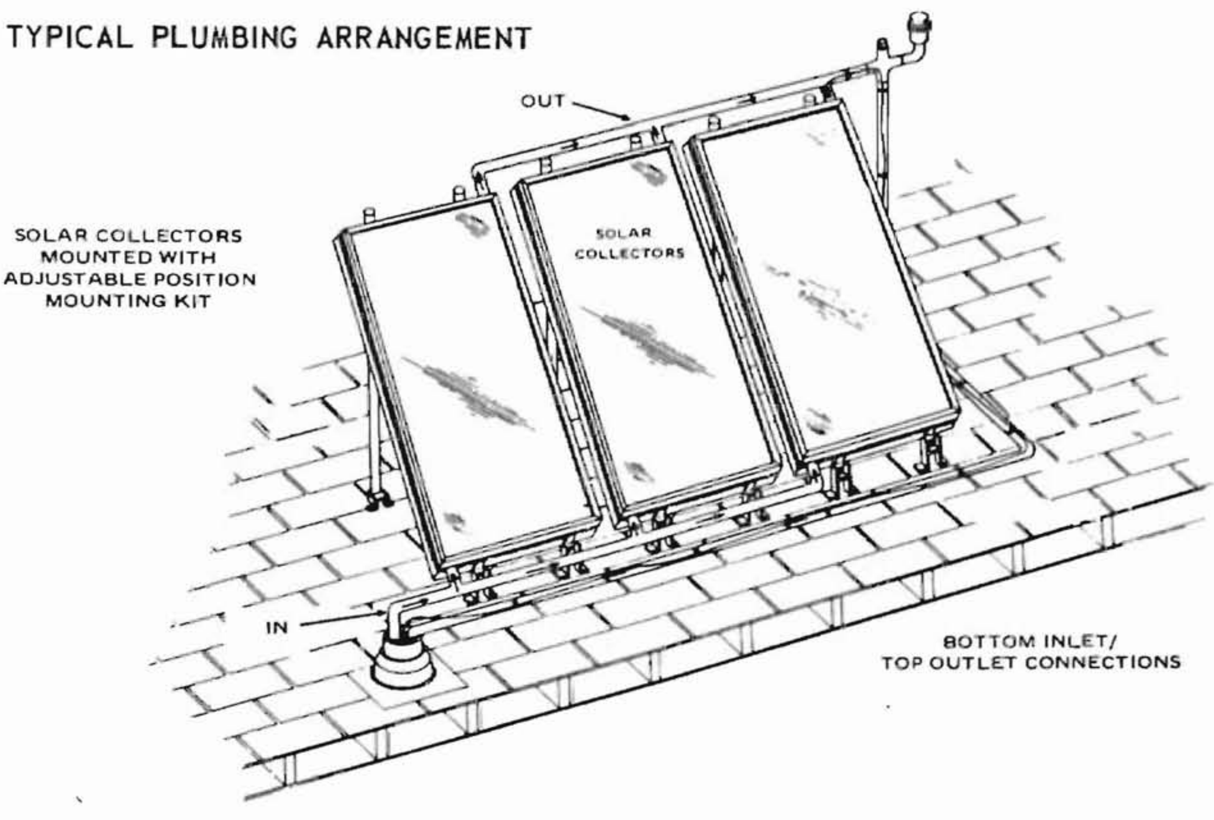
LIMITED WARRANTY OUTLINE

If the panel should leak any time during the first five years, under the terms of the warranty, A. O. Smith will furnish a replacement panel; installation, labor, handling and local delivery extra. This outline is not a warranty. For complete information, consult the written warranty or A. O. Smith Consumer Products Division.

DIMENSIONS
SOLAR COLLECTOR
No. NSC-186



TYPICAL PLUMBING ARRANGEMENT



ECO #7

TITLE: Use flow restrictor for showerhead

EXECUTIVE SUMMARY:

There is great potential saving of energy by reducing hot water usage. This can easily be accomplished by installing flow restrictors in the showerheads. By Installing flow restrictors, the motel will save energy and water.

REQUIRED DATA:

water production of shower head	5 gal/min
average shower length	5 minutes
number of shower heads	60
water temperature - cold	$60^{o}F$
hot	$140^{o}F$
average occupancy per year	65%
single occupancy	75%
double occupancy	25%
efficiency of water heater	85%
% hot water	65%
water reduced due to restrictor	2 gal/min
cost of natural gas	$\$3.842/10^{6}$BTU

CALCULATIONS:

Water Savings:

1. Number of times showerhead used per day:

   = [(no. of showerheads)(average occupancy) (% single) + (no. of showerheads)(average occupancy)(% double)(2)]

   = [(60)(0.65)90.75) + (60)(0.65)(0.25)(2)]

   = 49

2. Number of showers per year:

   = (no. of showers/day)(no. of days/yr)

   = (49 showers/day)(365)

   = 17,885

3. Gallons of water saved per year:

   = (no. of showers/yr)(average time shower used) X (water saved due to restrictor/min)

   = (17.885 showers/yr)(5 min/shower)(2 gal/min)

   = 178,850 gallons/year

4. Dollar savings per year:

   = (no. of gals. saved/yr)(cost/gal)

   = (178,850 gal/yr)($1.05/1000 gal)

   = $187.80/year

Energy Savings:

5. Hot water saved:

   = (gals. of water saved)(% hot water used in mix)

   = (178,850 gallons)(0.65)

   = 116,253 gallons

6. Energy saving (BTU/year):

   = (no. of gals.)(T)(1/EFF)(1 BTU/1lbm-^{o}F) (8.33 lbm/gal)

$= (116{,}253)(140^{o}-60^{o})F(1/0.85)(1\ BTU/1\ lbm\text{-}^{o}F)(8.33\ lbm/gal)$

$= 91.2 \times 10^{6}$ BTU/year

7. Dollar savings per year:

= (BTU saved)(cost/BTU)

$= (91.20 \times 10^{6})(\$3.842/10^{6}\ BTU)$

= $350.39/year

8. Total savings:

= water savings + energy savings

= $187.80 + $350.39

= $538.19

IMPLEMENTATION COST:

= (no. of flow restrictors)(cost/restrictor)

= (60)(0.90)

= $54.00

PAYBACK:

= (cost)/(savings/year)

= $54.00/$538.19

= 0.10 years

ECO #8

TITLE: Reduce temperature of hot water heater in the rooms

EXECUTIVE SUMMARY:

The domestic hot water temperature of rooms was found to be hotter than required. Energy savings are possible through reduction of water temperature to approximately 115° F. The payback is immediate since the only investment is the time required to reset the hot water tank temperatures.

REQUIRED DATA:

current hot water temperature	140° F
proposed hot water temperature	115° F
number of people per year	17,885
average hot water consumption	15 gallons/person-day
natural gas cost	$3.842/10^6 BTU

CALCULATIONS:

1. Estimated energy savings:

   = (no. of people/yr)(average water consumption) (1 BTU/lbm-°F)(8.33 lbm/gal)(current temperature - proposed temperature)

   = (17,885 people)(15 gal/person-day)(1 BTU/lbm-°F) (8.33 lbm/gal)(140°F-115°F)

   = 55.87×10^6 BTU/year

2. Dollar savings:

   = (BTU saved/yr)(cost/MCF)(conversion factor)

   = (55.87×10^6 BTU/yr)($3.842/MCF)(MCF/$10^6$ BTU)

= $214.65/year

IMPLEMENTATION COST:

negligible

PAYBACK:

immediate (no investment required)

SUMMARY OF ECO #6, #7, AND #8

ECO #7 (use of flow restrictors) and ECO #8 (reduced temperature of hot water heater) can be done easily. Management should not simply add the savings.

Assume ECO #8 is done first.

current gas consumption cost reduced

= current gas cost - \$ saving in ECO #8

= \$4149.36 - \$214.65

= \$3934.71

Then, ECO #7 is done.

gas cost

= reduced gas cost - \$ savings in ECO #7

= \$3934.71 - \$350.39

= \$3584.32

The company can use this gas cost for solar water heater ECO calculation. This will result in an increased payback period. Similarly, gas consumption BTU's are reduced to 932.93 X 10^6 BTU/year.

Good

ECO #9

TITLE: Install weatherstripping on the doors

EXECUTIVE SUMMARY:

Cracks around the doors in the conditioned space allow infiltration of outside air. This results in an additional requirement of energy to maintain desired temperature during both summer and winter. The loss of energy can be prevented by adding weatherstripping around the doors and sealing the cracks around air conditioners.

REQUIRED DATA:

width of cracks	3/4" on bottom, 1/4" on one side edge and top edge
size of opening	36" X 75"
infiltration velocity	4 MPH (winter) 2 MPH (summer)
inside temperature	68^{o}F (winter) 75^{o}F (summer)
average outside temperature	61^{o}F (winter) 84^{o}F (summer)
heating unit efficiency	0.8
cooling unit efficiency	3.0
hours of infiltration	900 hours (winter) 1200 hours (summer)
number of doors	32
cost of natural gas	$3.842/MCF
cost of electricity	$0.03623/KWH

CALCULATIONS:

1. Saving in energy (summer)

= (area)(wind velocity)(temperature difference) (hrs of operation/yr)(specific heat of air) (density of air)(1/cooling unit efficiency) (conversion factor)(no. of doors)

= $(0.38\ ft^2/door)(2\ mi/hr)(9^oF)(1200\ hrs/yr)$ $(0.24\ BTU/lbm\text{-}^oF)(0.075\ lbm\text{-}^oF)(1/3)(5280\ ft/hr)$ $(32\ doors)$

= 8.328×10^6 BTU/year

2. Saving in dollars

= (energy saving in BTU/yr)(conversion factor) (cost of electricity)

= $(8.328 \times 10^6\ BTU/yr)(1\ KWH/3412\ BTU)$ $(\$0.03623/KWH)$

= $88.43

3. Saving in energy (winter)

= (area)(wind velocity)(temperature difference) (hrs of operation/yr)(specific heat of air) (density of air)(1/heating unit efficiency) (conversion factor)(no. of doors)

= $(0.38\ ft^2/door)(4\ mi/hr)(7^oF)(900\ hrs/yr)$ $(0.24\ BTU/lbm\text{-}^oF)(0.075\ lbm\text{-}^oF)(1/0.8)$ $(5280\ ft/hr)(32\ doors)$

= 36.434×10^6 BTU/year

4. Saving in dollars

= (energy saving in BTU/yr)(natural gas cost)

= $(36.434 \times 10^6\ BTU/yr)(\$3.842/10^6 BTU)$

= $139.98

5. Total dollar savings

= $ savings in winter + $ savings in summer

= $139.98 + $88.43

= $228.41

6. Total energy savings

= energy savings in winter + energy savings in summer

= $(36.434 \times 10^6$ BTU/yr$) + (8.328 \times 10^6$ BTU/yr$)$

= 44.76×10^6 BTU/yr

IMPLEMENTATION COST:

1. Door strip for bottom of door (including installation)

= $2.75/door

2. Side weatherstrip cost

= $3.00/door (material) + $1.50/door (installment)

= $4.50/door

3. Total implementation cost

= (no. of doors)(weatherstrip cost for bottom of door) + (no. of doors)(weatherstrip cost for side of door)

= (32 doors)($2.75/door) + (32 doors)($4.50/door)

= $88.00 + $144.00

= $232.00

PAYBACK:

Payback Period:

= implementation cost/total savings for year

= $232.00/($228.41/yr)

= 1.02 years

ECO #10

TITLE: Thermal insulation of hot water heaters, storage tanks, and pipelines

EXECUTIVE SUMMARY:

Thermal insulation plays a key role in the overall energy management picture. It is important to consider that by using insulation, the entire energy requirements of a system are reduced. Most insulation systems reduce the unwanted heat transfer, either loss or gain, by at least 90% as compared to uninsulated systems. Since the insulation system is so vital to energy efficient operations, the proper selection and application of that system is very important.

