

EXECUTIVE SUMMARY

for

INCREMENT A, B and G

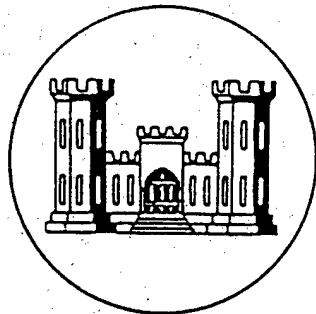
ENERGY STUDY

at

Forest Glen

Walter Reed Army Medical Center

Washington, D.C.



DEPARTMENT OF THE ARMY

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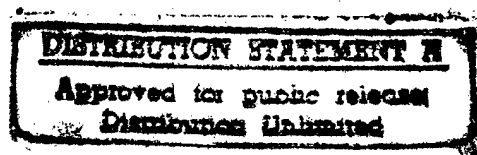
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SECTION 1
EXECUTIVE SUMMARY

**SECTION 1
EXECUTIVE SUMMARY**

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SECTION 1.1
INTRODUCTION

1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

1.1.1 Purpose

The purpose of this study is to determine the amount of energy being used, the cost of this energy, and to recommend projects that will reduce energy consumption for Buildings 101, 104, 107, 114, 116, 118, 119, 120, 122, 125 and 138, located in the Forest Glen Complex, which is part of the Walter Reed Army Medical Center (WRAMC).

Executive Order No. 12003, 20 July 1977, established energy conservation goals for existing Federal facilities requiring a reduction of 20% in the average energy use in FY 85 from the average annual energy requirements in FY 75.

The Energy Conservation Investment Program (ECIP) is a Military Construction funded program for retrofitting existing DOD facilities to make them more energy efficient and thus providing substantial savings in utility costs.

Each project is assessed in terms of source energy saved, the value of the energy and the capital and operating costs of the changes.

The ECIP guidance provides two criteria for evaluating energy saving opportunities. These are an energy/cost ratio (E/C) and a benefit/cost ratio (B/C). For FY 84 the E/C ratio must be 13 or more with a B/C greater than one.

Beginning with FY 85, ECIP projects will be prioritized on the basis of the greatest life cycle payback as determined by the savings to investment ratio (SIR).

Overall projects and discrete portions of projects must be life cycle cost effective (SIR equal to or greater than 1).

All energy savings projected in FY 85 shall be based on full occupancy of the buildings in the study.

1.1.2 Scope

The study covers the basic forms of energy used in the buildings, oil and electricity.

Oil as a source of energy for these buildings is primarily for space heating and domestic water heating.

Electricity as a source of energy for these buildings is primarily for lighting and air conditioning.

Natural gas is used in some of the buildings, but because its use has fallen dramatically and it is presently used only in kitchen facilities, it is not considered a significant factor in the analysis. Figures on historic gas consumption are included in this study; however, they are included only for the purpose of documenting this trend.

1.1.3 Overview

The buildings investigated for this energy study are located on the north side of the Forest Glen Complex and are generally more than seventy-five (75) years old. They are listed with the Maryland State Historical Preservation Society and the condition of the buildings and their systems is poor. The buildings are multi-story except for the chapel, and have stucco exterior finish with masonry foundations. Most of the buildings are partially occupied with administrative services and three are used as barracks.

The Architectural investigation covered the reduction of heat transfer through the building envelopes including glass, sealing infiltration cracks around doors and windows, weatherstripping doors and installing storm doors and windows.

The HVAC investigation centered on developing more efficient operation of steam heating systems for these buildings and eliminating overheating by the use of control valves. Cooling is primarily with window air conditioning units and a few large self-contained and small split system units. Measures studied included the reduction of outdoor air for these units with automatically controlled dampers and economizers. Replacement of these old systems with more efficient systems is recommended but the cost would not allow such projects to fall within the guidelines for an ECIP project.

The plumbing investigation centered on domestic water heating and water restrictors for plumbing fixtures.

The electrical investigation centered on energy savings through the use of more efficient lighting by replacing lamps and ballasts.

The energy monitoring and control system (EMCS) investigation studies the possibility of energy savings by extending the existing EMCS system to control heating and air conditioning within a building. The measures would include scheduling of equipment and controlling night setback temperatures.

Existing utility and distribution systems are discussed within the narrative report. Alterations of these systems are outside the scope of this study; however, it is recommended that metering systems be installed to document energy usage described within the analysis.

SECTION 1.2
EXISTING ENERGY CONSUMPTION

1.2 EXISTING ENERGY CONSUMPTION FY 75

1.2.1 Basewide Adjusted Consumption FY 75

The Basewide adjusted energy consumption in FY 75 consisted of oil and electricity in the amount of 922,319 MBTU. This amount was derived by obtaining actual fuel usage records from WRAMC Facility Engineering Department and adding to it an estimated energy consumption which assumed full occupancy for FY 75.

