

**ENERGY REPORT**

**ENERGY ENGINEERING  
ANALYSIS PROGRAM**

**LIMITED ENERGY STUDY**

**FORT HUNTER-LIGGETT, CALIFORNIA  
1993**

**VOLUME I**

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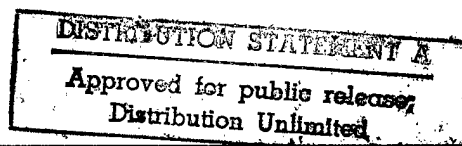
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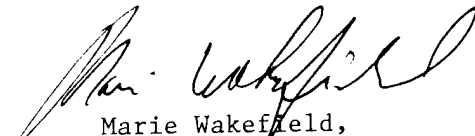


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## 1.0 Executive Summary

### 1.1 Introduction

This report summarizes all work of the Limited Energy Study, Energy Engineering Analysis Program (EEAP), Fort Hunter Liggett, California, authorized under Contract Number DACA 05-92-C-0155 with the U.S. Army Corps of Engineers, Sacramento District, California.

The purpose of this study is to develop projects and actions that will reduce facilities energy consumption and operating costs at Fort Hunter Liggett. Implementation of these projects will contribute to achieving the goal of the Army Facilities Energy Plan of a reduction in energy consumption per square foot of building floor area of 20 percent by FY2000 from FY1985 baseline levels.

### 1.2 Installation Profile

There are 205 numbered structures at Fort Hunter Liggett, containing a total of 791,034 square feet of gross floor space. This Limited Energy Study evaluates 52 surveyed buildings with results extended to an additional 44 identical or similar buildings. Together, these buildings contain a total of 632,386 gross square feet and account for approximately 93 percent of overall energy usage.

### 1.3 Present Energy Consumption

Total energy consumption at Fort Hunter Liggett in FY1992 of non-transportation energy sources was 79,728 million Btu. This figure includes electricity at 3,413 Btu per kWh, No. 2 fuel oil at 138,700 Btu per gallon and propane at 95,000 Btu per gallon.

A breakdown in FY1992 energy consumption and cost for all three sources is as follows:

Energy Source	Quantity	Million Btu's	Cost
Electricity	11,605,000 kWh	39,608	\$1,034,746
No. 2 Fuel Oil	136,058 gallons	18,871	\$97,845
Propane	223,700 gallons	21,249	\$174,724

### 1.4 Energy Conservation Analysis

A summary of all potential energy conservation opportunities (ECOs) investigated is presented in Table 1-1. This table includes a matrix of reasons for eliminating ECOs from further consideration. A summary of analysis results of recommended ECOs is





presented in Table 1-2, and a summary of analysis results of ECOs rejected is presented in Table 1-3.

#### 1.4.1 ECIP Projects Developed

An ECIP project covering cantonment facility energy improvements was developed that includes the following retrofit measures:

- a. Install batt insulation in the ceilings of 9 buildings.
- b. Install programmable controllers in 9 buildings.
- c. Insulate hot water heating and cooling water piping in 12 buildings.
- d. Install 24-hour programmable thermostats in 28 buildings.
- e. Replace spare cooling equipment in 10 buildings with more efficient systems.
- f. Install automatic-draft damper controls on space heating equipment in 20 buildings.
- g. Convert dual-duct air handling system to variable air volume in 5 barracks buildings.
- h. Replace boilers with high-efficiency units in 7 buildings.
- i. Insulate domestic hot water piping in 6 buildings.
- j. Insulate 16 domestic hot water storage tanks in 13 buildings.
- k. Install self-metering lavatory faucets in 3 buildings and install lavatory and shower flow restrictors in 2 buildings.
- l. Install dishwasher heat recovery unit in Building 206.
- m. Install automatic-draft dampers on domestic hot water heaters in 3 buildings.
- n. Replace incandescent lighting fixtures with fluorescent fixtures in 9 buildings.
- o. Install automatic power factor correction equipment at utility metering point. Install power factor correction capacitors on 10 HP and larger motors in 6 buildings.