REQUIRED DATA:

All data shown in Table V (Input for Hot Water Tanks, Line and Storage Tanks).

CALCULATIONS:

See information in Table VI (Undiscounted Payback Calculations).

IMPLEMENTATION COST:

= hot water line cost + two hot water tank costs + two storage tanks costs

= $25.00 + $32.25 + $18.24 + $38.00 + $38.00

= $151.49

PAYBACK:

= implementation cost/net $ savings per year

= ($151.49)/($281.06/yr)

= 0.54 years

TABLE V

INPUT FOR HOT WATER TANKS, LINE, AND STORAGE TANKS

Sr. No.	Name of Installation	Length/ Height of Pipe/ Tank	Diameter of Pipe	Surface Temp. Ts (^{o}F)	Ambient Temp. Ta (^{o}F)	Hours of Operation Per Year	$Tm = \frac{Ts+95}{2}$	Heating Degree Hours = (Ts-Ta) Hrs. Oper.	Rs	K
1	Hot Water Tank #1	52"	30"	108	80	8760	101.5	245,280	0.518	0.252
2	Hot Water Tank #2	32"	27.5"	112	80	8760	104.5	280,320	0.518	0.252
3	Hot Water Line	25'	1"	106	80	8760	100.5	227,760	0.52	0.251
4	Storage Tank #1	60"	30.6"	106	80	8760	100.5	227,760	0.52	0.252
5	Storage Tank #2	60"	30.6"	106	80	8760	100.5	227,760	0.52	0.252

TABLE VI

UNDISCOUNTED PAYBACK CALCULATIONS*

No.	Name of Installation (1)	Length of Pipe in Ft. or area to be Insulated in Sq. Ft. (2)	Optimum Thickness Insulation From Output (3)	BTU Saved Per Ft. or Sq. Ft. (4)	MBTU Saved (4)(2) (5)	Net Dollar Savings Per Year (5) X $3.842/MCF) (6)	Installed Cost in $ Per Ft. or Sq. Ft. (7)	Total Installation Cost in $ (7)(2) (8)	Payback Year (8)/(6) (9)
1	Hot Water Tank #1	33.95	1.5	544,506.8	$18.49X10^6$	71.04	0.95	32.25	0.45
2	Hot Water Tank #2	19.20	1.5	620,998.4	$11.93X10^6$	45.84	0.95	18.24	0.398
3	Hot Water Line	25'	0.5	97,909	$2.45X10^6$	9.42	1.0	25.00	2.65
4	Storage Tank #1	40	1.5	503,513.3	$20.14X10^6$	77.38	0.95	38.00	0.491
5	Storage Tank #2	40	1.5	503,513.3	$20.14X10^6$	77.38	0.95	38.00	0.491
TOTAL					$73.15X10^6$	281.06		151.49	0.54

*All calculations done using information from Appendixes A, B, and C.

ECO #11

TITLE: Night setback for the Lounge and Dining Room Area

EXECUTIVE SUMMARY:

Energy and therefore dollar savings can be realized by using night setback. This can easily be done by installing a seven day, 24 hours/day programmable automatic night setback timer to control the thermostats. During the heating season, a timer can set the temperature at 72°F for normal working hours and at 57°F during unoccupied hours. Since the air handling units would be heating to a lower temperature, less energy would be used. For your system of present operating conditions, calculations have been made to show savings during the heating season. However, total savings could be even greater, depending upon the temperature chosen for summer.

REQUIRED DATA:

present temperature	72°F
proposed temperature	57°F
heating degree-days in Stillwater	3600°F days/year
natural gas cost	$\$3.842/10^6$ BTU
setback	15°F
lounge area	6000 ft^2
dining area	6500 ft^2

CALCULATIONS:

1. For 3600 heating degree-days and 15°F of setback and for your present average heating consumption of 28,000 BTU/yr-ft^2*, figure 15 shows an energy savings of 14,000 BTU/ft^2-yr.

*Determine from Figure 14.

2. The actual annual energy savings would, therefore, be

   = (energy savings read from graph)(conditioned space area)

   = $(14{,}000\ BTU/ft^2\text{-}yr)(12{,}500\ ft^2)$

   = 175×10^6 BTU/year

3. Dollar savings in natural gas

   = (annual energy savings)(cost of natural gas)

   = $(175 \times 10^6\ BTU/yr)(\$3.842/10^6\ BTU)$

   = $672.35/year

IMPLEMENTATION COST:

1. Instrument for your system:

   a night setback sequence, 7 day programmable two channel version

   = about $525.00

2. Labor cost

   = about $100.00

3. Total cost

   = instrument cost + labor cost

   = $525.00 + $100.00

   = $625.00

PAYBACK:

Payback Period:

   = total cost/annual savings

   = ($625)/($672.35/yr)

   = 0.93 years

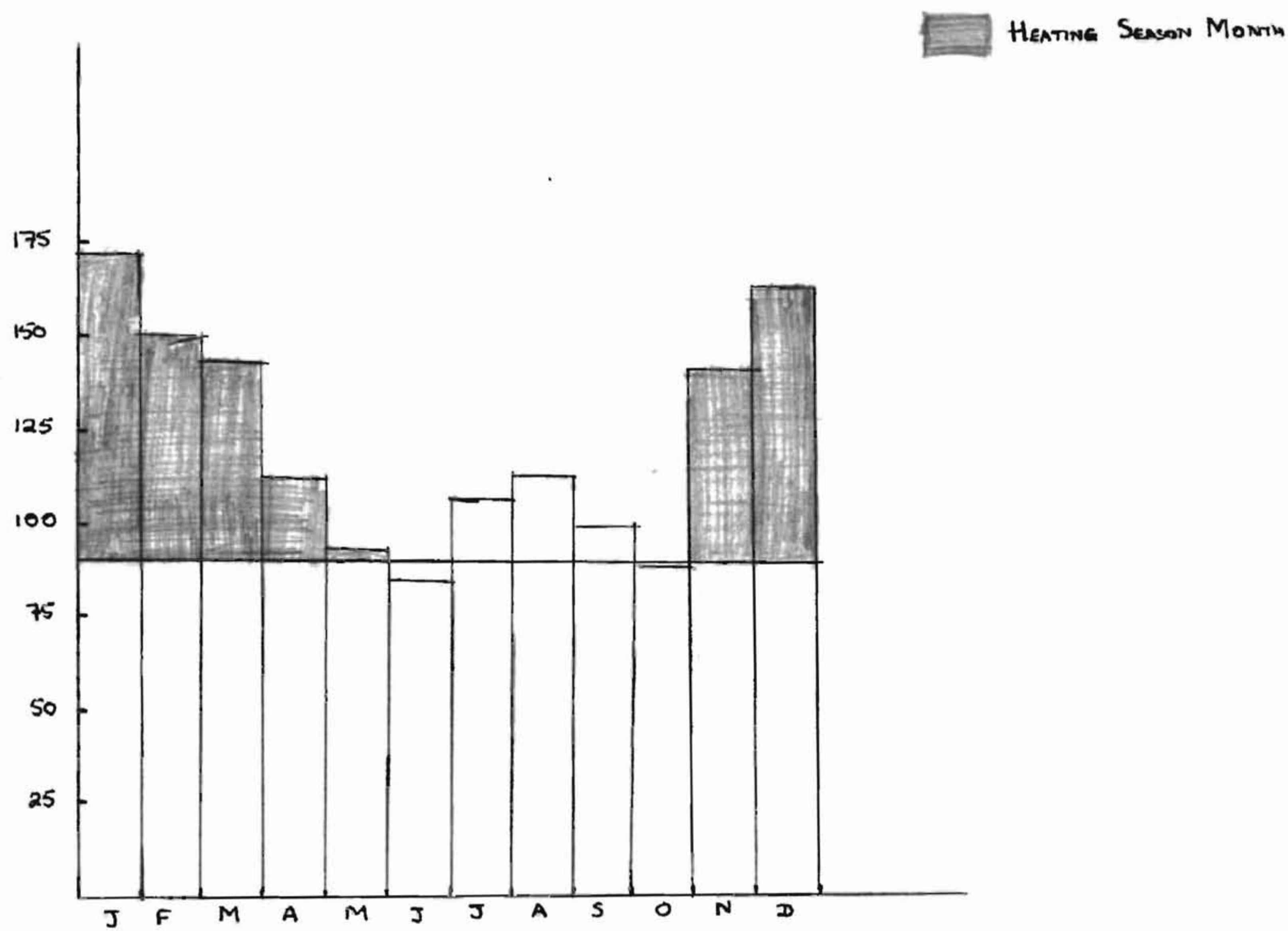
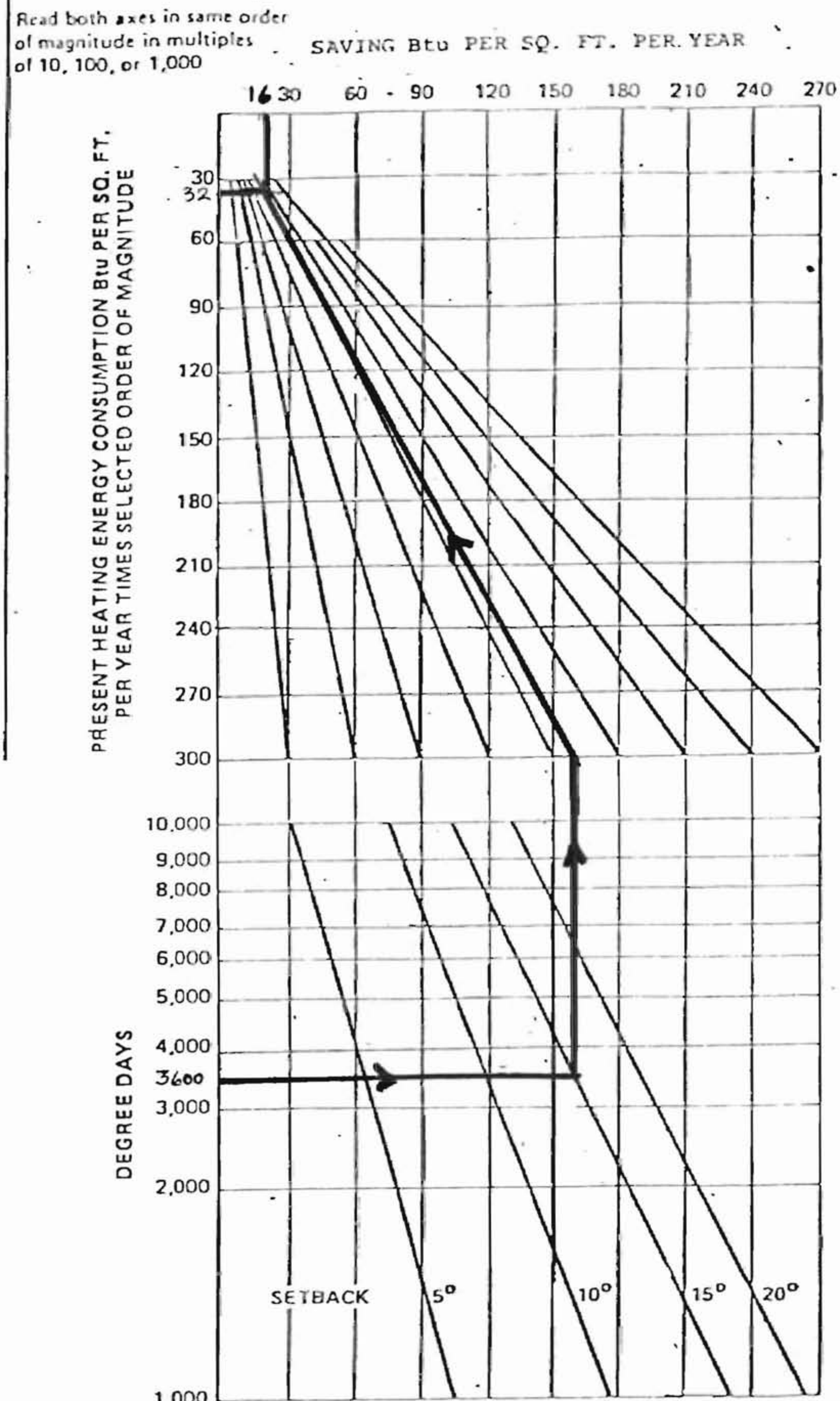