1.2.2 Actual Energy Consumption (Basewide)

Actual fuel usage and costs were acquired from records supplied by Walter Reed's Facilities Engineering Department. (See Table 1.2.1)

Fuel oil usage records for FY 75 indicate 4,655,460 gallons used at an average cost of 33 cents per gallon resulting in a total cost of fuel oil for the year of \$1,533,141. Annual energy consumption for fuel oil was 707,629 MBTU at a cost of \$2.17 per MBTU. (See Table 1.2.1)

Electrical energy usage records for FY 75 indicate 55,667,650 KWH at an average cost of 2.9 cents per KWH, resulting in a total cost of electricity for the year of \$1,629,845. Annual energy consumption for electricity was 645,745 MBTU at a cost of \$2.52 per MBTU. (See Table 1.2.1).

The combined energy consumption for fuel oil of 707,629 MBTU and electricity of 645,745 MBTU give a total amount of 1,353,374 MBTU per year (See Table 1.2.2).

1.2.3 Adjusted Energy Consumption

One of the requirements of the energy criteria is to calculate energy savings in FY 85 based upon full occupancy of all buildings in the study. Therefore, to be consistent, the energy consumption in the base year FY 75 must be based on full occupancy also. Since the buildings historically have been only partially occupied and are presently only 60% occupied, the actual fuel consumption is not representative, and some approximations must be made to estimate energy usage.

Total energy consumption based upon 100% occupancy was estimated using average BTU/SF/YR consumption figures for different consumer groups, extracted from the WRAMC Basewide energy study (Table 1.2.3) and the square footages of each building (See Table 1.2.4). The total estimated energy consumption of the buildings included in the study for base year FY 75 is therefore 63,193 MBTU/YR.

1.2.1 BASEWIDE SOURCE OF ENERGY CONSUMPTION

THIS TABLE SUMMARIZES THE ACTUAL BASEWIDE ELECTRICITY AND FUEL OIL USED FOR THE YEARS FY 75 THROUGH FY81.

ACTUAL ELECTRICITY (KWH), OIL (GALLONS) AND COSTS WERE ACQUIRED FROM RECORDS SUPPLIED BY WALTER REED'S FACILITIES ENGINEERING DEPARTMENT.

SOURCE OF ENERGY CONSUMPTION

YEAR	SOURCE	AMOUNT USED *	UNIT COST	TOTAL COST (\$)	MBTU	COST MBTU	TOTAL MBTU
FY75	ELECTRICITY	55667650	.0292	1629845	645745	2.52	1353374
	OIL	4655460	.3293	1533141	707629	2.17	
FY76	ELECTRICITY	62447250	.0295	1843639	724388	2.55	1452886
	OIL	4792755	.3274	1569401	728498	2.15	
FY77	ELECTRICITY	77015720	.0379	2924012	893382	3.27	1684882
	OIL	5207242	.3820	1988959	791500	2.51	
FY78	ELECTRICITY	102688060	.0379	3895135	1191182	3.27	2203519
	OIL	6660111	.3810	2537502	1012337	2.51	
FY79	ELECTRICITY	121681760	.0374	4556037	1411508	3.23	2425218
	OIL	6669146	.3882	2588736	1013710	2.55	
FY80	ELECTRICITY	126285912	.0425	5368816	1464917	3.67	2481020
	OIL	6684891	.9837	6576243	1016103	6.47	
FY81	ELECTRICITY	116566000	.0523	6090998	1352166	4.50	2150159
	OIL	6114520	.8691	5313981	797993	6.66	

* NOTE: THE AMOUNT OF ELECTRICITY USED IS MEASURED IN KILOWATT HOURS (KWH) AND THE AMOUNT OF FUEL OIL USED IS MEASURED IN GALLONS.

1.2.2 BASEWIDE ANNUAL ENERGY COSTS

THIS TABLE SUMMARIZES THE AVERAGE ENERGY COST PER MBTU AT THE BASE FOR THE YEARS FY75 THROUGH FY81.

TOTAL ANNUAL ENERGY USED AND COSTS (BASEWIDE)

<u>YEAR</u>	<u>COST(S)</u>	<u>MBTU</u>	<u>COSTS (\$)/MBTU</u>
FY75	3162986	1353374	2.34
FY76	3413040	1452886	2.35
FY77	4912971	1684882	2.92
FY78	6432637	2203519	2.92
FY79	7144773	2425218	2.95
FY80	11945059	2481020	4.81
FY81	11404979	2150159	5.30

1.2.3 TYPICAL BUILDINGS ENERGY CONSUMPTION

THE FOLLOWING DATA WAS EXTRACTED FROM THE WALTER REED ARMY MEDICAL CENTER BASEWIDE ENERGY STUDY FINAL REPORT DATED 4/17/81. THIS DATA WAS USED IN COMPUTING TOTAL ENERGY CONSUMPTION FOR THE BUILDING GROUP.

