BALTIMORE DISTRICT

CORPS OF ENGINEERS

Ainsworth Clinic, Fort Hamilton, New York

ENERGY ENGINEERING ANALYSIS PROGRAM

Contract No. DACA31-84-C-0184

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EXECUTIVE SUMMARY

JANUARY 1986

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DEPARTMENT OF THE ARMY
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AINSWORTH CLINIC

FORT HAMILTON, NEW YORK

ENERGY ENGINEERING ANALYSIS PROGRAM

FOR

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT CORPS OF ENGINEERS

- Einhorn Yaffee Prescott, P.C
  The Argus Building
  Broadway at Beaver
  Albany, NY 12207

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A. INTRODUCTION

PURPOSE

In September of 1984, the firm of Einhorn Yaffee Prescott, P.C. was retained by the Army Corps of Engineers to perform energy conservation services for the Walson Army Community Hospital at Fort Dix and the Ainsworth Clinic at Fort Hamilton. The architectural/engineering/health planning field team studied the existing heating, ventilating, air conditioning, and electrical systems, results of all prior or ongoing energy conservation studies, projects, and designs or plans, the facilities operation and environment, and past energy usage. A comprehensive report has been prepared which documents the work accomplished, the results and the recommendations. This report reflects a joint effort between the field investigation team and the Clinic staff. The scope of this study included the following objectives:

- Perform a complete energy audit and analysis of the entire facility.
- Identify all energy conservation opportunities, including low cost/no cost items and perform complete evaluations of each.
- Prepare programming documentation for all energy conservation investment program projects including DD Form 1391, a life cycle cost analysis summary sheet with backup calculations and a Project Development Brochure.
- Prepare implementation documentation for all justifiable energy conservation opportunities.
- List and prioritize all recommended energy conservation opportunities.

APPROACH

The methodology through which this study was conducted consisted of several steps:

1. The field investigation team began with a review of existing building plans and previous energy studies and projects provided by the Corps of Engineers, clinic staff, and Directorate of Engineering and Housing (DEH). The documents reviewed include:

   - Department of the Army Productivity Improvement Program, regulation AR 5-4, Change Number 1.
   - ETL 1110-3-282, February 10, 1978, Energy Conservation.
   - ETL 1110-3-326, September 25, 1981, General Criteria for Medical Facilities.
   - ETL 1110-3-332, March 22, 1982, Economic Studies.
   - ETL 1110-3-335, November 22, 1982 General Planning/Design Criteria for Medical Facilities.
   - ETL 1110-3-344, October 4, 1983, Interior Mechanical Design Criteria for Medical Facilities.
   - ETL 1110-3-345, October 14, 1983, Heat Transfer Valves.
   - TM5-785, July 1, 1978, Weather Data (in part).
   - Army Facilities Energy Plan, November 17, 1983.
   - Applicable codes including Joint Committee for Accreditation of Hospitals (JCAH), Occupational Safety and Health Act (OSHA) and the National Fire Protection Association (NFPA) Life Safety Code.

2. A field team consisting of architects, electrical and mechanical engineers, control specialists, health planners, and energy audit technicians spent two days in the field gathering data and inspecting the facility. The results of this audit are documented in this report.

3. With the above information, a list of potential energy conservation opportunities was developed. These measures were computer analyzed using a program comparable to the Building Loads Analysis and Systems Thermodynamic (BLAST) program. This program incorporates field survey data, weather data, occupancy schedules, building construction data, energy distribution and systems data into a model of the total facility.

4. A comprehensive report was prepared, meeting the objectives of this study and providing the Ainsworth Clinic with a useful instrument for reducing energy consumption.

GENERAL BUILDING CHARACTERISTICS

The Ainsworth Clinic was constructed in 1960. The building consists of two floors and a basement. The walls are a brick and block construction. The roof is flat and consists of built-up roofing, stone ballast, and two inches of rigid insulation.

Heating and cooling is provided by a two pipe system and fan coil units with individual controls. No centralized controls capable of providing night setback or occupied/unoccupied controls exist. Chilled water is provided by a reciprocating chiller in the building. Domestic hot water is provided by two gas-fired hot water heaters. The main heating boilers are at the end of their useful life and need replacement.

Air handling equipment with local controls serve the storage areas, lobby, and some office areas. Louvers on each fan coil unit supply the outdoor air requirements. Air is exhausted through roof mounted fans, the majority of which were inoperable at the time of the field survey.

AINSWORTH CLINIC ZONE DESCRIPTION

Zone 1 - Second Floor Perimeter: The Second Floor Perimeter area is served by 2 pipe fan coil units with individual heating/cooling controls. The combined air flow supplied by the units is 23,800 CFM.