Figure 14. Gas Consumption (Restaurant-Cantina)

Figure 15. Heating Energy Saved
by Night Setback



Source: Guidelines for Saving Energy in Existing Buildings, ECM-1, FEA, 1975.

ECO #12

TITLE: Heat recovery from chilling equipment to preheat dish machine and laundry washing machine water

EXECUTIVE SUMMARY:

The mechanical refrigeration process is a thermodynamic cycle in which heat is absorbed during one part of the cycle and rejected during another part of the cycle. Traditionally, the heat is removed through the thermodynamic cycle by rejecting it to the atmosphere using an evaporative cooling tower, a dry cooling tower, or a fan coil condensor. This rejected heat is wasted energy. By replacing the condensor with a heat exchange system, the waste heat of the refrigeration cycle can be used to heat water. This ECO examines the savings potential of installing a heat exchanger to capture the waste heat of refrigeration gases for the 1 1/2 hp walk-in chiller.

REQUIRED DATA:

water temperature	$60^{o}F$
temperature increase provided by heat exchanger system	$54^{o}F$
water consumption*	1040 gallons/day

*based on 200 gallon/hr for dish machine and 60 gallon/hr for washing machine

hours of operation - dish machine	4 hours/day
washing machine	4 hours/day
size of walk-in chiller	1 1/2 hp
discharge rate*	60,000 BTU/hp/hr

*based on specification per Mr. Weinbeck of Energy Extender (types of walk-ins)

run time	12 hours/day
natural gas cost	\$3.842/MCF

heater efficiency 0.80

CALCULATIONS:

1. Amount of recoverable energy

= (discharge rate of walk-in)(run time of walk-in)(size of walk-in)

= (60,000 BTU/hp/hr)(12 hrs/day)(1.5 hp)

= 1,080,000 BTU/day at $121^{o}F$

2. Saving in energy

= (amount of recoverable energy)(1/efficiency of heater)(days/year)

= (1,080,000 BTU/day)(1/0.8)(365 days/yr)

= 492.75×10^6 BTU/year

3. Saving in dollars

= (BTU saved/year)(natural gas cost)

= (492.75×10^6 BTU/yr)($3.842/MCF)(1 MCF/$10^6$ BTU)

= $1893.15/year

IMPLEMENTATION COST:

energy extended SM10	$804.00
80 gallon storage tank	$475.00
assorted copper fittings, valves, insulation, and extra refrigerant	$200.00
labor (5 hours at $35.00/hr)	$175.00
TOTAL	$1654.00

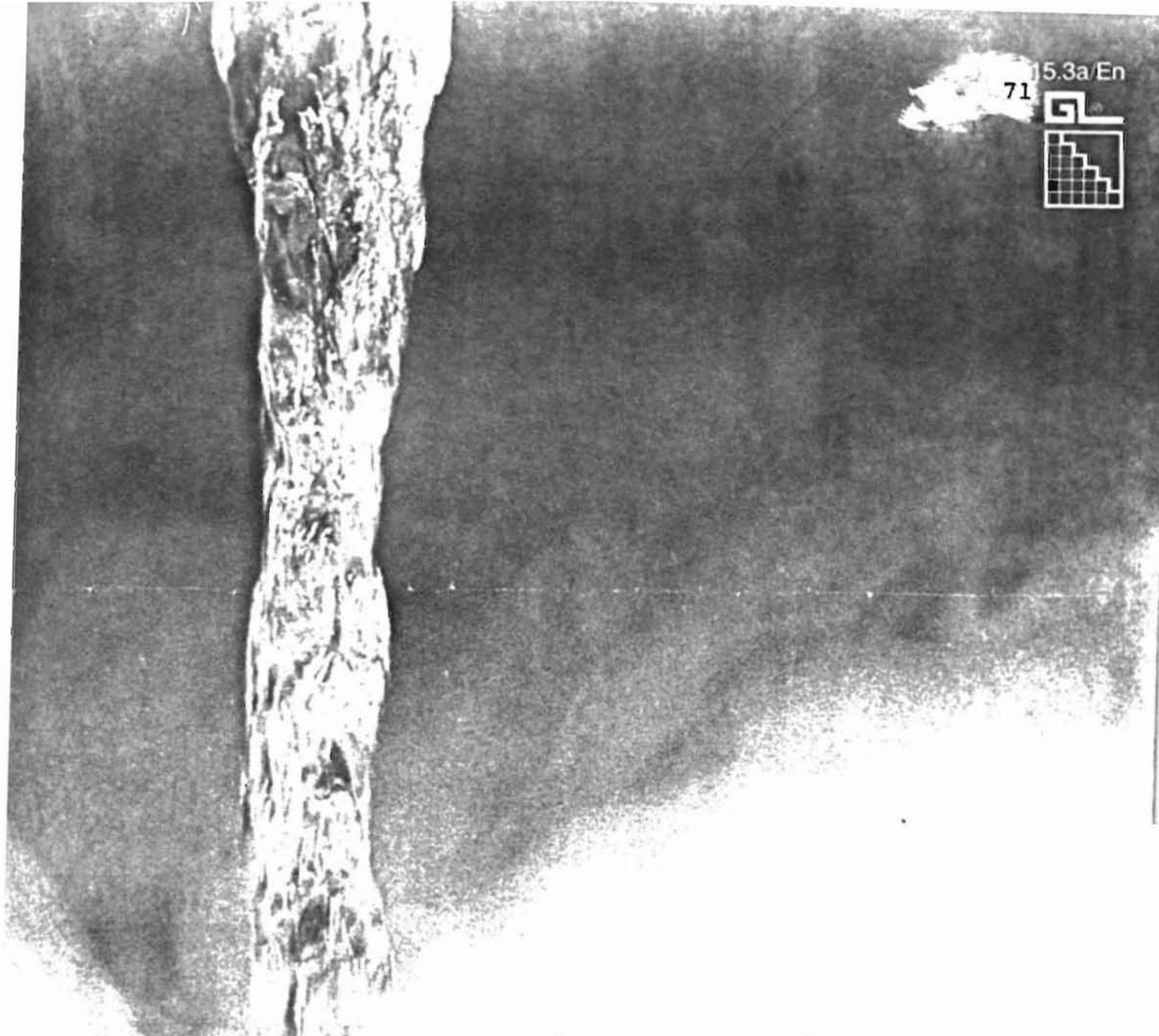
PAYBACK:

= cost/(savings/yr)