TYPICAL BUILDING TYPE ENERGY CONSUMPTION (FY75)

ELECTRICAL CONSUMPTION

CONSUMER GROUP	ESTIMATED BTU/SF/YR.
TROOP HOUSING	148200
MAINTENANCE	254000
ADMINISTRATION	105850
* CHAPEL	60000

FUEL OIL CONSUMPTION

CONSUMER GROUP	ESTIMATED BTU/SF/YR.
TROOP HOUSING	100000 **
MAINTENANCE	210516
ADMINISTRATION	112725
* CHAPEL	80000

REFER TO U.S.ARMY CORPS OF ENGINEERS CONSTRUCTION ENGINEERING RESEARCH LABORATORY, CHAMPAIGN, ILLINOIS, INTERIM REPORTS E127 OF FEB.1978 AND E143 OF FEB.1979.

* DATA NOT AVAILABLE FROM U.S. CORPS OF ENGINEERS REPORT. ESTIMATE BASED ON CALCULATIONS FROM HEAT LOSS/HEAT GAIN LOAD SHEET.

** THIS ESTIMATE WAS CONSIDERED LOW AND WAS ADJUSTED BASED ON HEAT LOSS/HEAT GAIN LOAD SHEETS.

1.2.4 BUILDING GROUP ENERGY CONSUMPTION

THE TABLE BELOW IS PRODUCED FROM HISTORICAL DATA OF ENERGY USAGE TABULATED FOR VARIOUS TYPES OF MILITARY BUILDINGS BY THE U.S. ARMY CORPS ENGINEERS CONSTRUCTION ENGINEERING RESEARCH LABORATORY, CHAMPAIGN, ILLINOIS. THREE TYPE GROUPS ARE REPRESENTED IN THE TABLE WITH AREAS LISTED AND THE HISTORICAL FACTOR REPRESENTING ENERGY USED IN BTU/SQ.FT/YR. DATA PROVIDED FOR THE CHAPEL AND EXCEPTION FOR OIL USED IN HOUSING IS NOTED IN SECTION 2.6. THE RESULTING ELECTRICAL OR OIL CONSUMPTION IN MBTU/YR IS CALCULATED FOR THE BASE YEAR FY75.

BUILDING ENERGY CONSUMPTION (BASE YEAR FY75)

BLDG.	TYPE GROUP*	AREA (SQFT)	ELECTRIC		OIL		TOTAL CONSUMPTION MBTU/YR
			ESTIMATED BTU/SF/YR*	CONSUMPTION MBTU/YR	ESTIMATED BTU/SF/YR*	CONSUMPTION MBTU/YR	
101	ADMIN.	172957	105850	18307	112725	19497	37804
104	ADMIN.	26605	105850	2816	112725	2999	5815
107	ADMIN.	3427	105850	363	112725	386	749
118	ADMIN.	14950	105850	1582	112725	1685	3267
120	ADMIN.	6829	105850	723	112725	770	1493
114	CHAPEL	2943	60000	177	80000	235	412
116	HOUSING	9027	148200	1338	100000	903	2241
119	HOUSING	17922	148200	2656	100000	1792	4448
125	HOUSING	11105	148200	1646	100000	1111	2757
138	HOUSING	6840	148200	1014	100000	684	1698
122	MAINT.	5400	254000	1372	210516	1137	2509
		278005		31994		31199	63193

* CONSUMER GROUP TYPE AND ESTIMATED BTU/SF/YR ARE FROM TABLES 3 & 8 OF THE BASEWIDE ENERGY STUDY FINAL REPORT DATED 4/17/81 (SEE TABLE 2.3). ALL ENERGY CONSUMPTION ESTIMATES ARE BASED ON FULL OCCUPANCY OF BUILDINGS.

This data is adequate as a base for projected energy savings for the buildings in the study, however, the Basewide energy consumption should be increased to reflect energy consumption created by assuming full occupancy. The actual occupancy rate in base year FY 75 is assumed to be 60%.

The fuel oil consumption increase would have been forty percent of 31,199 MBTU (See Table 1.2.4) used by this group of building which results in 12,480 MBTU per year.

The electrical consumption increase would have been forty percent of 31,994 MBTU (See Table 2.4) used by this group of buildings which results in 12,798 MBTU per year.

The energy consumption for fuel oil of 12,480 MBTU and electricity of 12,798 MBTU combine to a total amount of 25,278 MBTU per year.

The actual Basewide energy consumption for FY 75 of 1,353,374 MBTU (See Table 1.2.2) combined with the 25,278 MBTU of energy consumption that would have been used for unoccupied portions of this building group gives an adjusted total basewide energy consumption of 1,378,652 MBTU for FY 75 (See Table 1.2.5).

1.2.8 Adjusted Energy Consumption For FY 75 (Basewide)

This table combines the calculated 25,278 MBTU of energy consumption that would have been used for unoccupied portions of the building group with the actual 1,353,374 MBTU for an adjusted basewide energy consumption of 1,378,652 MBTU for FY 75.