The following ECIP project data is from the life cycle cost analysis summary sheet:

Construction Cost (Including SIOH)	\$833,000	
Annual Energy Savings		
Electricity	2,188 million Btu	} 9,707 x 10 <sup>6</sup> Btu
No. 2 Fuel Oil	3,277 million Btu	
Propane	4,242 million Btu	
Annual Dollar Savings (Annualized)	\$142,191	
Savings-to-Investment Ratio (SIR)	2.25	
Simple Payback Period	5.9 years	
Analysis Date	June 1993	

1.4.2 Non-ECIP Projects Developed

It is recommended that Fort Hunter Liggett Directorate of Engineering and Housing program personnel to adjust the temperature setpoints on domestic hot water heating systems annually. A summary of the life cycle cost analysis supporting this recommendation follows:

Construction Cost (First Year Operations)	\$5,585
Annual Energy Savings	
Electricity	199 million Btu
No. 2 Fuel Oil	578 million Btu
Propane	430 million Btu
Annual Dollar Savings	\$4,891
Savings-to-Investment Ratio (SIR)	13.33
Simple Payback Period	1.1 years
Analysis Date	June 1993

1.5 Energy and Cost Savings

If all recommended ECOs are implemented, total energy savings of 11,500 million Btu and total annual cost savings of \$167,000 will result.

As shown in the pie chart in Figure 1-1, the potential savings represents 17.2 percent of the existing base-wide energy consumption.



## PROJECTED ENERGY CONSUMPTION BY END USE

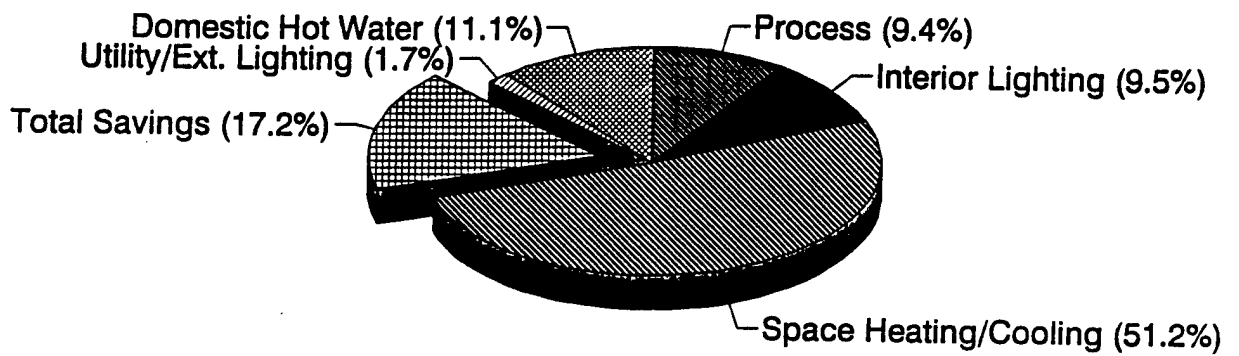


FIGURE 1-1

**TABLE 1-1**  
**Summary of ECO Evaluations**  
**Fort Hunter Liggett, California**

No.	Description of ECO	Recommended Project	SIR Less Than 1.0	DEH Maintenance	PG&E Project	N/A
<b>Architectural</b>						
A1	Caulk and Weatherstrip		✓			
A2	Install Double Glazing					✓
A3	Insulate Exterior Walls		✓			
A4	Insulate Ceilings and/or Roofs	✓				
A5	Install Solar Film		✓			
A6	Reduce Glass Area					✓
A7	Install Shading Devices		✓			
<b>HVAC</b>						
B1	Install Duty Cycling Controls	✓				
B2	Shade Condensers from Direct Sunlight		✓			
B3	Insulate Ductwork		✓			
B4	Replace Heating System Pipe Insulation	✓				
B5	Install Outside Air Temperature Reset		✓			
B6	Install Time Clocks and Programmable Thermostats	✓				
B7						
B8	Replace Inefficient Chillers	✓				
B9	Install Heat Recovery System		✓			
B10	Install Automatic Flue Dampers on Heating System Boilers	✓				
B11	Install Economizer Cycle		✓			
B12	Install Boiler Oxygen Trim Controls and Revise Controls		✓			
B13	Install Evaporative Precoolers		✓		✓	
B14	Install Multizone Controls		✓		✓	
B15	Convert Multizone HVAC System to Variable Air Volume	✓			✓	
B16	Automate Summer/Winter Switchover	Evaluated as part of ECO B6/B7			✓	
B17	Relocate Transformer	✓		Done May 93	✓	
B18	Add Zone Optimizer to Reheat Systems		✓		✓	
B19	Add Deadband Controls	Evaluated as part of ECO B6/B7			✓	
B20	Consolidate Food Storage				✓	✓



