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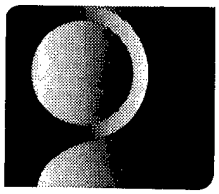
systems



ENERGY AUDIT OF
MARTIN ARMY COMMUNITY HOSPITAL
FORT BENNING, GA

VOLUME 1 OF 4: EXECUTIVE SUMMARY

Contract #DACA21-84-C-0578
September 27, 1985

Final Report submitted to:

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US Army Engineer District, Savannah
ATTN: EN-MP-5
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Marie Wakefield,
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EXECUTIVE SUMMARY

1. EXECUTIVE SUMMARY

1.1 Introduction

1.1.1 Scope of Work

The complete Scope of Work (SOW) is included in Appendix 1 but the essential elements are repeated here. Integrated Energy Systems/Koenigshofer Engineers (IES/KE) was contracted by the Savannah District of the US Army Corps of Engineers in June 1984 to perform a complete energy audit and analysis of Martin Army Community Hospital (MACH) and nine affiliated support facilities at Fort Benning, Georgia. All of the buildings are permanent structures with a remaining life of over 20 years. They are listed in Table 1-1.

Table 1-1. List of Facilities to be Audited

MACH Complex
- Martin Army Community Hospital - Building 9200
- AC Plant Building - Building 9201
- Boiler Plant - Building 9202
- Emergency Generators
- Electrical Substation and Distribution System
- Hospital Parking, Area Lighting and Street Lighting
- Incinerators

Support Facilities
- Troop Medical Clinic, Bldg 2822
- Troop Medical Clinic, Bldg 9052
- Dental Clinic No. 1, Bldg 9240
- Bernheim Dental Clinic, Bldg 2828
- Medical Annex, Bldg 322
- Medical Annex, Bldg 323
- Medical Annex, Bldg 324
- Medical Annex, Bldg 316
- Medical Annex, Bldg 392

1.1.2 Organization and Contents of this Report

The submittals for this contract include the following, each separately bound:

- Energy Audit of Martin Army Community Hospital, Ft. Benning GA
  Vol. 1 of 4 - Executive Summary
- Energy Audit of Martin Army Community Hospital, Ft. Benning, GA
  Vol. 2 of 4 - Martin Army Community Hospital and MEDDAC
  Support Facilities
- Vol. 3 of 4 - Appendices
  1. Reference Materials & Results
     SOW & Mtg. Minutes
     References
     PDB
     QRIP, OSD PIF PECIP Low and No Cost Projects
     EMCS Points List
     Field Test Reports
     Outline of O&M Workshop
  2. Detailed Calculations
     BLAST Input Sheets
     EMCS Analyses
     Calculations for Not Recommended ECOs, MACH
     Weather Analysis Printouts
     Carrier E20-II Printouts, MEDDAC
       Support Facilities
     Calculations for Not Recommended ECOs, MEDDAC
       Support Facilities
- Vol. 4 of 4 Field Notes
  (submitted with interim report only to Ft. Benning DEH
  and Savannah COE)
- Other Submittals
  5 sets of PDBs to DEH Ft. Benning

1.2 Present Energy Consumption

1.2.1 MACH

The estimated energy consumption at MACH is shown in Table 1-2. The total energy cost in 1984 is estimated at $1.9 million. This consumption is compared to other hospitals in Figure 1-1. As indicated, natural gas consumption at MACH is quite high. This is partially explained by the steam turbine chillers, though St. Dominics had absorption chillers. Electricity consumption at MACH is slightly higher than the other hospitals listed.

Table 1-2. Current Estimated Energy Use by Fuel, MACH

ENERGY	UNIT	MBTU/YR	KBTU SQFT-YR	TOTAL $	$/SQFT-YR
Electricity	12.7 mil kWh	148,000	448	573,200	1.74
Peak demand	1460 kW				
Natural gas	2.7 mil therm	273,340	828	1,356,000	4.11
Total		421,340	1276	$1.9 mil	5.85

Figure 1-2 shows the breakdown of energy use at MACH. Cooling accounts for about 60% of the total. All of these data are based on BLAST simulation since metered gas data are suspect and no electricity meter exists.