TABLE 1.2.5 SUMMARY ADJUSTED ENERGY CONSUMPTION FOR FY 75 (BASEWIDE)

	Electrical (MBTU/YR)	Fuel Oil (MBTU/YR)	Total (MBTU/YR)
Actual Energy Used (See Table 1.2.1)	645,745	707,629	1,353,374
Energy that would have been used for unoccupied areas	12,798	12,480	25,278
Adjusted Energy Consumption	<u>658,543</u>	<u>720,109</u>	<u>1,378,652</u>

SECTION 1.3

ENERGY CONSERVATION MEASURES INVESTIGATED

1.3 ENERGY CONSERVATION MEASURES INVESTIGATED

1.3.1 General

In order to arrive at the largest number of projects and possibilities available for this study, a master list of possible energy conservation measures was used as indicated in Table 1.3.1. This list includes the suggested list as required by the Annex "A" of the Scope of Work. Other measures were added which pertain to these particular buildings, and some which our experience indicated might prove feasible.

An "X" in the "ECMS investigated" column indicates the energy conservation measure was investigated, some in great depth and some very briefly, depending on the application.

An "X" in the second column indicates an ECIP project was developed for this energy conservation measure and is developed in detail in the Narrative Report. Also, PDB's and 1391's have been developed.

An "X" in the third column indicates the energy conservation measure has been developed as a separate Increment Project. (See Narrative Report Section 5)

An "X" in the fourth column indicates the measure was not justified as an energy conservation measure. Some are obviously not applicable and some were investigated and simply did not meet the criteria.

Further discussion of the projects, and the basis for determining justification of ECIP projects, is found in the Narrative Report.

1.3.2 ECIP Projects Developed

The following have been developed as Increment "A" and "B" ECIP projects which meet the criteria, and result in significant energy savings to the building group. PDB's and 1391's have also been developed for these projects.

Building Weatherization: (Increment A)

- Roof/Ceiling Insulation
- Wall/Partition Insulation
- Floor Insulation
- Flow Restrictors
- Weatherstripping and Caulking

HVAC: (Increment A)

Radiator Controls
Reduced Minimum Outdoor Air
Economizer Cycles

EMCS: (Increment B)

Equipment Scheduling
Night Setback

TABLE 1.3.1
ENERGY CONSERVATION MEASURES INVESTIGATED

<u>DESCRIPTION</u>	<u>ECMS INVESTIGATED</u>	<u>ECIP PROJECTS DEVELOPED</u>	<u>OTHER ENERGY CONSERVATION PROJECTS</u>	<u>MEASURES NOT JUSTIFIED</u>
WEATHERIZATION				
INSULATION	X	X		
WEATHERSTRIPPING AND CAULKING	X		X	
STORM WINDOWS OR DOUBLE GLAZING	X		X	
INSULATED PANELS	X			X
VESTIBULES	X			X
REDUCTION OF GLASS AREA	X			X
SOLAR FILM	X			X
LOAD DOCK SEALS	X			X
HVAC				
RADIATOR CONTROLS	X	X		
LOW LEAKAGE DAMPERS	X			X
REDUCED MINIMUM OUTDOOR AIR	X	X		
REDUCTION OF VENTILATION AIR	X			X
ECONOMIZER CYCLES	X	X		
EXHAUST AIR	X			X
DUTY CYCLING (EMCS)	X			X
EQUIPMENT SCHEDULING (EMCS)	X	X		
NIGHT SETBACK (EMCS)	X	X		
VARIABLE AIR VOLUME	X			X
INFRARED HEATERS	X			X
STEAM CONDENSATE RETURN	X			X
INSULATE STEAM PIPING	X			X
FM RADIO CONTROLS	X			X
CONTROL HOT WATER CIRCULATION PUMP	X			X

TABLE 1.3.1 Continued
 ENERGY CONSERVATION MEASURES INVESTIGATED

DESCRIPTION	ECMS INVESTIGATED	ECIP PROJECTS DEVELOPED	OTHER ENERGY CONSERVATION PROJECTS	MEASURES NOT JUSTIFIED
-----HVAC (CONT'D)-----				
HEAT RECLAIM FROM HOT REFRIGERANT GAS	X			X
REDUCE AIR FLOW	X			X
PREVENT AIR STRATIFICATION	X			X
BOILER OXYGEN TRIM CONTROL	X			X
BLOWDOWN HEAT RECOVERY	X			X
REVISE BOILER CONTROLS	X			X
CHILLER CONTROLS	X			X
CHILLER REPLACEMENT	X			X
REPLACE ABSORPTION CHILLER	X			X
-----ELECTRICAL-----				
ENERGY CONSERVING FLUORESCENT LAMPS	X		X	
RECEPTACLE INSULATION	X			X
REPLACE INCANDESCENT LIGHTING	X			X
ENERGY CONSERVING FLUORESCENT BALLAST	X			X
USE OF MORE EFFICIENT LIGHTING	X			X
REDUCE LIGHTING LEVELS	X			X
LOW PRESSURE SODIUM STREET LIGHTING	X			X
REDUCE STREET LIGHTS	X			X
HIGH EFFICIENCY MOTOR REPLACEMENT	X			X
IMPROVE POWER FACTOR	X			X
-----PLUMBING-----				
FLOW RESTRICTORS	X		X	
SHUTDOWN ENERGY TO WATER HEATERS	X			X
DECENTRALIZE DOMESTIC HOT WATER HEATERS	X			X

SECTION 1.4
ENERGY AND COST SAVINGS

1.4 ENERGY AND COST SAVINGS

This section describes, in summary form the projected energy savings of the building group in FY 85 as a percentage of the base year FY 75 energy consumption. Each of the projects has been developed in detail, and is presented in detail in the Narrative Report. All "A" and "B" projects have been developed, complete with PDB's and 1391's.