= $1654.00/($1893.15/yr

= 0.88 years

Figure 16. Energy for Hot Water From Refrigeration or Air Conditioning Equipment

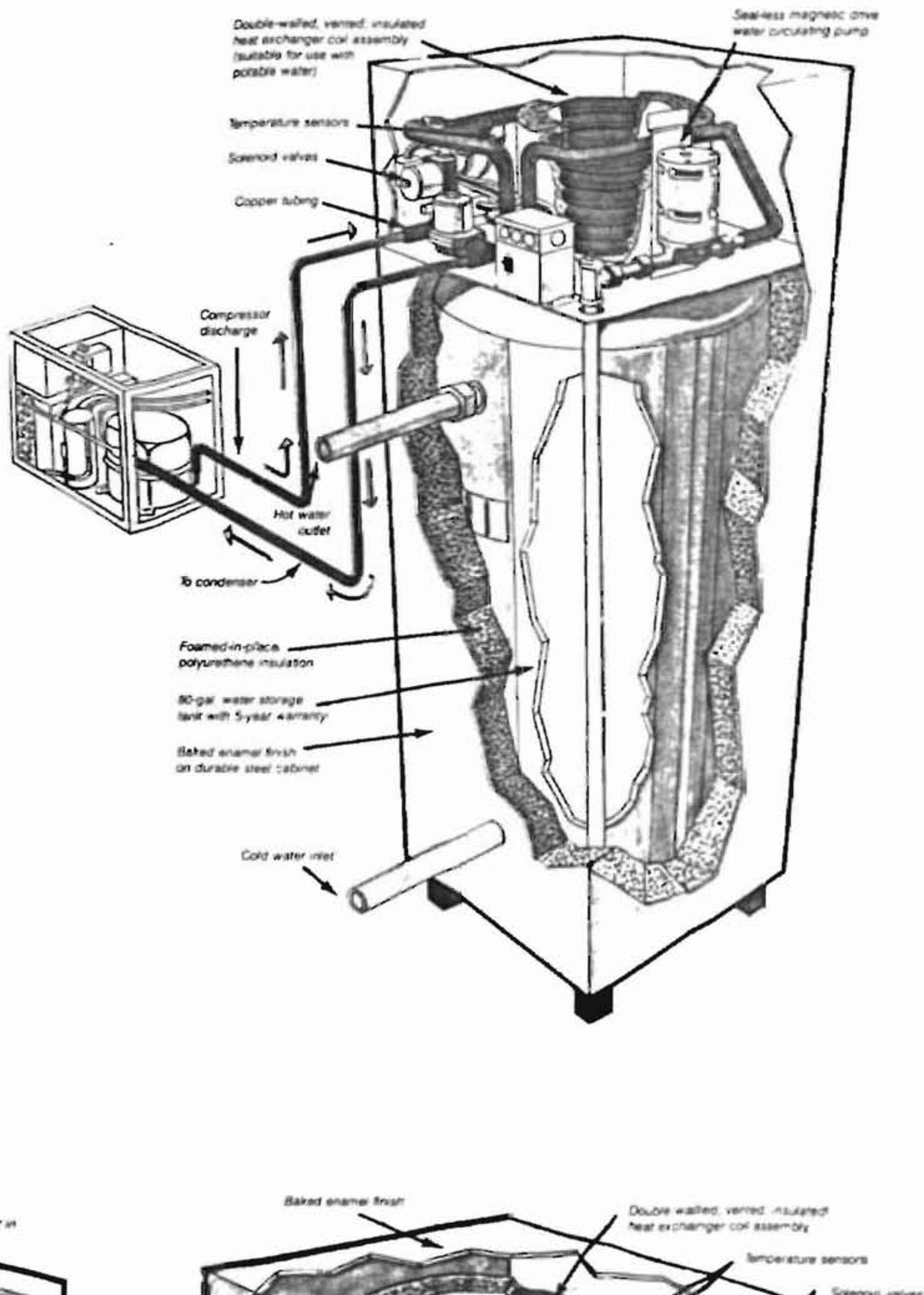


Energy for Hot Water

from refrigeration or air conditioning equipment

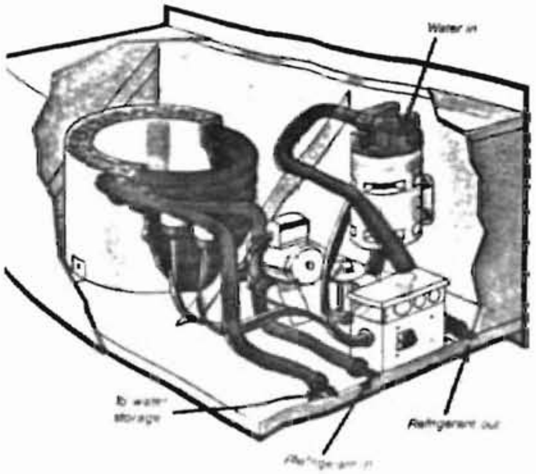
energy extender T.M.

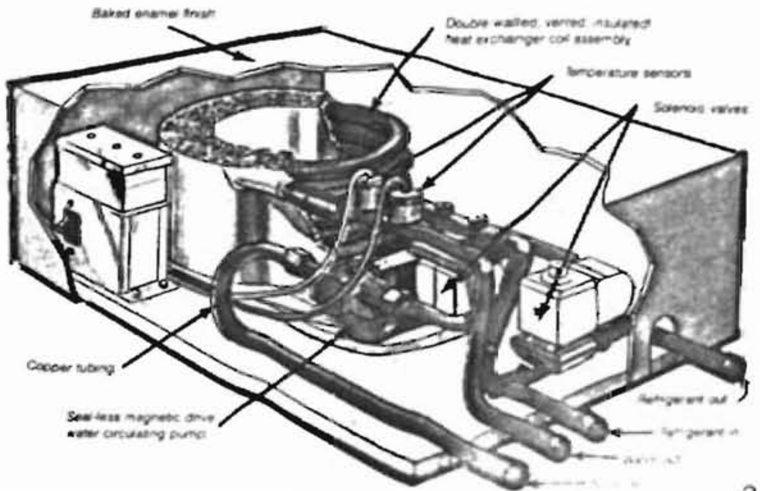
energy extender™



Classified for use with
[r]efrigeration or air condi-
[tion]ing units up to 15 ton
[(R1]2, R22, R502).

[Th]e Energy Extender is a trademark for
[a] patented heat recovery unit manufac-
[ture]d by Schneider Metal Manufacturing
Inc., Mason City, Iowa 50401.





Pre-heat water with heat normally wasted by refrigeration or an air conditioning system.

The Energy Extender™

Essentially, the Energy Extender is a heat exchanger, which transfers waste heat from connected refrigeration or air conditioning equipment to the water heating system...therefore reducing the cost of heating water.

The Energy Extender reduces air conditioning load in areas where air-cooled refrigeration is used, and lowers the operating and maintenance costs of air-cooled refrigeration equipment, as well as water heaters. When used with one-pass water-cooled systems, the Energy Extender significantly reduces water consumption, therefore water and sewage costs.

The highly efficient Energy Extender has proven it can pay for itself in less than a year, depending on the current installation and local utility rates. It also qualifies for a 10% Federal energy tax credit.

The UL Classified Energy Extender heat recovery system reduces energy costs for virtually any large volume user of hot water: restaurants, hotel/motels, laundries, hospitals, nursing homes, dairies, spas, clubs, schools, food stores, apartments and condominiums.

Patented system uses a double-walled and vented exchanger to reclaim the heat of condensation as well as that from desuperheating for 100% recovery of compressor heat on equipment through 5 hp. Since the heat of condensation can be up to 75% of heat available, the Energy Extender is up to four times more efficient than other types of refrigerant-to-water heat exchangers on the market.

The Energy Extender controls maximum water temperature through a refrigerant by-pass system. Consequently, the water circulating pump runs continuously, maintaining a turbulent flow of water at the rate of 2-5 gal./min. This avoids scaling and clogs, and insures maximum heat transfer efficiency.

Scale buildup is the primary cause of inefficient operation and system failure in the two types of heat exchangers available today. In passive systems, scale can build up continuously on the heat exchange surface, due to the lack of water circulation — especially when no water is being drawn from the system.

Some active systems are equally prone to scaling when the pump shuts off or water flow is restricted in order to prevent further water heating. Scaling tends to form at the hottest spot as stagnant water continues to pick up heat from the superheated refrigerant circulating through the heat exchanger. This is prevented by the continuous, turbulent flow of water through the heat exchanger in the Energy Extender.

Eight models are available, all UL Classified for use with any manufacturer's refrigeration or air conditioning system up to 15 ton (R12, R22, R502). They may be used with a remote condenser and either air- or water-cooled condensers. Tank models require only 4 sq. ft. of floor space. Wall-hung models may be used with the customer's own water storage tank or in conjunction with a floor model Energy Extender. Energy Extenders may be located anywhere between the refrigeration or air conditioning and the water heating system. Installation procedure is similar to a remote water-cooled condenser.

Energy Products Division

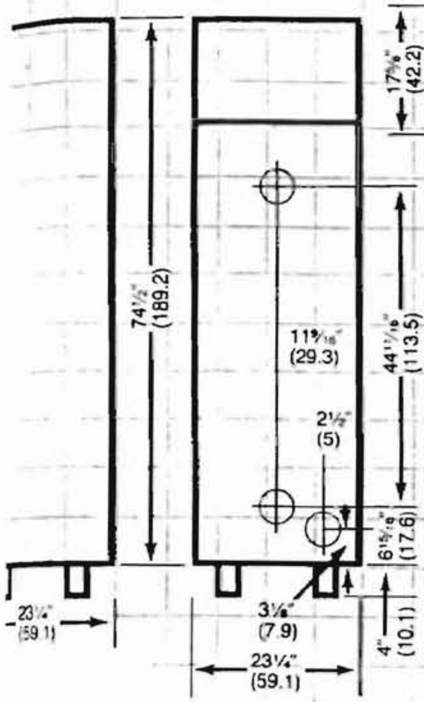
The Energy Products Division was formed as a separate Division of Schneider Metal Manufacturing Company in 1980 to market the Energy Extender. Schneider Metal is a 70 year old company, now in its third generation as a family-owned business. The firm is located at a plant built eight years ago in the Mason City, Iowa Industrial Park.

Schneider Metal has nearly 25 years of experience designing and building refrigeration equipment, primarily ice-making equipment for its Ross-Temp Division. The firm has also manufactured products for such companies as Borg-Warner, General Electric, General Motors, IBM, McGraw Edison, Western Electric and Whirlpool.

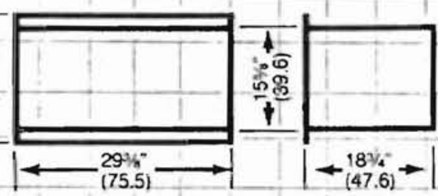
Every Energy Extender is carefully inspected and tested during production to make sure it meets rigid, high quality standards.

ıergy Extender Specifications

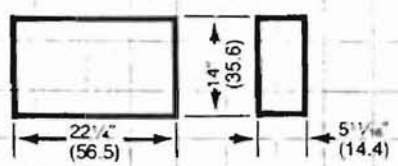
ɟ-80 Series



SM-10 Series



SM-15 & SM-17



ıc dimensions shown in parenthesis
essed in centimeters.

Plumbing connections

(SM 80 Series)

Water inlet (from main) .... 1½" I.P.S.
Water Outlet (to water heater) .... 1½" I.P.S.
Tank drain (plugged) .... ¾" I.P.S.
Pressure relief port (capped)* .. ¾" male pipe

*Refer to local code

(SM-10, 15, 17)

Water inlet .... ½" OD**
Water outlet .... ½" OD**

(SM-12, 13)

Water inlet .... ⅝" OD**
Water outlet .... ⅝" OD**

Electrical Data

Power supply ..... 115 volt, 60 Hz, 1 phase*
normal running

SM-17	63 watts	1 amp
SM-15	63 watts	1 amp
SM-80	63 watts	1 amp
SM-10	63 watts	1 amp
SM-82	290 watts	2.6 amps
SM-12	290 watts	2.6 amps
SM-83	290 watts	2.6 amps
SM-13	290 watts	2.6 amps

Cord connected*

Shipping information

	WEIGHT	SHIPPING WEIGHT
SM-17	33 lbs (14 kg)	39 lbs (17.7 kg)
SM-15	36 lbs (16.3 kg)	42 lbs (19 kg)
SM-10	69 lbs (31.1 kg)	79 lbs (35.6 kg)
SM-80	300 lbs (135 kg)	339.5 lbs (152.8 kg)
SM-12	95 lbs (43.2 kg)	105 lbs (47.3 kg)
SM-82	326 lbs (146.7 kg)	365.5 lbs (164.5 kg)
SM-13	95 lbs (43.2 kg)	105 lbs (47.3 kg)
SM-83	326 lbs (146.7 kg)	365.5 lbs (164.5 kg)

All models available in standard bonderized baked enamel finish.