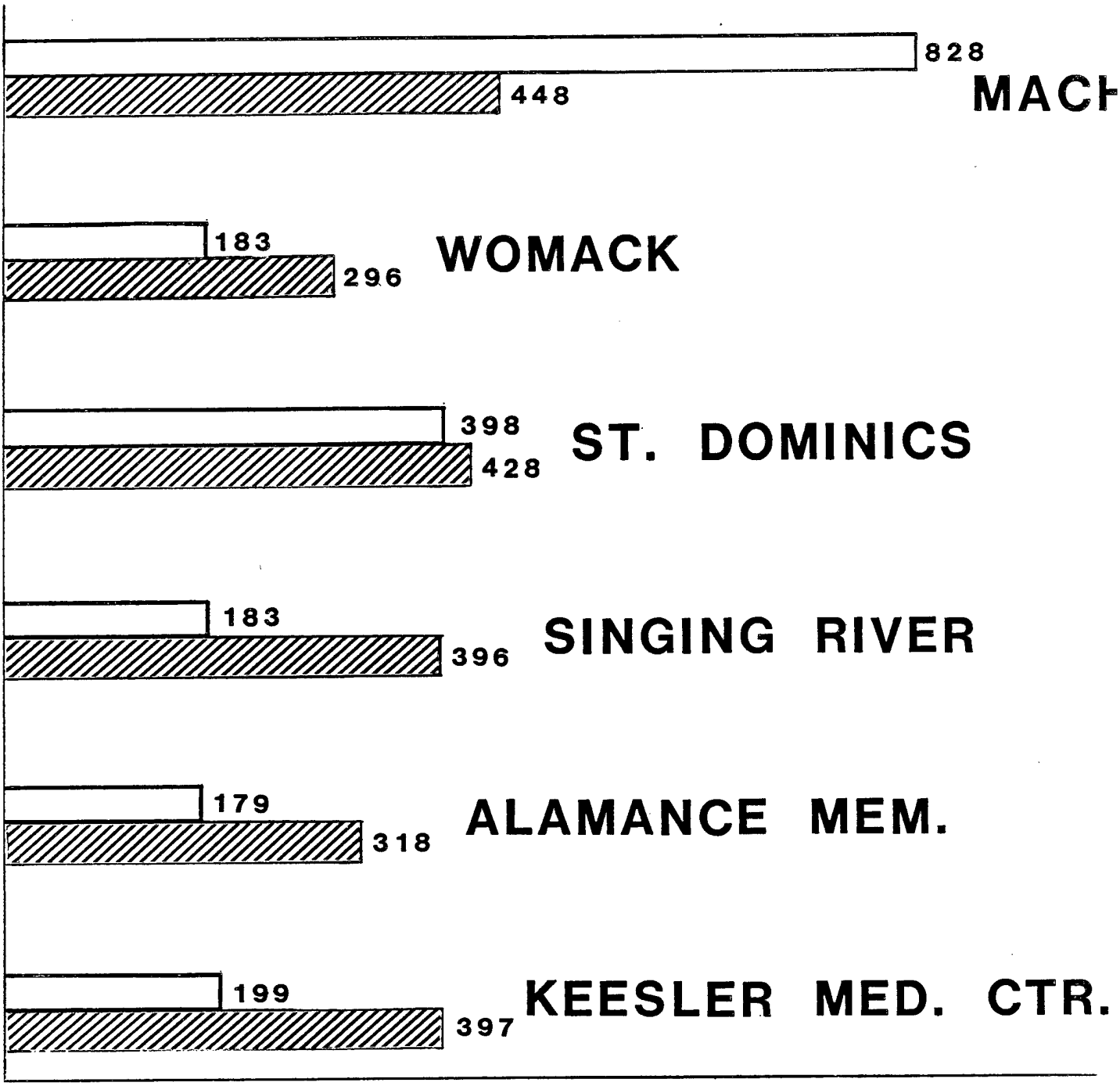

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