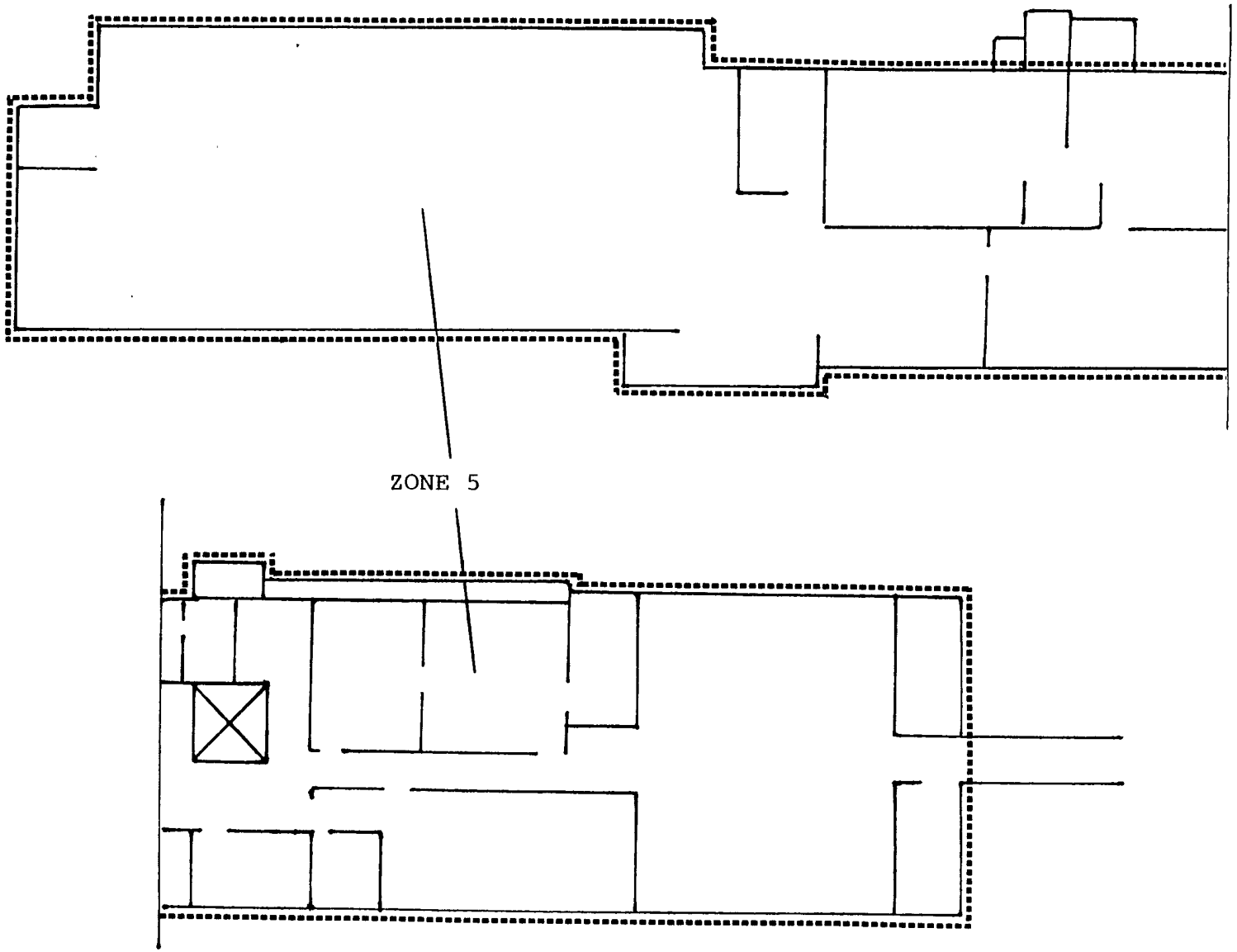
Zone 2 - Second Floor Core Area: The Second Floor Core Area (the dental waiting room) is served by the AC-3 fan coil unit. AC-3 is a 100% O.A. fan coil unit with zone control, supplying 1,680 CFM of fresh air.

Zone 3 - First Floor Perimeter: The First Floor Perimeter area is served by 2 pipe fan coil units with individual heating/cooling controls. The combined air flow supplied by the units is 19,100 CFM.

Zone 4 - First Floor Core Area: The First Floor Core Area (waiting and emergency areas) is served by the AC-1 fan coil unit. AC-1 is a 2 pipe fan coil unit with zone control. This unit supplies 4,640 CFM of conditioned air to the zone.

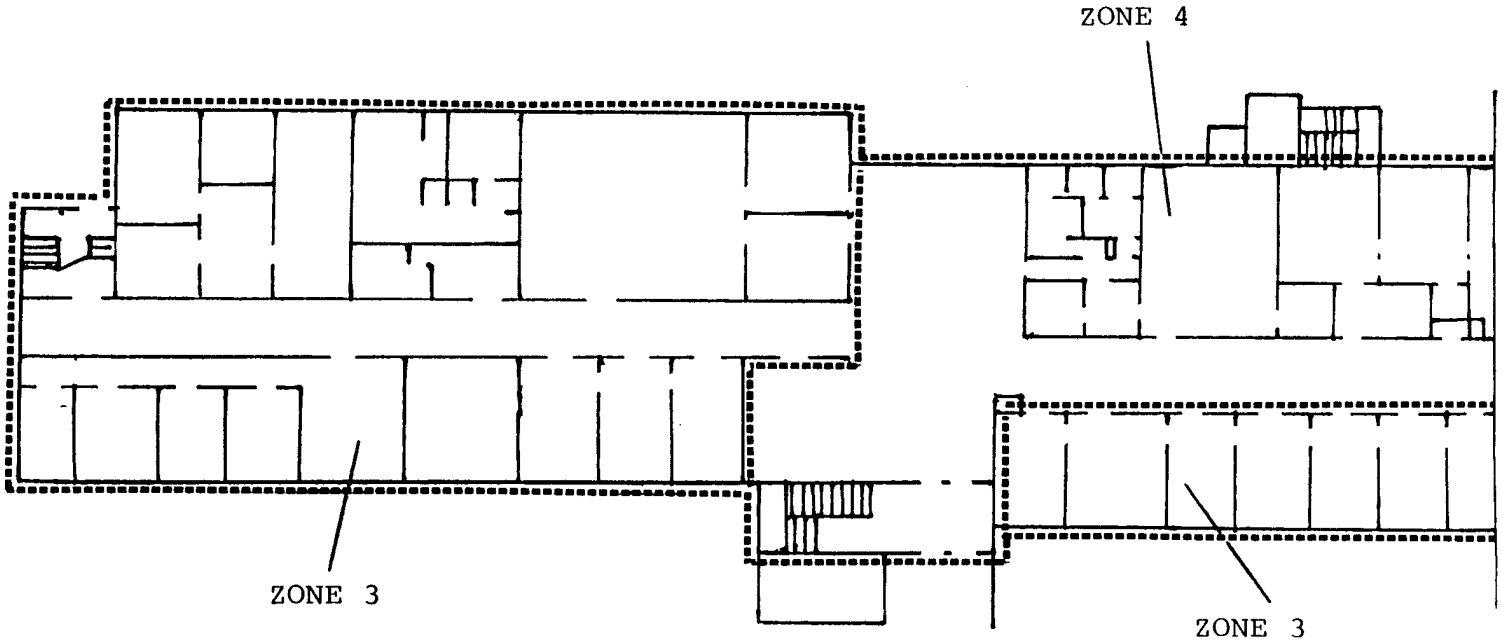
Zone 5 - Basement: The Basement area is served by 2 heating/cooling units (H.V. - 1 & H.V. - 2) with a combined air flow of 10,530 CFM.