**Copper

	SM-17	SM-15	SM-10	SM-80	SM-12	SM-82	SM-13	SM-83
ensing capacity	.75 hp	1 hp	3 hp	3 hp	5 hp	5 hp		
perheating capacity	4 hp	5 hp					15 hp	15 hp
hung model	X	X	X		X		X	
l tank (302.8 liters)				X		X		X
gerant line size	½"	⅝"	½"	½"	⅞"	⅞"	1⅛"	1⅛"
oad amps	1.0	1.0	1.0	1.0	2.6	2.6	2.6	2.6

ıder Metal Manufacturing Co., Inc. reserves the right to make engineering improvements without notice

further information contact the Energy Products Division of Schneider Metal Mfg. Co. or Sweet's BUYLINE.

Energy Products Division
Schneider Metal Manufacturing Co., Inc.
P.O. Box 1588/2421 15th St. S.W.
Mason City, Iowa 50401
Phone: 515/424-6150

T.M.

Patent #4270363

ECO #13

TITLE: Remove the existing motel sign and install energy efficient sign

EXECUTIVE SUMMARY:

There is great potential savings by changing the present sign for a new, attractive, modern, and energy efficient sign. At present, the sign consumes more power causing wastage of energy

REQUIRED DATA:

size of current sign	5000 watts
hours of operation	12 hours/day
size of proposed sign (34 watts fluorescent light	816 watts
cost of electricity	$0.03255/KWH
fuel adjustment charge	$0.00388/KWH
demand charge (min. 75 KW) - off peak	$283/month
on peak	$449/month
cost of electricity (commercial rate)	$0.0701/KWH
average total consumption per month	10,000 KWH/month

CALCULATIONS:

1. Effective cost of electricity

= 1.1(cost of electricity) + 1.05(fuel adjustment charge)

= 1.1($0.03255/KWH) + 1.05($0.0388/KWH)

= $0.0399/KWH

2. Energy consumption of present sign

= (size of sign)(hours of operation/day)(days/year)

= (5 KW)(12 hrs/day)(365 days/yr)

= 21,900 KWH/year

3. Energy consumption of proposed sign

= (size of sign)(hours of operation/day)(days/year)

= (0.816 KW)(12 hrs/day)(365 days/yr)

= 3574 KWH/year

4. Saving in KWH

= energy consumption for present sign - energy consumption for proposed sign

= (21,900 KWH/yr) - (3574 KWH/yr)

= 18,326 KWH/year

5. Saving in BTU's

= (savings in KWH)(conversion factor)

= (18.326 KWH/yr)(3413 BTU/KWH)

= 62.55×10^6 BTU/year

6. Dollar saving per year

= (energy consumption/yr)($0.0399/KWH)

= (18,326 KWH/yr)($0.0399/KWH)

= $731.20/year

IMPLEMENTATION COST:

The proposed sign can be installed by a local sign company. The implementation cost of the new sign, including the trade-in of the old sign is $3275.25.

PAYBACK:

Payback Period:

= cost/savings per year

= \$3275.25/(\$731.20/yr)

= 4.48 years

Note: This ECO is economically justified only if it changes the rate schedule from power electric to commercial schedules. This ECO is calculated according to old rate schedule (PL1). There is a large amount of savings (approx. \$2000/yr) by changing the rate schedule to commercial rate after the proposed sign is installed.

ECO #14

TITLE: Use of energy management system for turning off and on air conditioning

EXECUTIVE SUMMARY:

The energy management system is very easy to operate, and there is a great potential savings. It becomes a more efficient and less expensive system if the company has many outlets to use. This ECO is easy to implement, but the cost is higher. The ECO has a long payback period, however, the company can save wastage of energy.

REQUIRED DATA:

cost of electricity	\$0.03255/KWH
fuel adjustment charge	\$0.00388/KWH
number of rooms available	60
average occupancy	72%
number of months air conditioner used	May thru October
average hours of operation per day	18 hours
hours of energy wasted per room	3 1/2
% of guests who turn off air conditioner when they leave	45%

CALCULATIONS:

1. Effective cost of electricity

   = 1.1(cost of electricity) + 1.05(fuel adjustment charge)

   = 1.1(\$0.03255/KWH) + 1.05(\$0.0388/KWH)

   = \$0.0399/KWH

2. Number of rooms rented per year

   = (no. of rooms available)(average occupancy)(160 days/year)

   = (60)(0.72)(160)

   = 6912 rooms/year

3. Number of hours saved per year

   = (no. of rooms rented/yr)(% guest who do not turn off air conditioner)(no. of hrs of energy wasted)(effective factor)

   = (6912)(0.55)(3.5)(0.8)

   = 10.644.5 hours/year

4. Energy saving in KWH

   = (energy consumed/hr)(conversion factor)(no. of hrs/yr)

   = (12,000 BTU/hr)(1 KWH/3413 BTU)(10,644.5 hr/yr)

   = 37,425,65 KWH/year

5. Dollar saving

   = (energy saving/yr)(cost of electricity)

   = (37,425.65 KWH/yr)($0.0399/KWH)

   = $1493.28

6. BTU's saved

   = (energy saving in KWH)(conversion factor)

   = (37,425.65 KWH/yr)(3413 BTU/KWH)

   = 127.73×10^6 BTU/year

IMPLEMENTATION COST:

Use RCA Energy Management System proposed by Mr. Jack Slentz.

84 month lease - $358.81/month or $21,000 including installation

PAYBACK:

Cost of the system is very high. This ECO is not recommended. If the management turns off the air conditioning manually, there is a great potential savings. It can be done by desk clerks or maintenance men in their free time.

Note: There is a possibility of reducing the payback period by using a low cost manual powerline carrier which can be more easily installed than an RCA Energy Management System.

Figure 17. Manual for RCA Energy Management System

ENERGY MANAGEMENT PROPOSAL

FOR:

EL SOL MOTEL

Stillwater, Oklahoma, 74074

PROPOSED BY: *Jack L. Slentz*

BRANCH #: *1849*

PROPOSAL #: *3218-01*

DATE: *September 8, 1983*

CUSTOMER: El Sol Motel
Stillwater, Oklahoma

DATE: September 8, 1983

PROPOSAL #3218-01
BRANCH #1849

LEASE PURCHASE WITH ONE YEAR MAINTENANCE

Will transfer title of the system to your Motel at the end of the contract period. Includes full maintenance for one year. Upon expiration of the first twelve months, maintenance will be performed on a demand basis at the then prevailing rates for the remainder of the lease term except as otherwise agreed.

Seven Years (84 Months)	$358.81 per month plus applicable tax

If your maintenance people do the electrical work, the monthly payment would be $319.73 plus applicable tax.

RCA Telephone Systems

RCA ENERGY MANAGEMENT SYSTEM

EQUIPMENT	FUNCTION
Master Control Unit, MCU	This unit is the "brains" of the system. It plugs into a 120 volt power source and allows the desk clerk to control individual room remote units through a keyboard. The MCU also contains a microprocessor to accomplish scheduled automatic turn-on and turn-off of specific loads.
MCU Components	Keyboard-Used for daily operational changes and programming adjustments.
	Key-Required to make program changes.
	LED Display-Indicates month, day, hour, and minute during IDLE mode; room number and status during UPDATE mode; and individual control point programs during PROGRAM mode.
Status Display Unit, SDU	The Status Display Unit is a television-type display unit that indicates the status of rooms and auxiliary loads. This unit shows rooms that are occupied, unoccupied, or on standby. In addition, it displays all energy programs.
Signal Insertion Unit, SIU	The SIU is the enclosure and power supply for the phase amplifier mounted inside the SIU. This unit is responsible for injecting the signal from the MCU onto the building's circuitry.
Interconnect Box, ICB	This unit accepts thermostats and demand control inputs.
Remote Control Unit, RCU	This device mounts to the loads to be controlled and accepts signals from the MCU.
Outside Air Thermostat, OAT	Four OAT's are mounted on the outside of the building to input climate conditions to the MCU
Demand Controller*	Receives demand signal and outputs information necessary for peak demand reduction.

*Optional

BENEFIT SUMMARY

Lower Electric Bills

RCA's Energy Management System will allow you to reduce your energy consumption by turning off energy consuming loads. When the system is turning off loads it is cutting your energy consumption and saving you money.

State-of-the-Art Technology

RCA's advanced system design and solid state circuitry will assure you of quality and dependability.

Flexible Purchase Arrangements

You can purchase an RCA system through a direct sale arrangement with convenient terms, or conserve capital with a lease purchase.

Tax Advantages

An investment tax credit of 10% of the Fair Market Value is available to you on an Energy Management System. This credit would be taken in the year of acquisition as a direct reduction of your federal tax liability-with limitation.

Ease of Installation

The advanced design of RCA's Energy Management System allows installation to be completed quickly and quietly. With RCA's system there is no distraction to you, your staff, and especially your guests.

Ease of Operation

Although advanced in design, RCA's system is easier to use than a cash register.

Fail Safe Design

RCA's system is specially designed to accommodate your guests. Should the system become inoperative it automatically initiates normal thermostat control. No guest discomfort will be felt.

Return on Investment

Your return on investment depends on your system's specific design, and energy conservation programs. You decide how quickly you want your return by the energy saving programs you initiate.

RCA Accommodates your Special Needs

RCA allows you to control all rooms individually to maximize energy savings and guest comfort. You set the desired level of energy savings for each room to compensate for your building's specific needs.

Single Source Responsibility

RCA DESIGNS YOUR SYSTEM

RCA SUPPLIES THE EQUIPMENT

RCA INSTALLS THE EQUIPMENT

RCA TRAINS YOUR STAFF

RCA MAINTAINS THE EQUIPMENT

RCA FINANCES THE SYSTEM-NO THIRD PARTY FINANCING

IMPLEMENTATION PLAN

Your RCA Sales Representative has already completed a thorough analysis of your company's specific energy management needs with regard to the needed equipment and the installation services required to ensure a functioning Energy Management System. Listed below are the steps RCA will initiate once you purchase your Energy Management System. These are provided as a normal part of our total customer commitment.