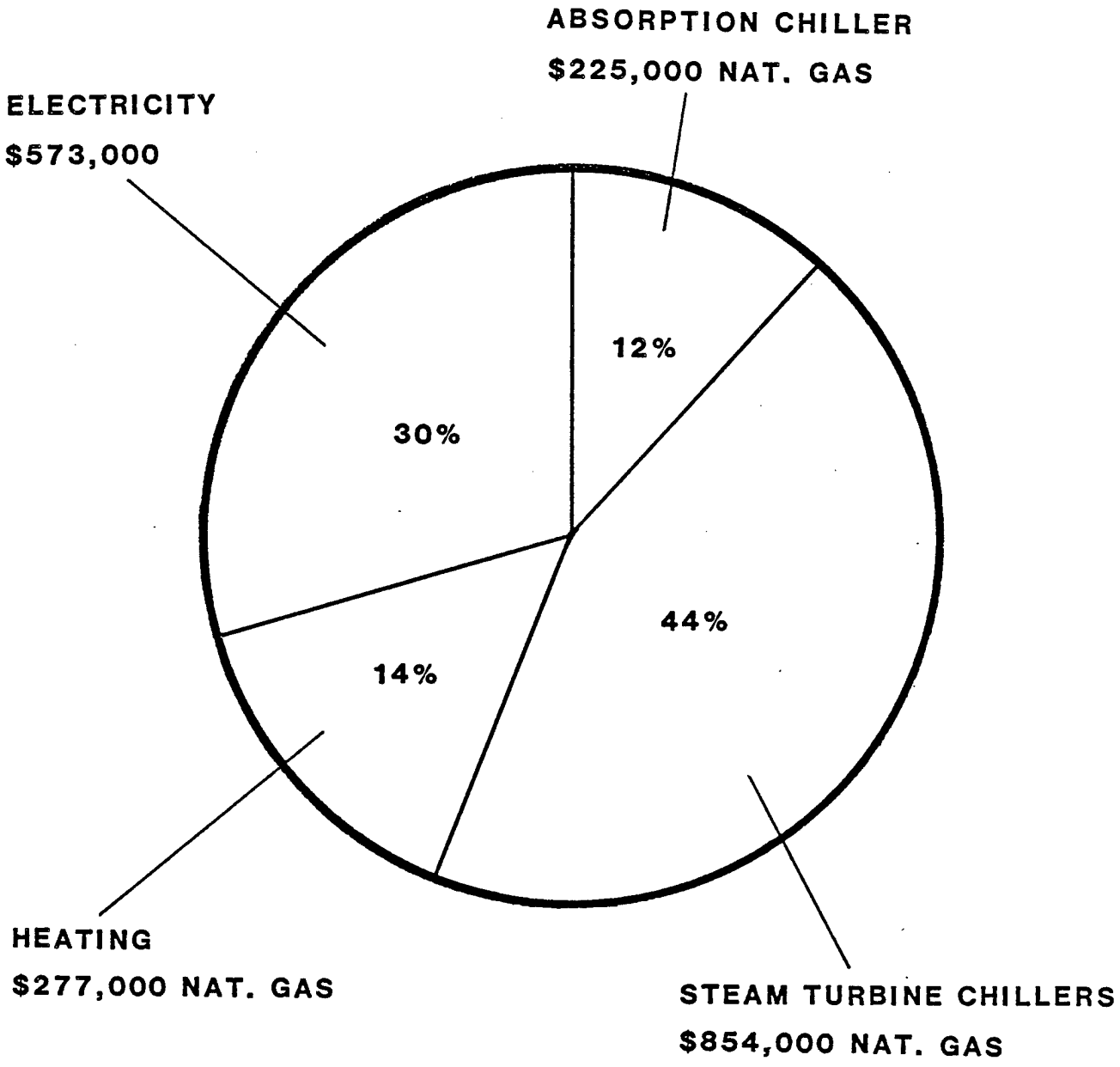
FIGURE 1-1: COMPARISON OF HOSPITAL ENERGY USE



TOTAL $1,929,000/YR.