The Narrative Report and Appendix also document the change in ECIP analysis results that occur when the actual energy cost escalation varies from the stipulated escalation noted in Table 1.4.5. It was found that B/C ratios and payback periods are affected by the escalation rate, but that even under worst-case situations, the projects still meet the ECIP criteria.

In summary, development of all projects recommended by this study will result in a 29.49% reduction in energy usage by the buildings in the study, and 1.4% basewide reduction in FY 85 expressed as a percentage of FY 75 assuming 100% occupancy of all buildings.

1.4.1 BUILDING GROUP CONSUMPTION AFTER ENERGY CONSERVATION PROJECTS

THE PROJECTED BUILDING GROUP ENERGY CONSUMPTION AFTER PROJECTS ARE IMPLEMENTED WILL BE 44,559 MBTU PER YEAR (SEE SECTION 4.4 BELOW).

	ELECT	OIL	TOTAL
1.4.2 EXISTING ENERGY CONSUMPTION (MBTU/YR) (FY75) (SEE TABLE 2.4)	31994	31199	63193

1.4.3 ALLOCATION OF ENERGY CONSERVATION PROJECT SAVINGS

PROJECTS DEVELOPED	INCREMENT	ELECT	OIL	TOTAL
HVAC/PLUMBING/WEATHERSTRIPPING CAULKING	A	3117	4997	8114
INSULATION ALL BUILDINGS	A	1160	4926	6086
EMCS PROJECTS	B	2397	2037	4434
TOTAL SAVINGS (MBTU)		6674	11960	18634

1.4.4 PROJECTED ENERGY CONSUMPTION (MBTU) (FY85)	25320	19239	44559
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1.4.5 PROJECTED ENERGY COST (BUILDINGS IN STUDY)

ELECTRICITY 25320 MBTU @ 11600 BTU/KW EQUALS 2182759 KWH
COST PER KWH (SEE BELOW) EQUALS .091/KWH

PROJECTED ELECTRICAL COST FY85 (\$) 198631

OIL 19239 MBTU @ 152000 BTU/GAL EQUALS 126572 GAL
COST PER GAL (SEE BELOW) EQUALS 1.52/GAL

PROJECTED OIL COST FY85 (\$) 192390

THE ESCALATION RATE FOR THE DIFFERENT ENERGY SOURCES, OIL AND ELECTRICITY COSTS AS DERIVED FROM TABLE 2.1 ARE AS FOLLOWS:

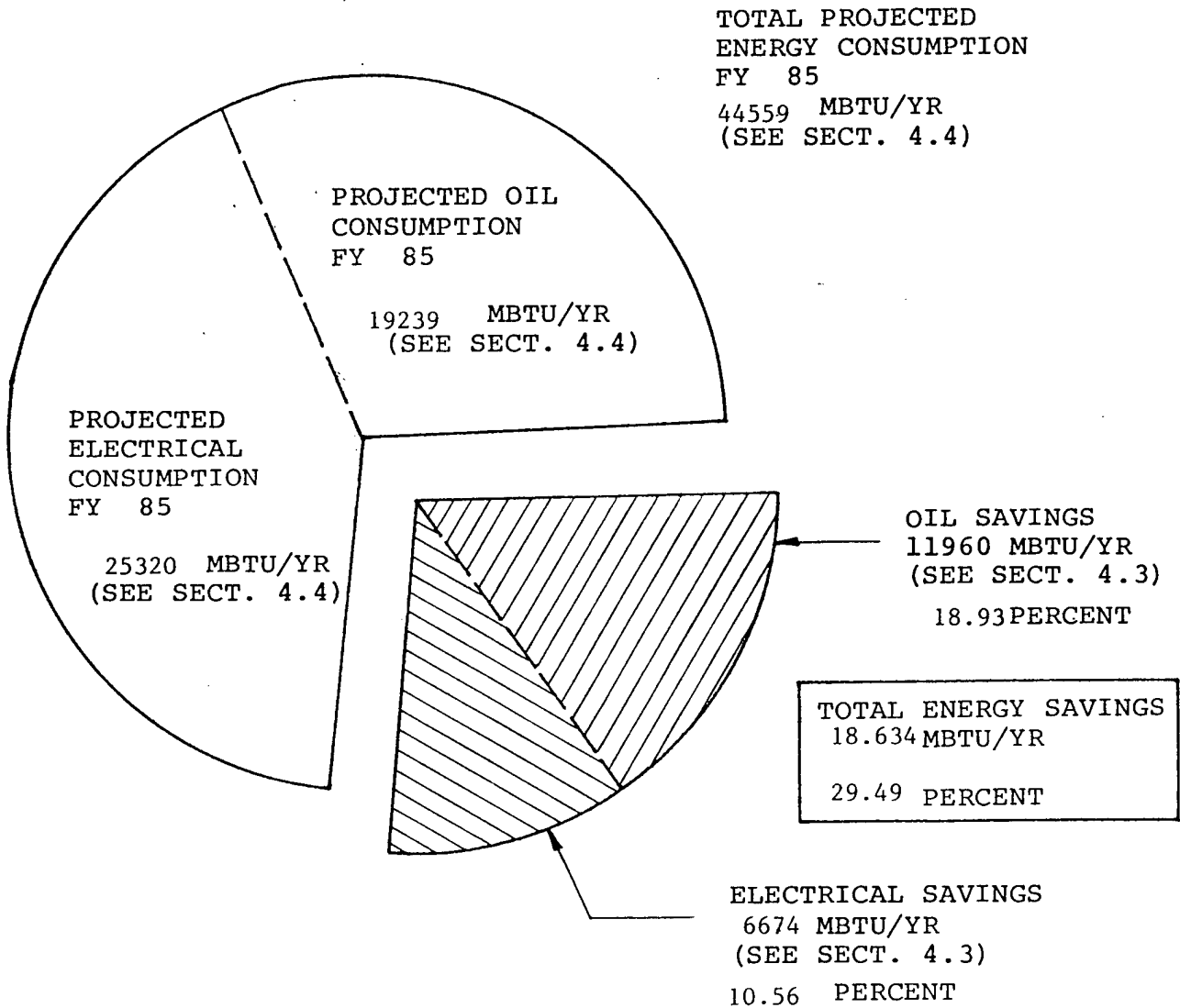
ELECTRICITY 15%/YEAR @ \$0.052/KWH (FY81) EQUALS \$ 0.091 (FY85)
OIL 15%/YEAR @ \$0.869/GAL (FY81) EQUALS \$ 1.520 (FY85)