**TABLE 1-1**  
**Summary of ECO Evaluations**  
**Fort Hunter Liggett, California**

No.	Description of ECO	Recommended Project	SIR Less Than 1.0	DEH Maintenance	PG&E Project	N/A
B21	Replace Inefficient Boilers with Higher-Efficiency Boilers	✓				
<b>Domestic Hot Water (DHW)</b>						
C1	Reduce Hot Water Temperatures	✓				
C2	Replace Pipe Insulation DWH Systems	✓				
C3	Insulate Hot Water Storage Tanks	✓				
C4	Install Electrical Ignitors in Gas Hot Water Heaters					✓
C5	Install Aerators/Flow Restrictors in Lavatories and Showers	✓				
C6	Use Cold Water for Laundering					✓
C7	Replace Electric Booster for Garbage Can Washer	✓		Disconnected by DEH	✓	
C8	Recover Heat from Dining Facility Dishwashing	✓				
C9	Install Automatic Draft Damper Controls on DHW Heaters	✓				
<b>Lighting and Electrical</b>						
D1	Reduce Lighting Levels					✓
D2	Install Time Clocks on Exterior Lighting				✓	✓
D3	Retrofit Exterior Lighting with HPS Fixtures		✓		✓	
D4	Replace Incandescent Lighting with Fluorescent	✓			✓	
D5	Install Electronic Ballasts and T8 Lamps		✓			
D6	Revise Transformer Loading					✓
D7	Improve Voltage Regulation					✓
D8	Improve Power Factor	✓				
D9	Replace Motors with High Efficiency Units		✓	✓		
D10	Install FM Radio EMCS		✓			

Table 1-2  
Summary of Analysis Results for Recommended ECO's

ECO No.	Description of ECO	Energy Savings:				Total Equiv. MBTU/Yr	Cost Savings		Investment \$	SIR
		Fuel Oil MBTU/Yr	Propane MBTU/Yr	Electric MBTU/Yr	MBTU/Yr		\$/Yr	LCC \$		
C7	Replace Electric Booster for Garbage Can Washer (Implemented by DEH)	(144.0)		102.0	(42)	\$7,865	\$90,526	\$536	168.79	
C1	Reduce Hot Water Temperatures (DEH O&M project)	430.0	578.0	199.2	1,207	\$4,891	\$74,457	\$5,585	13.33	
B6/B7	Install Time Clocks & Night Set Back/Setup	2,460	3,399	1,252	7,111	\$53,286	\$715,760	\$66,368	10.79	
B1	Install Load Shedding System (Local Controllers)			130.8 kW	130.8 kW	\$14,122	\$165,227	\$26,187	6.03	
C5	Install Aerators/Flow Restrictors in Lavatories and Showers		2.0	13.0	15	\$250	\$2,964	\$501	5.91	
C2	Replace Insulation on DHW Pipes and Fittings	48.0	15.0		63	\$357	\$4,968	\$856	5.81	
C9	Install Automatic Draft Damper Controls	51.0	31.0		82	\$498	\$6,954	\$1,909	3.64	
C8	Recover Heat From Dishwasher Hot Water	339.0			339	\$1,528	\$21,483	\$6,510	3.30	
B17	Relocate Transformer (Implemented by DEH)			21.5	22	\$588	\$8,540	\$2,676	3.19	
B10	Automatic Draft Damper Control on Space Heating Equipment	282.2	174.3		457	\$2,777	\$38,790	\$14,561	2.66	
A4	Insulate Ceilings/Roofs	88.0	289.0	69.0	446	\$4,220	\$71,904	\$28,430	2.53	
B4	Replace Insulation on Heating Piping and Fittings (See Note 1)	60.6	39.1	0.1	100	\$540	\$7,750	\$3,115	2.49	