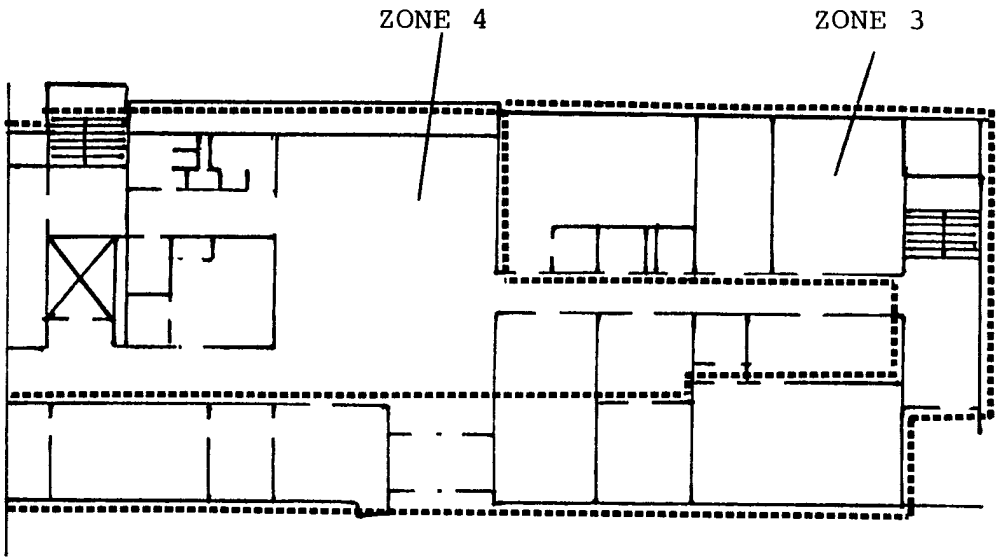
Note: There are also 9 roof mounted exhaust fans originally designed to integrate with zone HVAC systems. The exhaust fans are not operating, however, and conditions indicates they have not been used for several years.
ENSIM BASE RUN