1.4.6 BUILDING GROUP ENERGY SAVINGS

THE PIE CHART BELOW SHOWS GRAPHICALLY THE PROJECTED FY85 ENERGY SAVINGS AS A PORTION OF THE FY75 BASE YEAR (SEE PARAGRAPH 1.1)

ENERGY CONSUMPTION 63.193 MBTU/YR (FY75 BASE YEAR)
(SEE TABLE 2.4)

ENERGY SAVINGS AMOUNTS TO 18634 MBTU PER YEAR WHICH IS EQUIVALENT TO A 29.49 PERCENT SAVINGS.



CHART

ENERGY SAVINGS FOR BUILDINGS
IN THIS STUDY

1-15

1.4.7 BASEWIDE ENERGY SAVINGS

THE PIE CHART SHOWN BELOW GIVES A GRAPHIC DESCRIPTION OF THE IMPACT OF THESE ENERGY SAVING PROPOSALS ON THE BASEWIDE ENERGY PLAN.

ENERGY CONSUMPTION 1,353,374 MBTU/YR
(BASEWIDE FY '75) (SEE TABLE 2.5)

BASEWIDE ENERGY SAVINGS

BASEWIDE ENERGY STUDY (4/17/81)

SAVINGS
MBTU/YR SAVINGS
PERCENT

218,534 16.15

HOUSING STUDY (11/30/81)

7101 .52

VARIABLE AIR VOLUME CONVERSION (9/10/82)