Table 1-2 (Cont.)  
Summary of Analysis Results for Recommended ECO's

ECO No.	Description of ECO	Energy Savings:				Total Equiv. MBTU/Yr	Cost Savings		Investment \$	SIR
		Fuel Oil MBTU/Yr	Propane MBTU/Yr	Electric MBTU/Yr	\$ / Yr		LCC \$			
D4	Replace Incandescent Lighting With Fluorescent			160.5	161	\$7,649	\$88,515	\$37,658	2.35	
C3	Insulate Hot Water Storage Tanks	28.0	35.0	5.0	68	\$510	\$6,925	\$3,334	2.08	
D8	Improve Power Factor			46.6	47	\$7,745	\$106,444	\$61,973	1.72	
B15	Retrofit to Variable Air Volume			178.0	178	\$3,246	\$37,973	\$25,848	1.47	
B8	Replace Inefficient Chillers (See Note 2)			353.7	354	\$49,554	\$597,123	\$426,488	1.40	
B21	Replace Boiler		915.7		916	\$7,206	\$102,039	\$77,778	1.31	
B18	Add Zone Optimizer to Reheat Systems			15.1	15	\$329	\$3,849	\$3,556	1.08	
<b>Totals for Recommended ECO's</b>		<b>3,643</b>	<b>5,478</b>	<b>2,416</b>	<b>11,537</b>	<b>\$167,161</b>	<b>\$2,152,191</b>	<b>\$793,869</b>	<b>2.71</b>	

Notes:

1. ECO B4 is evaluated also for use of removable insulation; standard insulation is recommended and is displayed above.
2. Annual cost savings includes annualized nonrecurring cost savings.

Table 1-3  
Summary of Analysis Results for ECO's Not Recommended

ECO No.	Description of ECO	Energy Savings:				Total Equiv. MBTU/Yr	Cost Savings		Investment \$	SIR
		Fuel Oil MBTU/Yr	Propane MBTU/Yr	Electric MBTU/Yr	\$ / Yr		LCC \$			
B14	Install Multizone Controls	88.0	32.0	396.0	516	\$7,907	\$94,047	\$128,183	0.73	
B11	Install Economizer Cycle for 'Free' Cooling			323.4	323	\$6,407	\$74,959	\$107,227	0.70	
D3	Retrofit Exterior Lighting With HPS Fixtures (unit screening analysis)			3.9	4	\$107	\$1,229	\$1,858	0.66	
D10	Install FM Radio EMCS	2,460.0	3,399	1,841	7,700	\$86,136	\$1,102,103	\$2,329,435	0.47	
A1	Caulk and Weatherstrip Doors and Windows	1,435.0	670.0	94.2	2,199	\$14,476	\$68,581	\$154,110	0.45	
B3	Insulate Ductwork		5.4		5	\$42	\$593	\$1,337	0.44	
D5	Install Electronic Ballasts and T8 Lamps (unit screening analysis)			0.1	0	\$4	\$40	\$94	0.43	
B5	Install Outside Air Temperature Reset Controls	7.0			7	\$28	\$403	\$1,231	0.33	
A5	Install Solar Film on Windows			355.0	355	\$7,753	\$34,812	\$117,382	0.30	
B9	Install Heat Recovery System	58.0			58	\$289	\$3,980	\$16,247	0.24	
B2	Shade Refrigerant Condensers From Direct Sunlight			279.0	279	\$2,386	\$29,480	\$187,624	0.16	
A3	Insulate Exterior Walls	47.0	1.0	14.0	62	\$547	\$8,709	\$116,161	0.07	



Table 1-3 (Cont.)  
Summary of Analysis Results for ECO's Not Recommended

ECO No.	Description of ECO	Energy Savings:				Total Equiv. MBTU/Yr	Cost Savings		Investment \$	SIR
		Fuel Oil MBTU/Yr	Propane MBTU/Yr	Electric MBTU/Yr	\$ / Yr		LCC \$			
A7	Install Shading Devices for Windows			17.0	17	\$85	\$394	\$20,411	0.02	
A2	Install Double Glazing	ECO was deemed not justified through screening analysis. (Refer to text and Appendix D for complete explanation)								
A6	Reduce Glass Area	ECO was deemed not justified through screening analysis. (Refer to text and Appendix D for complete explanation)								
C4	Install Electric Ignitors in Gas Hot Water Heaters	ECO was deemed not justified through screening analysis. (Refer to text and Appendix D for complete explanation)								
C6	Use Cold Water for Laundering	ECO was deemed not justified through screening analysis. (Refer to text and Appendix D for complete explanation)								
D1	Reduce Lighting Levels	ECO was deemed not justified through screening analysis. (Refer to text for complete explanation)								
D2	Install Time Clocks on Exterior Lighting	ECO was deemed not justified through screening analysis. (Refer to text for complete explanation)								
D6	Revise Transformer Loading	ECO was deemed not justified through screening analysis. (Refer to text for complete explanation)								
D7	Improve Voltage Regulation	ECO was deemed not justified through screening analysis. (Refer to text for complete explanation)								
D9	Replace Motors with High Efficiency Units	ECO was deemed not justified through screening analysis. (Refer to text and Appendix D for complete explanation)								