BASEMENT

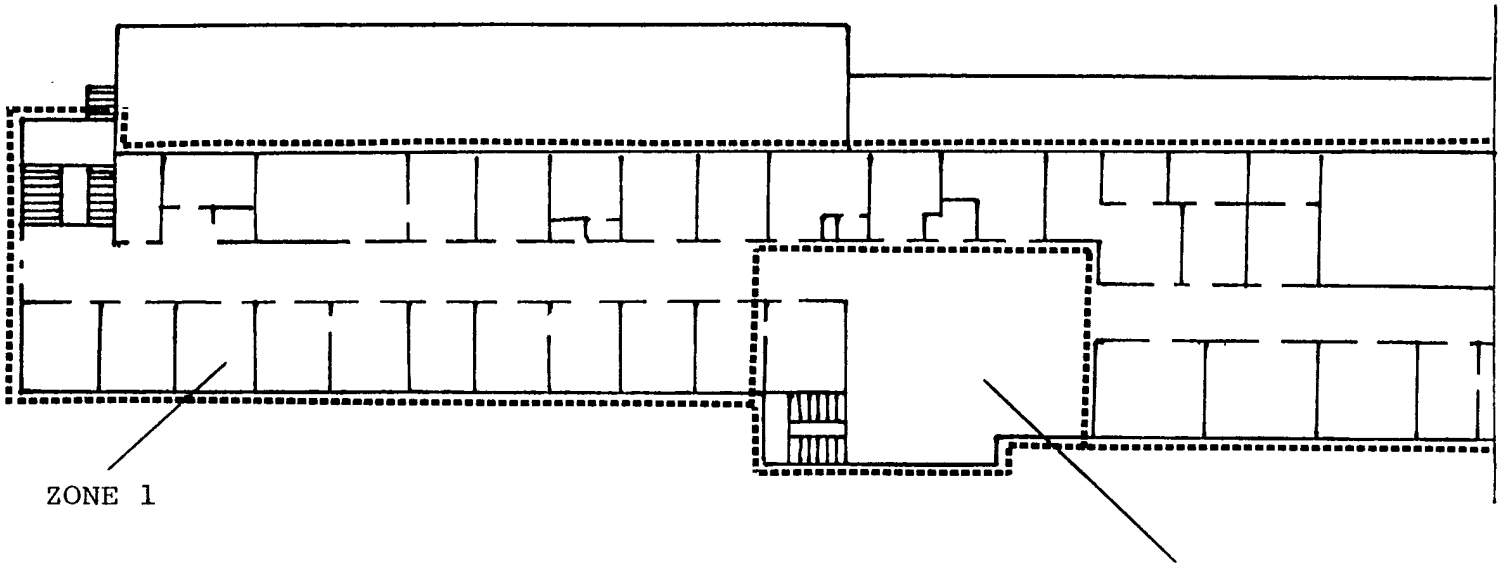
FORT HAMILTON

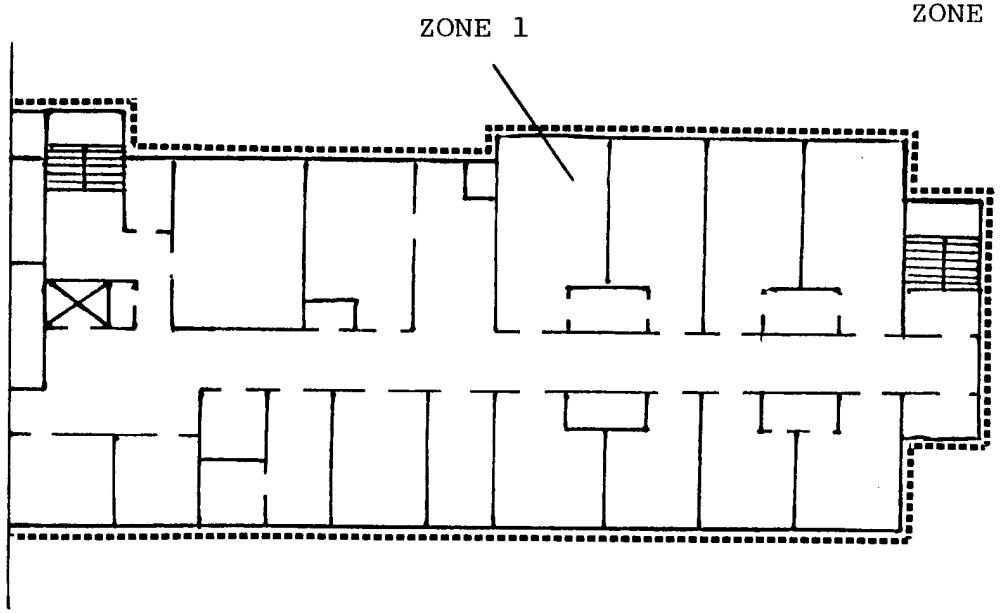




FIRST FLOOR

FORT HAMILTON





SECOND FLOOR
FORT HAMILTON

B. PRESENT ENERGY CONSUMPTION

TOTAL ANNUAL ENERGY USED

The annual energy requirements of Ainsworth Clinic are presented in the table below. This information is used as a theoretical baseline of energy usage in the analysis of energy conservation measures and is derived from the EnSim base run.

	Natural Gas (THMS)	No. 4 Oil (Gal.)	Elec. (KWH)
Cooling			51,848
Domestic Hot Water	207		4,380
Lights			84,777
Miscellaneous Equipment			24,469
Fans			47,929
Heating		27,028	
Total	207	27,028	213,403

Energy rates used in the economic analysis of each energy conservation opportunity were TRADOC, Fort Monroe, Virginia and DEH, obtained from Fort Dix, New Jersey. The rates are as follows:

Natural Gas: $0.92/CCF
No. 2 Fuel Oil: $0.95/gal.
No. 4 Fuel Oil: $0.68/gal.
Electric Consumption: $0.114/KWH
Electric Demand:

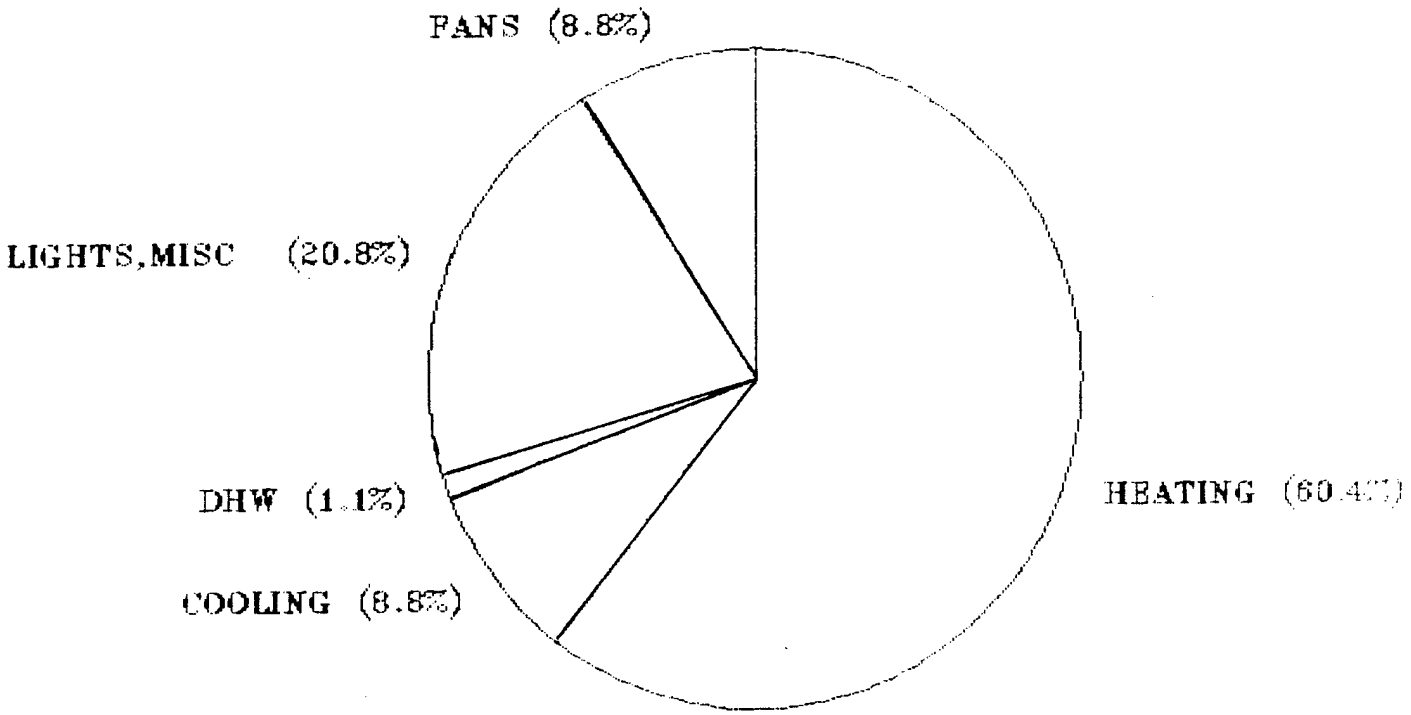
Summer -	First 5 KW or less:	$98.64
	5 KW to 899 KW:	$21.14/KW
	900 KW and above:	$18.46/KW
Winter -	First 5 KW or less:	$76.14
	5 KW to 899 KW:	$16.64/KW
	900 KW and above:	$14.46/KW

SOURCE ENERGY CONSUMPTION

The table and pie chart presented below show a breakout of energy consumption at Ainsworth Clinic. This information is derived from the ENSIM base run output and represents source energy consumption.