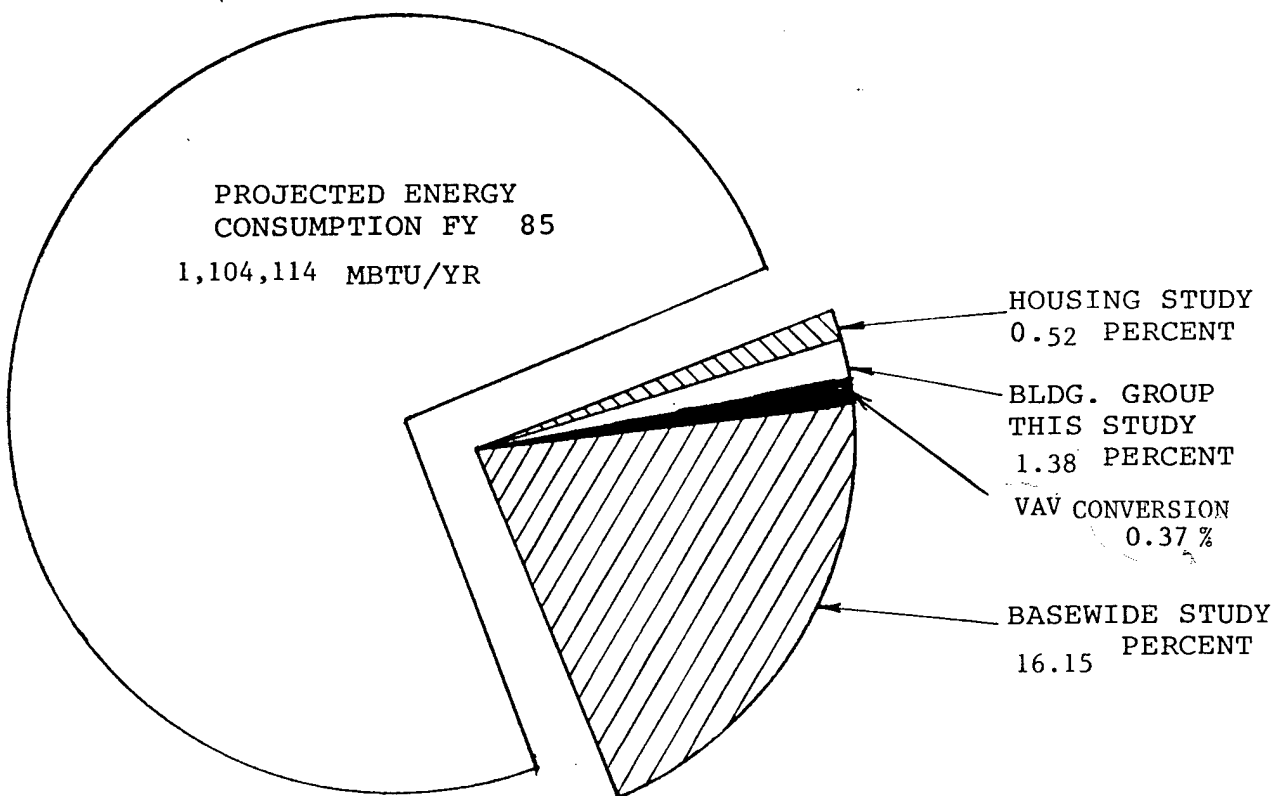
4991 .37

BUILDING GROUP IN THIS STUDY (SEE SECT.4.3)

18,634 1.38

TOTAL SAVINGS

249,260 18.42



CHART

BASEWIDE ENERGY SAVINGS

SECTION 1.5
ENERGY PLAN

1.5 ENERGY PLAN

1.5.1 Actions and Savings

Thirteen energy conservation projects have been investigated within the eleven building group. They are listed and prioritized in Table 1.5.4.1.

Three ECIP projects have been developed from the original group. These projects include modifications to heating and air conditioning systems and plumbing combined with weatherstripping and caulking, insulation of the eleven buildings and energy monitoring control systems for heating and air conditioning.

All of these ECIP projects are listed and prioritized in Table 1.5.4.2 using SIR (Savings Investment Ratio) criteria. Other data for evaluation is noted such as E/C, B/C, Contract Cost, etc. The total annual energy savings is 18634 MBTU amounting to a 29.49 percent savings.

Based on these findings and taking into account the parameters established in this study, we recommend that the projects identified in Increments "A" and "B" be funded and implemented.

1.5.2 Percent of Energy Reduction By FY85

The total energy savings of 18634 MBTU/year that would be realized by this project represents 29.49 percent of the total energy used by these buildings during FY75 (Assuming 100 percent occupancy). (See Table 1.4.1)

A breakdown of savings by energy source is as follows:

Electricity:

Electrical energy savings after implementing the projects for buildings in this study will be 6674 MBTU per year (See Table 1.4.3).

644568 KWH per year reduction in electricity (6674 MBTU per year at 11600 BTU per KW)

Fuel Oil:

Fuel oil energy savings after implementing projects for buildings in this study will be 11960 MBTU per year (See Table 1.4.3).

78684 gallons per year reduction in fuel oil (11960 MBTU per year at 152000 BTU per gallon).

1.5.4.1 ENERGY CONSERVATION PROJECTS INVESTIGATED

DESCRIPTION	E/C RATIO	B/C RATIO	CONTRACT COST (\$)	TOTAL ANNUAL ENERGY SAVINGS (MBTU)	TOTAL ANNUAL DOLLAR SAVINGS (\$)	PAYBACK PERIOD (YEARS)
(1) PLUMBING FLOW RESTRICTORS	1882.35	359.90	663	1248	16723	0.04
(2) EMCS EQUIPMENT SCHEDULING, NIGHT SETBACK	38.56	5.90	114980	4434	48989	2.35
(3) HVAC/PLUMBING/WEATHERIZATION RADIATOR CONTROL, REDUCED MIN. OUTDOOR AIR, ECONOMIZER CYCLES FLOW RESTRICTORS WEATHERSTRIPPING/CAULKING	36.48	5.99	222416	8114	95169	2.34
(4) WEATHERIZATION ALL 11 BUILDINGS WEATHERSTRIPPING AND CAULKING	26.16	4.77	45372	1187	15253	2.97
(5) ELECTRICAL ENERGY CONSERVING FLUOR. LAMPS	20.58	2.49	38974	802	7258	5.37
(6) WEATHERIZATION ALL 11 BUILDINGS TOTAL INSULATION	15.77	2.80	385972	6086	76506	5.04
(7) WEATHERIZATION BUILDING 101/104 TOTAL INSULATION	15.30	2.72	243439	3724	46770	5.21
(8) ALL REMAINING 9 BLDGS. TOTAL WEATHERIZATION	10.08	1.81	331977	3346	42361	7.84
(9) ALL 11 BUILDINGS TOTAL WEATHERIZATION	9.94	1.78	903998	8987	113783	7.94
(10) ELECTRICAL ENERGY CONSERVING FLUOR. LAMPS AND BALLAST	8.13	.54	138048	1122	10154	13.60
(11) WEATHERIZATION BUILDING 101/104 STORM DOORS AND WINDOWS/ WEATHERSTRIPPING/CAULKING	5.88	1.07	324732	1910	24585	13.21
(12) ALL 11 BUILDINGS STORM DOORS AND WINDOWS	3.61	.66	463970	1674	21566	21.51
(13) ELECTRICAL ENERGY CONSERVING FLUOR. BALLAST	2.87	.35	112204	322	2914	38.50