STEP I

Once your equipment has arrived, RCA will coordinate all installation activities necessary to make your system operative. Our trained technicians will provide on site coordination of all job activities to minimize distractions and installation time.

STEP II

After the equipment has been installed an experienced RCA technician will program your system to maximize your energy savings as well as maintain guest comfort.

STEP III

After programming has been completed our technician will train your employees on everyday use of the system. We will also show you and your system operator how to program the system.

FINAL STEP

As the final step in our total service commitment, your RCA Sales Representative will periodically visit your property to ensure that your system is working to save you money.

Lodging Industry
Energy Management System

RCA

We have the solution to your rising energy costs

The RCA Service Company Hotel/Motel Energy Management System saves you money by allowing you to control energy consumption. The system provides a means of turning electrical devices, on or off, automatically or manually, by remote control. Now you can turn the air conditioner/heater off and on from the front desk. No longer do you have high energy consuming devices operating when the room is unoccupied.

1. The system automatically performs duty cycling of electrical devices that are in use. Duty cycling is simply turning off a heating/cooling unit for brief intervals during its normal operation. There is no noticeable effect on comfort but there are substantial savings on your electrical bill due to reduced electrical demand and consumption.
2. End of day routines control electrical use in common areas such as lobbies, corridors, meeting rooms, and service areas.
3. The system performs peak demand limiting. An externally generated signal which indicates that the desired demand level is about to be exceeded initiates automatic load shedding. This activity continues until the demand is reduced to an acceptable level. The devices being controlled are then returned to their normal operating mode.
4. To provide improved guest comfort, skip cycling is employed to compensate for solar loads.
5. Automatic feedback from outside air temperature sensors provides the control strategy to insure optimum guest comfort.

Installation is Easy

Most important, you can get all these crucial energy-saving benefits without tearing out walls, disrupting your operations, or sending your employees to training classes.

The RCA Service Company Hotel/Motel Energy Management System is amazingly easy to install. It uses your existing ac wiring—*no new control wiring required.* That makes installation very economical.

The Energy Management System provides simple-to-operate, central registration desk remote control for turn-on and turn-off of room cooling/heating units as guests check in or out. A "Standby" status is also included to assure comfortable temperatures in rooms about to be occupied.

Operating the registration-desk control is easier than using a calculator. The system's security provisions prevent any alteration of your basic system parameters except by you or your authorized personnel.

The central control equipment includes a video display that shows the current status of every room in your facility—occupied (cooling/heating unit on), unoccupied (cooling/heating unit off) or standby (cooling/heating unit operating under control of its own thermostat). If you wish, the display can also carry an indication of which unoccupied rooms have been cleaned.

So in addition to helping you control energy costs, the system also gives you a convenient method of monitoring room status.

Setting the parameters that you want the system to follow is simple too. You can learn to do it yourself using the system guide. And you can make changes in minutes to accommodate new circumstances.

Fine-Tuning for Comfort

The RCA Service Company Hotel/Motel Energy Management System enables you to set the degree of duty cycling for each room and to vary the duty cycling according to time of day. You can keep each room comfortable in spite of varying sun loads, no matter what the season. You set these parameters when the system is installed and the system does the rest automatically. If you want to make adjustments later, that's simple too.

You can even have the system alter its control strategy on the basis of outside air temperature.

All the capabilities are there to help you keep a lid on energy costs while keeping your guests comfortable.

Facility-Wide Control

To help control the other high energy-consuming devices in your facility, the RCA Service Company Hotel/Motel Energy Management System also provides a means of regulating electrical use in common areas such as lobbies, corridors, meeting rooms, and service areas.

You can set the system to automatically turn off lights, cooling/heating and other electrical devices in these areas during certain hours, then automatically turn

CHAPTER IV

IMPLEMENTATION OF ENERGY AUDIT RECOMMENDATIONS AND CONCLUSIONS

The audit itself usually produces no direct savings; significant savings begin only after management approves the ECO recommendations of the energy audit report and they are put into effect as energy conservation measures.

The following is a list of energy audit recommendations which can be implemented immediately.

1. Switch the bug light from 60W to 25W.
2. Reduce the temperature of hot water heater.
3. Use higher efficiency, lower wattage fluorescent lamps in existing fixtures.
4. Thermal insulation of hot water tanks, hot water lines and storage tank.
5. Place photosensor on outside security lights and motel sign.
6. Install weatherstripping on doors.
7. Use flow restrictors for showerheads.
8. Net setback for the lounge and dining area.
9. Switch outdoor floodlight fixture to high pressure sodium light fixture.

No actual measured results are yet available for the El Sol Motel at the present time. The projected analytical results were as follows:

	Before Audit Implementation	After Audit Implementation
Electrical Energy Consumption, KWH	236,067	193,463
Natural Gas Consumption, MCF	3,667	1,662.60
Annual Energy Cost	$32,257.00	$21,786.84
Projected Annual Energy Cost Saving		$10,470.16

This represents a savings of 46% of total energy cost. However, we cannot add all savings individually because of overlapping. For example,

1) use of solar water heater with exchanger will save total usage of gas consumption by hot water heater currently.

2) Switching the rate schedule will be more effective if the existing motel sign is changed to an energy efficient sign.

This project shows that energy management is a viable profit improvement technique for the motel industry. The Energy Conservation Opportunities (ECO's) studied are summarized in Table VII.

The essential elements of an effective energy management program have been described with emphasis on the benefits of energy audits of sufficient scope performed by fully qualified auditing teams. The action-reaction analysis of steps must be continually updated as you move through the checklists. The checklists provided in Appendix D serve as guidelines for the operation phase (5, 7).

TABLE VII

SUMMARY OF ECO'S

ECO	Description	Implement-tation Cost	First Year Savings	Undis-counted Payback in years
1	Switch bug light from 60W to 25W	1.95	331.32	0.0058
2	Use higher efficiency, lower wattage fluorescent lamps in the existing fixtures	77.45	84.19	0.92
3	Switch outdoor floodlight fixture to high pressure sodium light fixture	650.00	240.30	2.70
4	Switch rate schedule from PL1 to commercial rate	0.00	484.67	Immedi-ate
5	Place photosensors on outside security lights and motel sign	105.00	215.54	0.49
6	Use solar water heater with exchanger	3120.00	4149.36	0.75
7	Use flow restrictor for showerheads	54.00	538.19	0.10
8	Reduce temperature of hot water heater in rooms	0.00	214.65	Immedi-ate
9	Install weatherstripping on doors	232.00	228.41	1.02

TABLE VII (Continued)

ECO	Description	Implementation Cost	First Year Savings	Undiscounted Payback in years
10	Thermal insulate hot water heater storage tank and pipeline	151.49	281.06	0.54
11	Night setback for lounge and dining room area	625.00	672.35	0.93
12	Heat recovery from chilling equipment	1654.00	1893.15	0.88
13	Remove existing motel sign and install new energy efficient sign	3275.25	731.20	4.48
14	Use of energy management system to turn off and on air conditioning	21,000.00	1493.28	14.06

It is the author's contention that the ultimate resolution of the current energy situation may be facilitated through continued research in the energy area and increased efforts to educate the motel industry. Only through the cooperative efforts of universities, private research foundations, the industrial complex, and the conserving actions of citizens will the energy problem be overcome.

Areas For Possible Future Research

This research was carried out from the viewpoint of a motel operator with the main objective of making them aware of energy management programs and use of new technologies. The motel operator is then concerned with potential energy savings to run his operation efficiently and effectively. It may be necessary to investigate the effect of energy cost for other areas not identified in this report.

Secondly, it would be interesting to study the technological difficulties which arise in implementing energy management programs for old structures as compare to new structures.

Finally, the study did not investigate how the restaurants in the United States could save money through energy management. Such a study will help to overcome energy usage problems and improve the economy of the United States.

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APPENDIXES

APPENDIX A

UNDISCOUNTED PAYBACK CALCULATIONS FOR HOT WATER TANKS #1 AND #2

ECONOMIC THICKNESS DETERMINATION
DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANGEMENT
OKLAHOMA STATE UNIVERSITY

INPUT PARAMETERS

FIRM: EL SOL MOTEL	CONTACT: HARSHAD PATEL
SYSTEM: HOT WATER TANK#1	DATE: OCTOBER 1 1983
INSULATION: FIBERGLASS BATT	K-VALUE: .2520 BTU-IN/HR-SQ.FT-DEG F
AFTER-TAX MARR: 20.0 %	GENERAL INFLATION RATE: 10.0 %
FUEL ESCALATION RATE: 15.0 %	PRESENT R-VALUE: .518 HR-SQ.FT-DEG F/BTU
HEATING DEGREE-HOURS: 245280.0	COOLING DEGREE-HOURS: .0
HEAT PLANT EFFICIENCY: 80.0 %	COOLING PLANT EFFICIENCY: 100.0 %
COST PER MMBTU OF HEAT: $ 3.842	COST PER MMBTU OF COOLING: $ .000
INCREMENTAL TAX RATE: 48.0 %	AVAILABLE TAX CREDIT: .0 %
PROJECT LIFE: 15 YEARS	DEPRECIATION LIFE: 10 YEARS

THICKNESS CALCULATIONS

INSULATION THICKNESS (IN INCHES)	INSTALLED COST ($/SQ FT)	ANNUAL ENERGY LOSS OR GAIN (BTU/SQ FT)	NPV OF SAVINGS ($/SQ FT)	ANNUALIZE COST ($/SQ FT)
.00	.00	591891.9	.00	1.495
.00	.00	591891.9	.00	1.495
.50	.65	122535.7	4.73	.482
1.00	.80	68342.1	5.19	.385
1.50	.95	47385.2	5.25	.372
2.00	1.10	36264.7	5.19	.384
2.50	1.25	29371.7	5.09	.407

UNDISCOUNTED PAYBACK CALCULATIONS

THICK-NESS (IN.)	INSTALLED COST ($/SQFT)	MAINT. COST ($/SQFT)	ANNUAL HEAT SAVED (BTU/SQFT)	ANNUAL COOL SAVED (BTU/SQFT)	ANNUAL SAVINGS ($/SQFT)	PAY BACK (YRS)	INCR. PAYBK (YRS)
.00	.00	.00	.0	.0	.000	####	6.9
.50	.65	.06	469356.1	.0	1.738	.4	.4
1.00	.80	.08	523549.8	.0	1.931	.4	8
1.50	.95	.09	544506.8	.0	1.997	.5	2.3
2.00	1.10	.11	555627.3	.0	2.025	.5	5.4
2.50	1.25	.13	562520.3	.0	2.036	.6	13.1