Energy Use By Category

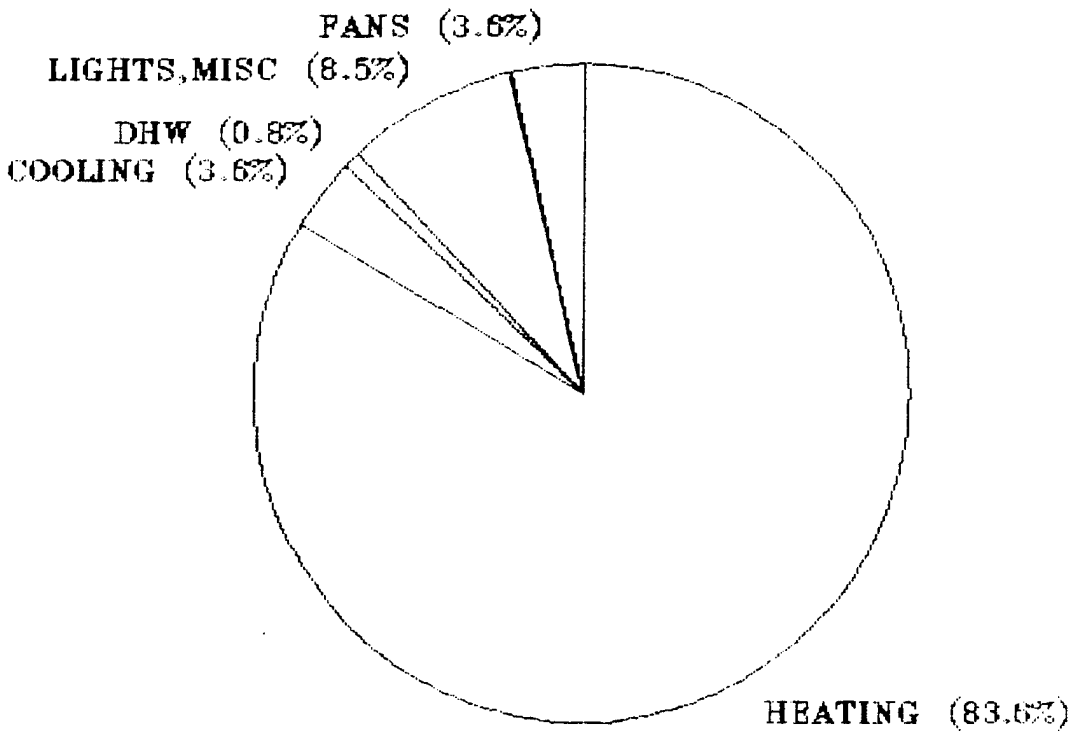
	Source (MBTU)
Cooling	553
Domestic Hot Water	72
Lights	1,315
Fans	556
Heating	3,811
Total:	6,307



BREAKOUT OF ENERGY CONSUMPTION

The table and pie chart presented below show a breakout of energy consumption at Ainsworth Clinic. This information is derived from the ENSIM base run output and represents site energy consumption.

Energy Use By Category	Site MBTU
DHW	36
Heating	3,811
Lights, Misc. Equipment	387
Fans	164
Cooling	163
Total:	4,561



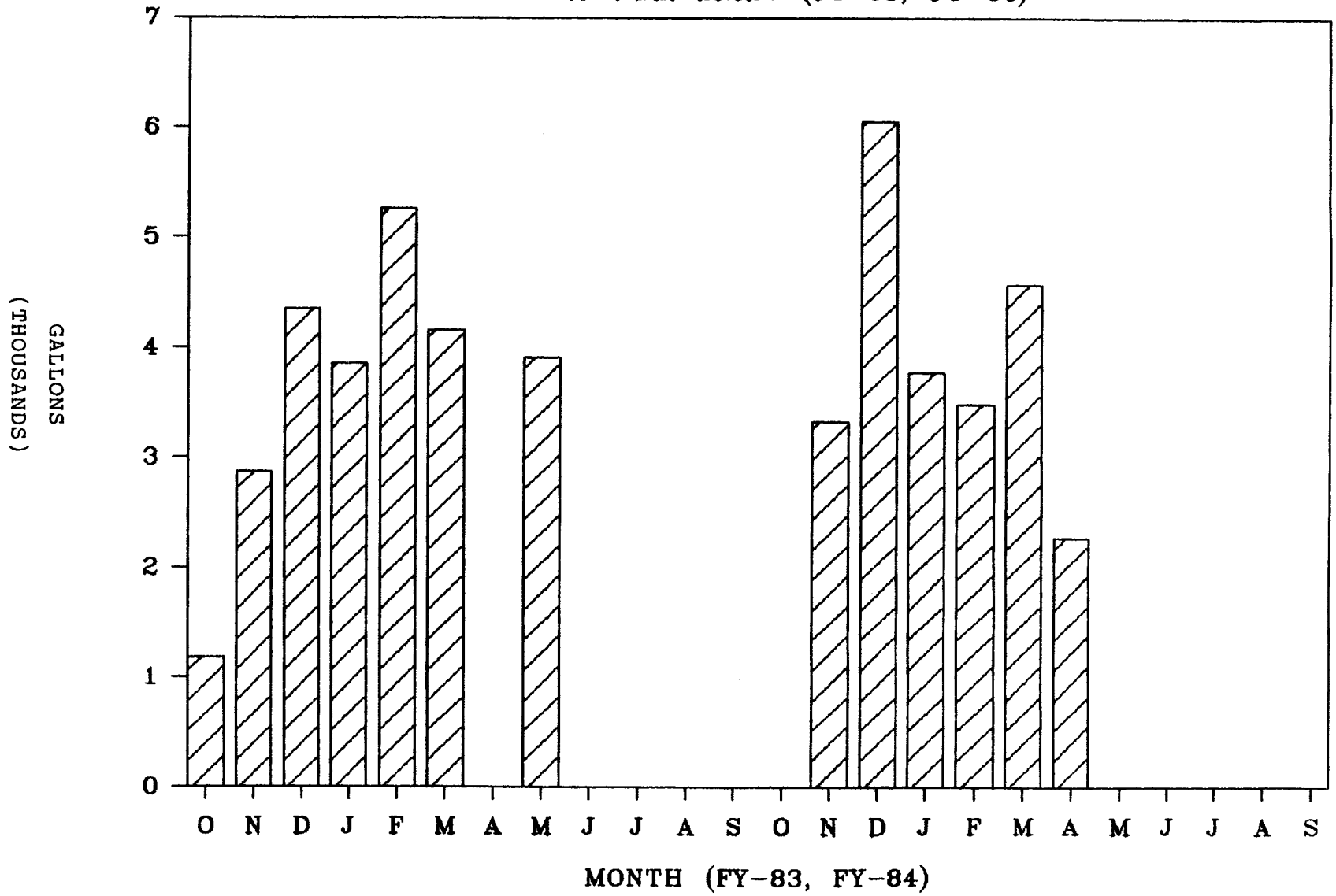
C. HISTORIC ENERGY CONSUMPTION

Oil deliveries for the past two years (FY83, FY84) are presented in the bar chart on the following page and the table below. Separate metering for clinic electrical consumption does not exist, therefore, no historical consumption data is available.