1.5.4.2 ENERGY CONSERVATION PROJECTS DEVELOPED

THE FOLLOWING ENERGY CONSERVATION PROJECTS HAVE BEEN DEVELOPED AND ARE LISTED IN ORDER ACCORDING TO THE HIGHEST SIR AS REQUIRED BY EEAP SCOPE OF WORK.

DESCRIPTION	SIR RATIO	CONTRACT COST (\$)	E/C RATIO	B/C RATIO	TOTAL ANNUAL ENERGY SAVINGS (MBTU)	TOTAL ANNUAL DOLLAR SAVINGS (\$)	PAYBACK PERIOD (YEARS)
1. INCREMENT A PROJECT:							
HVAC/PLUMBING/ WEATHERIZATION	5.44	222416	36.48	5.99	8114	95169	2.34
RADIATOR CONTROLS, REDUCED MINIMUM OUTDOOR AIR, ECONOMIZER CYCLE, FLOW RESTRICTORS, WEATHERSTRIPPING, CAULKING							
2. INCREMENT B PROJECT:							
EMCS EQUIP. SCHEDULING, NIGHT SETBACK	5.25	114980	38.56	5.90	4434	48989	2.35
3. INCREMENT A PROJECT:							
WEATHERIZATION ALL 11 BUILDINGS TOTAL INSULATION	2.61	385972	15.77	2.80	6086	76506	5.04
TOTAL					18634	220664	

1.5.3 Energy Usage per Sq.Ft. by FY85

The projected energy consumption after implementing the projects for the buildings in this study will be 44559 MBTU per year (See Section 1.4.4).

The total area of the buildings in this study is 278005 square feet (See Table 1.2.4).

The energy usage by FY85 for the buildings in this study will be 160281 BTU per square foot. (44559 MBTU/278005 sq.ft.)

1.5.4 Energy Conservation Projects Investigated and Developed

Initially, thirteen different projects (See Table 1.5.4.1) were considered for the study, most of which were different combinations of the same items. Projects 2 and 6 were selected for ECIP projects because they met the criteria and had adequate contract amounts to be considered under the program. Projects 8 through 13, obviously do not meet the E/C criteria, Project 1, 3 and 4 were combined to be Project 1, Project 5 did not meet funding requirements, and Project 7 was a part of Project 6. Therefore the list of thirteen was reduced to a list of three projects which are described in Section 1.5.4.2.

The projects investigated (Table 1.5.4.1) are prioritized in order of decreasing E/C ratio. The projects developed (Table 1.5.4.2) are prioritized in order of decreasing SIR ratios.

Energy/Cost (E/C) ratio is the total annual energy savings in MBTU divided by construction cost (CWE) divided by 1000. Benefit/Cost (B/C) ratio is total dollar benefits divided by total non-recurring initial capital costs. Payback period is the total construction cost less any salvage divided by annual dollar savings. (See Table 1.5.4.1).

The savings investment ratio (SIR) is determined in the life cycle cost analysis summary by dividing the net discounted savings by the total investment (See Table 1.5.4.2).

1.5.5 Schedule of Energy Conservation Projects

An analysis of the ratios and various data tabulated for the five energy conservation projects listed in Table 1.5.4.2 suggests a certain priority for the three projects developed. The priority for the projects is to achieve the highest percent saving in energy with the lowest construction cost.

Our recommendation is that all projects be funded as proposed; however, should it be necessary to reduce this scope, the following priority schedule is recommended:

<u>Project Priority</u>	<u>Percent Savings</u>
1. HVAC Projects	12.84
2. EMCS Projects	7.02
3. Weatherization-Total Insulation for all 11 Buildings	9.63
	<hr/>
	29.49

1.5.7 Project Savings, Costs and Economic Data Summary

In addition to the analyses described in this summary, additional data is included in Section 10 of the Narrative Report to enable the installation commander and the facilities engineer to better evaluate the various energy saving projects that have been developed. These data allow a detailed look at the effect of each building on a particular project as well as the effect of eliminating a building from an ECIP project.

The tables accompanying the data were prepared to give a life cycle cost analysis for each discrete retrofit action as well as a building breakdown for further evaluation.