ECONOMIC THICKNESS DETERMINATION

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANGEMENT
OKLAHOMA STATE UNIVERSITY

INPUT PARAMETERS

FIRM: EL SOL HOTEL	CONTACT: HARSHAD PATEL
SYSTEM: HOT WATER TANK #2	DATE: OCTOBER 1,1983
INSULATION: FIBRE GLASS BATT	K-VALUE: .2520 BTU-IN/HR-SQ.FT-DEG F
AFTER-TAX MARR: 20.0 %	GENERAL INFLATION RATE: 10.0 %
FUEL ESCALATION RATE: 15.0 %	PRESENT R-VALUE: .519 HR-SQ.FT-DEG F/BTU
HEATING DEGREE-HOURS: 280320.0	COOLING DEGREE-HOURS: .0
HEAT PLANT EFFICIENCY: 80.0 %	COOLING PLANT EFFICIENCY: 100.0 %
COST PER MMBTU OF HEAT: $ 3.842	COST PER MMBTU OF COOLING: $ .000
INCREMENTAL TAX RATE: 48.0 %	AVAILABLE TAX CREDIT: .0 %
PROJECT LIFE: 15 YEARS	DEPRECIATION LIFE: 10 YEARS

THICKNESS CALCULATIONS

INSULATION THICKNESS (IN INCHES)	INSTALLED COST ($/SQ FT)	ANNUAL ENERGY LOSS OR GAIN (BTU/SQ FT)	NPV OF SAVINGS ($/SQ FT)	ANNUALIZE COST ($/SQ FT)
.00	.00	675144.5	.00	1.705
.00	.00	675144.5	.00	1.705
.50	.65	139984.9	5.51	.526
1.00	.80	78087.8	6.05	.410
1.50	.95	54146.1	6.15	.389
2.00	1.10	41440.4	6.11	.397
2.50	1.25	33564.4	6.02	.417

UNDISCOUNTED PAYBACK CALCULATIONS

THICK-NESS (IN.)	INSTALLED COST ($/SQFT)	MAINT. COST ($/SQFT)	ANNUAL HEAT SAVED (BTU/SQFT)	ANNUAL COOL SAVED (BTU/SQFT)	ANNUAL SAVINGS ($/SQFT)	PAY BACK (YRS)	INCR PAYBK (YRS)
.00	.00	.00	.0	.0	.000	0	0
.50	.65	.06	535159.6	.0	1.991	3	.3
1.00	.80	.08	597056.6	.0	2.214	4	.7
1.50	.95	.09	620998.4	.0	2.291	4	1.9
2.00	1.10	.11	633704.1	.0	2.325	.5	4.4
2.50	1.25	.13	641580.1	.0	2.340	.5	9.8

APPENDIX B

UNDISCOUNTED PAYBACK CALCULATIONS

FOR HOT WATER LINE

ECONOMIC THICKNESS DETERMINATION

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANGEMENT
OKLAHOMA STATE UNIVERSITY

INPUT PARAMETERS

FIRM: EL SOL MOTEL	CONTACT: HARSHAD PATEL
SYSTEM: HOT WATER LINE	DATE: OCTOBER 1,1983
INSULATION: FIBERGLASS BATT	K-VALUE: .2510 BTU-IN/HR-SQ.FT-DEG F
AFTER-TAX MARR: 20.0 %	GENERAL INFLATION RATE: 10.0 %
FUEL ESCALATION RATE: 15.0 %	PRESENT R-VALUE: .520 HR-SQ.FT-DEG F/BTU
HEATING DEGREE-HOURS: 227760.0	COOLING DEGREE-HOURS: .0
HEAT PLANT EFFICIENCY: 80.0 %	COOLING PLANT EFFICIENCY: 100.0 %
COST PER MMBTU OF HEAT: $ 3.842	COST PER MMBTU OF COOLING: $ .000
INCREMENTAL TAX RATE: 48.0 %	AVAILABLE TAX CREDIT: .0 %
PROJECT LIFE: 15 YEARS	DEPRECIATION LIFE: 10 YEARS

THICKNESS CALCULATIONS

INSULATION THICKNESS (IN INCHES)	INSTALLED COST ($/LN FT)	ANNUAL ENERGY LOSS OR GAIN (BTU/LN FT)	NPV OF SAVINGS ($/LN FT)	ANNUALIZE COST ($/LN FT)
.00	.00	143335.5	.00	.362
.00	.00	143335.5	.00	.362
.50	1.00	45426.5	-.09	.381
1.00	1.68	31558.3	-.77	.526
1.50	2.73	25776.7	-2.01	.791
2.00	6.15	22517.6	-6.22	1.692
2.50	9.00	20387.4	-9.74	2.444

UNDISCOUNTED PAYBACK CALCULATIONS

THICK-NESS (IN.)	INSTALLED COST ($/LNFT)	MAINT. COST ($/LNFT)	ANNUAL HEAT SAVED (BTU/LNFT)	ANNUAL COOL SAVED (BTU/LNFT)	ANNUAL SAVINGS ($/LNFT)	PAY BACK (YRS)	INCR. PAYBK (YRS)
.00	.00	.00	.0	.0	.000	.0	[illegible]
.50	1.00	.10	97909.0	.0	.276	3.6	2.6
1.00	1.68	.17	111777.2	.0	.261	6.4	.0
1.50	2.73	.27	117558.8	.0	.179	15.3	.0
2.00	6.15	.62	120817.9	.0	-.151	.0	[illegible]
2.50	9.00	.90	122948.1	.0	-.428	.0	[illegible]

APPENDIX C

UNDISCOUNTED PAYBACK CALCULATIONS

FOR STORAGE TANKS

ECONOMIC THICKNESS DETERMINATION

DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANGEMENT
OKLAHOMA STATE UNIVERSITY

INPUT PARAMETERS

FIRM: EL SOL MOTEL
CONTACT: HARSHAD PATEL
SYSTEM: STORAGE TANK
DATE: OCTOBER 1,1983
INSULATION: FIBERGLASS BATT
K-VALUE: .2520 BTU-IN/HR-SQ.FT-DEG F
AFTER-TAX MARR: 20.0 %
GENERAL INFLATION RATE: 10.0 %
FUEL ESCALATION RATE: 15.0 %
PRESENT R-VALUE: .520 HR-SQ.FT-DEG F/BTU
HEATING DEGREE-HOURS: 227760.0
COOLING DEGREE-HOURS: .0
HEAT PLANT EFFICIENCY: 80.0 %
COOLING PLANT EFFICIENCY: 100.0 %
COST PER MMBTU OF HEAT: $ 3.842
COST PER MMBTU OF COOLING: $ .000
INCREMENTAL TAX RATE: 48.0 %
AVAILABLE TAX CREDIT: .0 %
PROJECT LIFE: 15 YEARS
DEPRECIATION LIFE: 10 YEARS

THICKNESS CALCULATIONS

INSULATION THICKNESS (IN INCHES)	INSTALLED COST ($/SQ FT)	ANNUAL ENERGY LOSS OR GAIN (BTU/SQ FT)	NPV OF SAVINGS ($/SQ FT)	ANNUALIZE COST ($/SQ FT)
.00	.00	547500.1	.00	1.383
.00	.00	547500.1	.00	1.383
.50	.65	113692.3	4.31	.460
1.00	.80	63432.2	4.72	.373
1.50	.95	43986.9	4.76	.364
2.00	1.10	33666.4	4.70	.377
2.50	1.25	27268.5	4.59	.401

UNDISCOUNTED PAYBACK CALCULATIONS

THICK-NESS (IN.)	INSTALLED COST ($/SQFT)	MAINT. COST ($/SQFT)	ANNUAL HEAT SAVED (BTU/SQFT)	ANNUAL COOL SAVED (BTU/SQFT)	ANNUAL SAVINGS ($/SQFT)	PAY BACK (YRS)	INCR. PAYBK (YRS)
.00	.00	.00	.0	.0	.000	.0	.0
.50	.65	.06	433807.9	.0	1.602	.4	.4
1.00	.80	.08	484067.9	.0	1.780	.4	.8
1.50	.95	.09	503513.3	.0	1.839	.5	2.5
2.00	1.10	.11	513833.8	.0	1.864	.6	6.1
2.50	1.25	.13	520231.7	.0	1.874	.7	15.7

APPENDIX D

INSPECTION AND/OR CHECKLIST FORMS

INSPECTION AND/OR CHECKLIST

Department: General Administration

Inspected by: _________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Are light levels adequate but not excessive?				
	Are the lights turned off when not needed?				
	Are the air exhaust vents over food preparation areas the correct size?				
	Are the air exhaust systems properly balanced?				
	Are air exhaust systems turned off when not required?				
	Is there a proper amount of make up air for the exhaust and vent system?				
	Are all H.A.C.V. vents free from obstruction?				
	Are all air filters clean?				
	Are all air filters replaced on a regular basis?				
	Are all grease filters clean?				
	Are all grease filters replaced on a regular basis?				
	Are all steam traps cleaned periodically?				
	Is there adequate insulation in floor, walls, and ceiling? (Insulation is one of the best investments the owner can make if he is sincerely trying to reduce energy consumption. Construction of the property may prevent any significant use of additional insulation).				
	Are all doors properly weather stripped?				
	Are all windows properly caulked?				
	Are outdoor signs turned on only during prescribed times? (Advertising signs should never be on during daylight hours and during periods the business is not in operation).				
	Are outdoor lights and gas torches turned off after hours except those needed for security purposes?				

INSPECTION AND/OR CHECKLIST

Department: General Administration

Inspected by ______________________

LOCATION	ITEMS	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Are heating and airconditioning units thermostats turned off or at least down to 60° F. and up to 80° F. during periods when the operation is closed?				
	Are all pieces of heating and cooling equipment in good working condition? (Dirty filters obstruct air flow to coils).				
	Are there any faucets or pipes that leak? (Be aware of this throughout inspection).				
	Are the room temperatures being maintained at the prescribed level. Summer / Winter Dining Room 75o F. / 65° F. Kitchen 85° F. / 75° F. Store Room 85° F. / 60o F. Lobby 75o F. / 65° F.				
	Is the heating equipment in separate areas or at least separated from the cooling area?				
	Are exhaust systems in separate areas from the cooling equipment?				
	Is the building properly insulated? (Walls, floors and ceilings).				