	No. 4 Oil Deliveries			
	FY83		FY84	
Month	Gallons	MBTU	Gallons	MBTU
October	1,180	166.4	0	0
November	2,874	405.2	3,328	469.2
December	4,346	612.8	6,060	854.5
January	3,853	543.3	3,772	531.9
February	5,265	742.4	3,480	490.7
March	4,161	586.7	4,564	643.5
April	0	0	2,265	319.4
May	3,905	550.6	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0

AINSWORTH CLINIC

OIL DELIVERIES (FY-83, FY-84)



D. ENERGY CONSERVATION ANALYSIS

ENERGY CONSERVATION OPPORTUNITIES RECOMMENDED

The following energy conservation measures have been analyzed and found to be cost effective. A detailed analysis of these measures can be found in the Narrative Report. A summary table of these measures is presented on the following page.

Install Photocell Control

The canopy and vestibule lights are presently controlled manually. It is recommended that a photocell be installed to control the operation of these lights.

Night Cycle Control - Time Clock

The existing air conditioning system has no automatic controls to shut the equipment off when the building is unoccupied. It is recommended that a timeclock to schedule the operation of the air handling units and exhaust fans be installed.

Install Time Clock for Pumps

The existing air conditioning system has no automatic controls to shut the equipment off when the building is not occupied. It is recommended that a time clock be installed to schedule the operation of the condensing and chilled water pumps.

Install Localized Switching

All lighting in the medical supply storage area is currently on during occupied hours. It is recommended that new switching be installed to allow local control of the lighting as required.

Night Cycle Control

The existing fan-coil units have no outside air dampers or night setback temperature controls. The outside air required during occupied hours also infiltrates into the building during unoccupied hours through open louvers in the exterior walls. The building is maintained at a constant temperature resulting in unnecessary energy usage when the space is unoccupied. It is recommended that outside air dampers and remote thermostats with night setback capabilities be installed in order to eliminate infiltration and ventilation and lower the space temperature during unoccupied hours.

Summary of Energy and Cost Savings - Recommended Measures.

	Construction Cost ($)	Saving ($)	Electric Savings (MBTU)	Electric Savings (KWH)	National Gas Savings (MBTU)	National Gas Savings (THRM)	Oil Savings (MBTU)	Oil Savings (GAL)	SIR	SPB
Install Photocell Control	94	322	32.8	2,829					33.22	0.3
Night Cycle Control-Time Clock	1,815	4,901	179.0	15,430			651.5	4,618	30.17	0.4
Timeclock for Pumps	638	327	33.3	2,869					4.97	2.0
Install Localized Switching	1,174	384	43.5	3,754			(9.1)	(64)	3.09	3.1
Night Cycle Control	30,438	4,157	728.9	11,054			600.7	4,260	1.54	7.3
TOTAL	34,159	10,091	416.8	35,936			1,243.1	8,814		3.4

OPPORTUNITIES INVESTIGATED/NOT RECOMMENDED

The following energy conservation measures have been analyzed and found to be non-cost effective. A detailed analysis of these measures can be found in the Narrative Report. A summary table of these measures is presented on the following page.

Hot Water Temperature Reset Control

The existing hot water heating system operates at a constant temperature of approximately 180°F throughout the heating season. This lowers the boiler efficiency when the outdoor temperature is above the design condition. It is recommended that hot water temperature reset controls be installed in order to schedule the hot water temperature with the outside temperature. This should improve the seasonal boiler efficiency and lower oil consumption.

Install Wall Insulation

The existing walls are masonry with a minimum amount of insulation. It is recommended that 2" of a rigid insulation be applied to the exterior surface of all walls.

Install High Efficiency Boilers

The existing oil fired boilers are at the end of their useful life. It is recommended that 90% efficient pulse burn, gas fired boilers be installed.

Summary of Energy and Cost Savings - Not Recommended Measures

	Construction Cost ($)	Saving ($)	Electric Savings (MBTU	Electric Savings (KWH)	National Gas Savings (MBTU)	National Gas Savings (THRM)	Oil Savings (MBTU)	Oil Savings (GAL)	SIR	SPB
HW Temperature Reset Control	1,404	110					22.8	162	0.94	12.8
Install Wall Insulation	84,462	1,308	3.4	293			264.2	1,874	0.28	64.6
High Efficiency Boilers	38,745	1,270			-2,540.6	-25,406	3,810.9	27,028	-1.65	-9.2

ECIP PROJECTS DEVELOPED

Programming documentation is not included with this submission. No single energy conservation measure or combination of measures is substantial enough to justify Energy Conservation Investment Program (ECIP) funding.

OTHER ENERGY CONSERVATION PROJECTS

Energy Monitoring and Control System

Installation of an Energy Monitoring and Control System (EMCS) at Ainsworth Clinic is not recommended at this time. The majority of heating, ventilating and air conditioning is provided by terminal equipment instead of a centralized system. For this case, improved individual controls could provide the same operation as an EMCS at a much lower cost. In addition, the control and scheduling required to meet the varied demands of a medical operation such as Ainsworth Clinic could not easily or effectively be provided from a remote location.

Solar Energy

No applications of solar energy appear feasible at this time. The initial construction cost and additional maintenance requirements make any potential solar applications uneconomical.

E. ENERGY AND COST SAVINGS

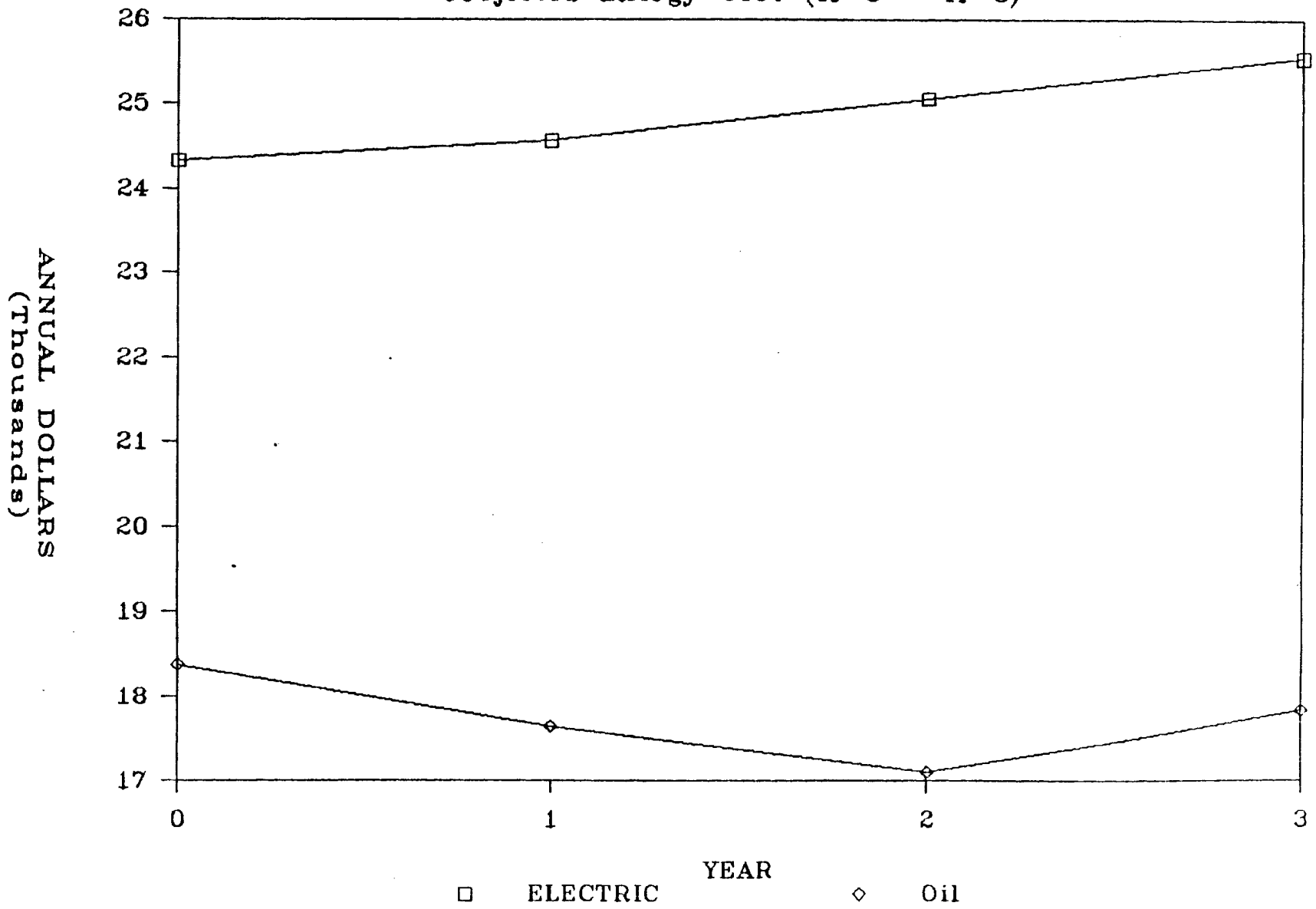
Each energy conservation opportunity investigated has been evaluated independently. In addition, the possible duplication of savings between related projects has been considered. The results presented in this section account for these synergistic effects.

Implementation of the cost effective energy conservation measures recommended in this report will provide a total energy savings of 1,659.9 MBTU's per year, consisting of 1,243.1 BMTU's of No. 4 oil and 416.8 MBTU's of electric consumption. The total annual cost savings will be $10,091 on an investment of $34,159. This represents a 26% reduction in energy usage compared to current consumption levels.

The graphs on the following page provides a comparison of energy consumption, in dollars, between that which is currently used, and the estimated consumption after implementation of the recommended measures.