INSPECTION AND/OR CHECKLIST

Department: Front Office, Lobby and Public Space

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Rooms are rented by area, wing, floor and specific areas, wings, floors are closed during low occupancy periods. (A period may be a day, week, etc.)				
	Is the temperature at the proper setting? Summer __________ Winter __________				
	There are no obstructions of air flow for HVAC units and/or vents.				
	Do all exterior doors close automatically?				
	Do all windows and doors have proper weather stripping and caulking?				
	Are lighting levels properly maintained? Drapes open during day __________ Unnecessary lights off __________				
	Are HVAC filters and coils clean?				
	Are HVAC filters and coils cleaned on a regular schedule?				
	Is outside air properly used?				
	Are all lighting fixtures and bulbs clean?				
	Is proper wattage used in fixtures?				
	Storeroom lights turned off when possible?				
	Office lights are turned off after working hours and when not needed?				
	Is all unused equipment turned off when not in use?				
	Elevators and or escalator service reduced during slow periods?				
	Public restroom lights are turned off during slow periods?				

INSPECTION AND/OR CHECKLIST

Department: Front Office; Lobby and Public Space

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	The public wash basin drain holds properly?				
	The public wash basin faucets are free of drips?				
	The toilet valve closes properly?				
	The flush valve is adjusted to seven seconds?				
	Public restroom exhaust fans off during slow periods?				
	Are check room lights turned off when the area is not in use?				
	Are check room lights turned down during slow periods?				
	Are tenant area lights off except for security purposes when business is closed?				
	Are excessive outdoor lights/signs reduced during slow periods?				
	Are outdoor lights/signs turned off after hours except those needed for security purposes?				

INSPECTION AND/OR CHECKLIST

Department: Guest Rooms

Inspected by ______________________________

One floor or area should be checked and all room deficiencies noted on this form.

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Do maids turn off all lights as they leave a guests room (no guest in the room)?				
	Do maids turn off the TV and or radio after cleaning the guest's room? (no guest in the room)				
	Are all windows closed?				
	Are thermostats turned to proper temperature? Summer _________ Winter _________				
	If room has individual HVAC units are they turned off if room is unoccupied?				
	If room has individual HVAC units are their filters and coils cleaned on a regularly scheduled basis?				
	Is the air flow unobstructed from the HVAC unit?				
	Are all light bulbs the proper wattage? Overhead _________ Reading Lamp _________ Decorative Lamp _________ Bathroom Lights _________ Shower Light _________				
	Drapery and/or shades properly adjusted?				
	Are flush valves adjusted to seven seconds?				
	Are flow restrictors installed in shower heads?				
	Are flow restrictors installed in faucets?				
	Are all faucets free of dripping?				
	Are showerheads free of dripping?				
	Does the toilet valve close properly?				
	Does the tub drain hold properly?				
	Does the wash basin drain hold properly?				
	Are all exterior doors and windows closed?				

INSPECTION AND/OR CHECKLIST

Department: Dining Room and Lounge Service Areas

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	If heat lamps, hot carts, or portable heaters are used, are they turned off when not in use?				
	Are heat lamps at as low level to insure maximum heat efficiency?				
	Are hot plates for coffee, etc. turned off when not in use?				
	Is coffee urn thermostat off at night when the service period is completed?				
	Is the dining room light level as low as possible and still maintain the desired atmosphere?				
	Are all lights not necessary for security turned off at night and during non working hours?				
	Are all ice cream cabinet doors closed and properly sealed by door gaskets?				
	Are table cleaning rags rinsed properly and used during the entire shift? (Replacement or change based only on management policy)				

INSPECTION AND/OR CHECKLIST

Department: Function Room

Inspected by ______________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Are light levels reduced immediately after the event is complete and the room is cleared of guests?				
	Are H.V.A.C. units turned off during employee clean up and resetting?				
	Are lights turned off immediately after employees have cleaned the room?				
	Are all exterior doors and windows closed?				
	Is the room temperature thermostat set at the proper level? Prior to function ________ During function ________ summer ________ winter After function ________ summer ________ winter				
	Is all supporting equipment turned off? (Hot carts, hot plates, public address, background music, table lamps, etc.)				
	Are H.V.A.C. filters and coils clean?				
	Are H.V.A.C. filters and coils cleaned on a regular schedule?				
	Are there no obstructions of air flow for H.V.A.C. units or vents?				

APPENDIX B

INSPECTION AND/OR CHECKLIST

Department: Sanitation

Inspected by ________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Is the dishmachine turned off when not being used?				
	Are conveyor belts turned off during slow periods?				
	Are sinks utilized to rinse silver, china and glassware to conserve running water?				
	Is cold water used for prerinse?				
	Are water valves and faucets properly maintained to prevent leaks?				
	Do the drains in sinks seal properly to prevent draining?				
	Are there accurate thermometers on the dishwashing machines.				
	When in operation do they register: 140° F Hot Water 160° F Power Rinse 180° F Rinal Rinse Temperature may vary according to local mimimum health regulations.				
	Are all dishwashing trays full when placed in the machine?				
	Does the final rinse on the dishmachine shut off completely if not in use?				
	Are booster water heaters turned off when the dishmachine is not in use?				
	Is heat from dishwasher ventilation system utilized or exhausted as waste?				
	Do all hot water and steam pipes have proper insulation?				
	Is enough detergent being used to insure clean dishes?				
	Is there adequate water pressure from pumps to insure clean dishes?				

INSPECTION AND/OR CHECKLIST

Department: Sanitation

Inspected by ____________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Is the garbage grinder turned off when not truly needed?				
	Is some waste being collected, stored, and ground at a later time?				

INSPECTION AND/OR CHECKLIST

Department: Maintenance and Engineering

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Are all pipes properly insulated?				
	Are all pipes and valves free of drips and leaks?				
	Are hot water tanks drained and or flushed every six months?				
	Is there a circulation system for hot water?				
	Are all controls working at their top efficiency rate?				
	Is condensate water being recirculated?				
	Is all the water utilized in the cooling system re-cycled?				
	Is fresh air utilized to heat and or cool?				
	Are controls installed to prevent heating and cooling equipment from operating at the same time?				
	Is the water pressure less than 40 pounds per square inch? If in excess of 40 pounds install reducing valve.				
	Is all of the equipment in a preventative maintenance schedule based on the manufactures recommendations?				

INSPECTION AND/OR CHECKLIST

Department: Heating and Cooling Systems

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Are all HVAC systems turned off in unoccupied areas?				
	Are all the proper heating and air conditioning temperatures being maintained? Day Summer ______ Winter ______ Night Summer ______ Winter ______				
	Are outside air dampers closed during periods of warm-up or cool-down?				
	Are all air filters and coils cleaned on a regular plan as needed basis?				
	Is the air flow balanced in all areas to prevent air leaks and/or excessive make up air being introduced?				
	Are all pipes properly insulated?				
	Are all valves and pipes properly maintained to prevent drips and leaks?				
	Are all system thermostats operating properly and their setting accurate?				
	Are individual room thermostats located in a position to give accurate room temperatures?				
	Are HVAC filters and coils clean?				
	Are HVAC filters and coils cleaned on a regular basis?				
	Are there no obstructions of air flow for HVAC units or vents?				
	Is every piece of equipment on a regularly scheduled preventative maintenance program?				
	Are all refrigerant lines checked on a regular basis to detect leaks?				
	Are all purge lines checked on a regular basis to detect leaks?				

INSPECTION AND/OR CHECKLIST

Department: Heating and Cooling Systems

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Can HVAC systems be turned off from a central control panel when specific areas (function rooms, laundry, leased space, etc.) be turned off when the area is unoccupied?				
	Can outside air be utilized to bring an area to proper temperature after it has been out of service?				
	Is the HVAC system designed to prevent heating and cooling units operating and feeding the same general areas?				
	Is the cooling tower water properly treated to prevent the growth of algae and prevent scale build-up?				
	Are the spray nozzles clean and free of scale and dirt?				
	If local utility companies suggest treatment of water due to high chemical concentrations do you utilize a water treatment system?				
	Is the air circulation equipment deducted to the minimum while maintaining guest satisfaction?				

INSPECTION AND/OR CHECKLIST

Department: Laundry

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Is equipment operated with a full load? washer _____ extractor _____ dryer _____				
	Are all pipes properly insulated?				
	Are all valves and faucets maintained to prevent leaks and drips?				
	Are all steam traps working properly to prevent leakage?				
	Are the water thermometers checked for accuracy?				
	Are water temperatures maintained at the lowest possible temperature?				
	Are cold water detergents and washing procedures utilized when possible?				
	When possible are loads of similar sized items and similar type materials utilized?				
	Do timer switches operate properly?				
	Are materials removed from dryers as soon as possible?				
	Are the dryers scheduled to operate for continuous periods of time?				
	Can exterior air be introduced into the dryer when the exterior temperature is 75°F or warmer?				
	Is outside air used to cool laundry whenever possible?				
	Are no-iron linens utilized in all areas possible?				
	Are ironer and mangle work loads scheduled to eliminate unnecessary heat-up times?				
	Are all friction bearings and motor bearings properly lubricated and in good repair?				

INSPECTION AND/OR CHECKLIST

Department: Laundry

Inspected by ______________________________

LOCATION	ITEM	YES	NO	CORRECTION REQUESTED OF	DATE CORRECTED
	Are all tumblers and tubs rotating at rpm's recommended by the manufacturer?				
	Does the work schedule utilize the off peak load periods?				
	Are ceilings, walls, and floors of a color and texture that will utilize the maximum reflective light and still maintain suitable working conditions?				
	Are lights turned off in work areas that are not being utilized?				
	Are exhaust fans off when the operation is closed?				
	Is the hot water tank drained and flushed every 6 months?				
	Are the gas jets and gas burners cleaned and adjusted on a regular basis to insure top efficiency?				
	Can the heat from the exhaust system be utilized in the laundry or any other part of the building?				
	Are all lint screens cleaned on a regular basis?				
	Based on the manufacturers recommendation is there a preventative maintenance program for each piece of equipment?				

VITA

Harshad Maganbhai Patel

Candidate for the Degree of

Master of Science

Report: IMPROVING PROFIT IN THE SMALL/MEDIUM SIZED MOTEL THROUGH ENERGY MANAGEMENT

Major Field: Industrial Engineering and Management

Biographical:

Personal Data: Born in Gahej, Gujarat, India, May 15, 1956, the son of Maganbhai and Shantaben Patel.

Education: Graduated from Madresa High School, Navasari, Gujarat State of India; received the Bachelor of Science degree from Maharaja Sayajirao University of Baroda, Gujarat, India in June 1978, in Civil Engineering; completed requirements for Bachelor of Science degree in Hotel and Restaurant Administration and for Master of Science degree in Industrial Engineering and Management in December, 1983.

Professional Experience: Special training for summer program in bridge construction and detail survey and plan for new housing society; Electronic Technician, Micro Peripheral Inc., Northridge, California, October 1978 through May 1979; Assistant Manager, El Sol Motel, Stillwater, Oklahoma, September 1980 to July 1982; Manager, El Sol Motel and Consultant for lodging industry on modernizing operations, July 1982 to present.