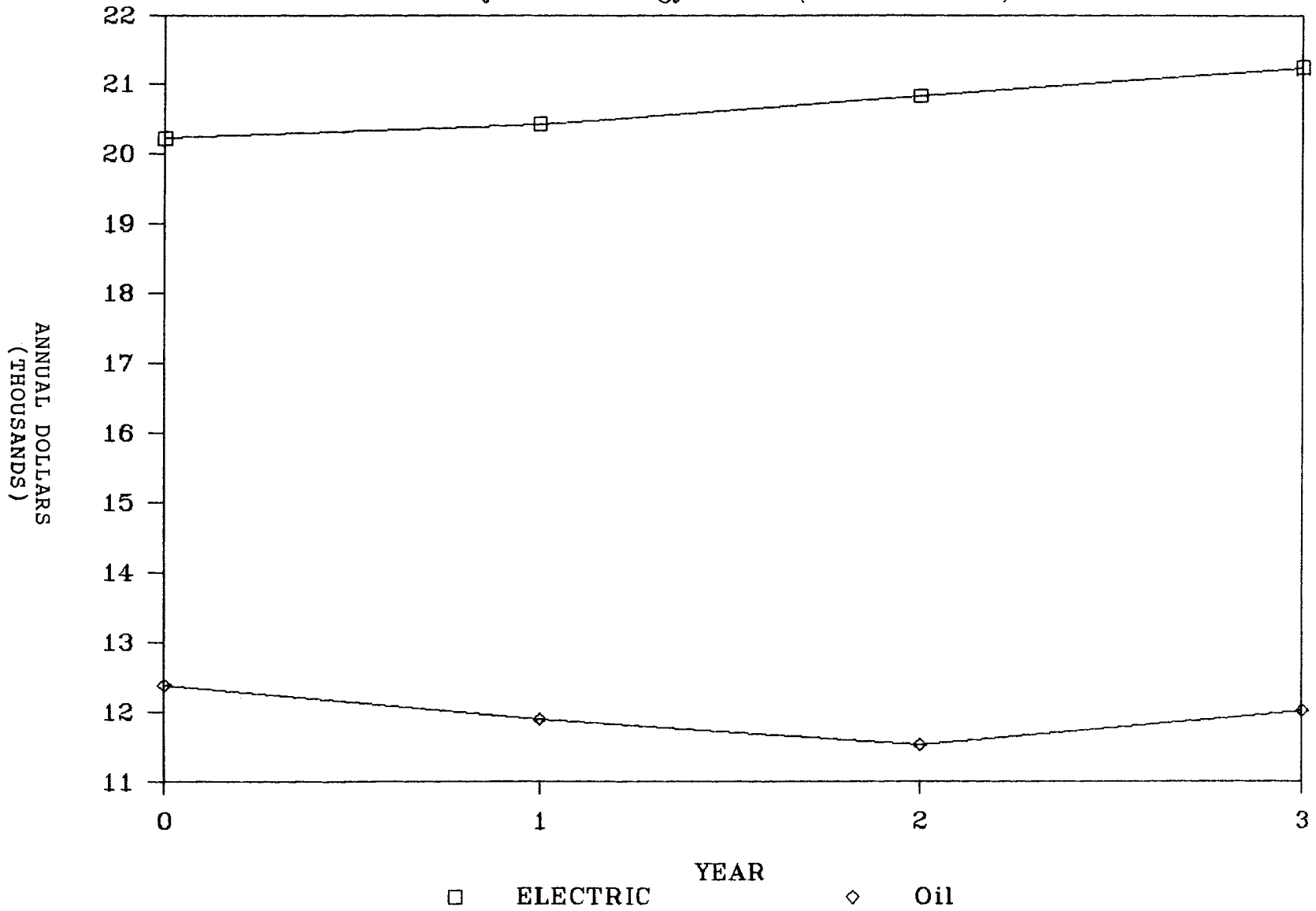
Ainsworth Clinic – Present Energy Use

Projected Energy Cost (Yr 0 – Yr 3)



Ainsworth Clinic – Proposed Energy Use

Projected Energy Cost (Yr 0 – Yr 3)



F. ENERGY PLAN

The energy conservation measures recommended in this report do not meet the minimum construction cost criteria and therefore do not qualify for Energy Conservation Investment Program (ECIP) Funding.

A summary report is presented on the following page. This report provides revised energy consumption data for the combined effect of implementing all recommended energy conservation measures. In addition, a life cycle cost analysis is provided for the combined cost effective measures.

The overall savings to investment ratio (SIR) is 3.26. The combined simple payback period is 3.4.

EnSim Report: REVISED END USE File Name: clinBASE Date: 01-10-1985

* BUILDING ANNUAL ENERGY BY *
* END USE AND FUEL TYPE *

	Nat Gas (THERMS)	Oil (GAL)	Electric (KWH)	Site (MBTU)
Heating Energy				
Oil Boiler		18,214		2,568.17
Cooling Energy				
Reciprocating Chiller			47,690	162.77
Domestic Hot Water Energy				
Domestic HW Heater	207			20.65
Domestic HW Heater			4,380	14.95
Building Miscellaneous				
Lights			78,194	266.88
Equipment			8,421	28.74
System Miscellaneous				
Fans			21,445	73.19
Plant Miscellaneous				
Cooling Tower			4,158	14.19
Pumping			6,938	23.68
Dental Equipment			6,240	21.30
Consumption Totals	207	18,214	177,467	
Unit Cost	$0.890	$0.680	$0.114	
Dollar Cost	$184	$12,384	$20,232	$32,800
Site Energy (MBTU)	20.7	2,568.2	605.7	3,194.6
Source Energy (MBTU)	20.7	2,568.2	2,058.6	4,647.5

LIFE CYCLE COST ANALYSIS SUMM|RY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION--------- FT. HAMILTON BUILDING NAME--AINSWORTH CLINIC
REGION NO.------- 2 ECONOMIC LIFE--15 YEARS
PROJECT TITLE---- SUMMARY OF ALL COST EFFECTIVE ECO'S

1. INVESTMENT COSTS

A. CONSTRUCTION COST	$34,159	
B. SIOH (5 1/2%)	$1,879	
C. DESIGN COST (6%)	$2,050	
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	$34,279	
E. TOTAL INVESTMENT		$34,279

2. ENERGY SAVINGS (+) / COST (-)
ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	COST $/MBTU	SAVINGS MBTU/YR	ANNUAL SAVINGS	DISCOUNT FACTOR	DISCOUNTED SAVINGS	
A. ELEC	$9.8280	416.9	$4,097	9.72	$39,826	
B. DIST						
C. RESID	$4.8230	1,242.8	$5,994	11.99	$71,868	
D. NG	$8.9000					
E. COAL						
F. TOTAL		1,659.7	$10,091		---------->	$111,694

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+ / -) $0
(1) DISCOUNT FACTOR 9.11
(2) DISCOUNTED SAVING/COST $0

B. NON RECURRING SAVINGS (+) / COST (-)

ITEM	SAVINGS (+) COST (-)	YEAR OF OCCURANCE	DISCOUNT FACTOR	DISCOUNTED SAVINGS/COST
a.				
b.				
c. TOTAL				

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) / COST (-) $0

D. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (.33 TIMES DISCOUNTED ENERGY SAVINGS) $36,859
a IF 3D(1) IS GREATER THAN 3C GO TO ITEM 4
b IF 3D(1) IS LESS THAN 3C CALCULATE SIR USING 3D - N/A
c IF 3D1b IS GREATER THAN 1.0 GO TO ITEM 4
d IF 3D1b IS LESS THAN 1.0 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS $10,091

5. TOTAL NET DISCOUNTED SAVINGS $111,694

6. DISCOUNTED SAVINGS RATIO 3.26

7. SIMPLE PAYBACK PERIOD 3.4