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FIGURE 1—2: BREAKDOWN OF CURRENT ENERGY USE AND COSTS, MACH

1.2.2 MEDDAC Support Facilities

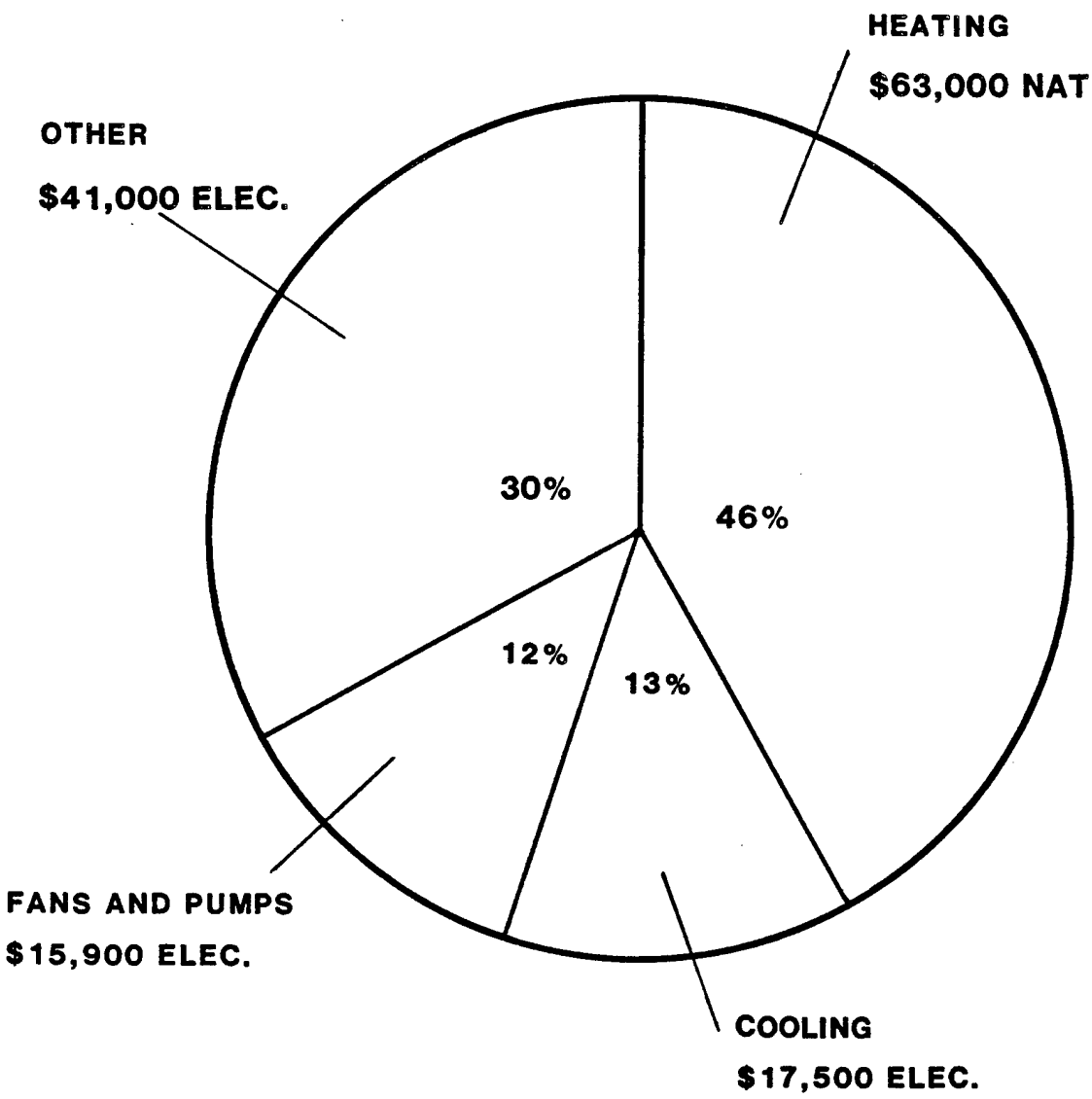
The estimated current cost of energy used in the Support Facilities is shown in Table 1-3. These estimates are from the Carrier models of each building as described in Chapters 12-20. As indicated, the estimated cost ranges from $0.72 to $2.41/sqft. The total estimated cost of energy for these nine buildings is $137,541.

A breakdown of energy costs is shown in Figure 1-3.

Table 1-3. Total Estimated Energy Use MEDDAC Support Facilities

BLDG NO.	SQFT	$	$/SQFT	MBTU	KBTU/SF
2822	3968	3457	0.87	740	186
9052	12004	12171	1.01	2811	234
9240	38438	55820	1.45	13451	350
2828	11270	27130	2.41	6285	558
322	9555	7946	0.83	1794	188
323	7656	14974	1.96	3338	436
324	6000	6724	1.12	1500	250
316	8240	6449	0.78	1382	168
392	4000	2870	0.72	598	150
TOTALS	101,131	137,541	1.36 ave	31,898	315 ave

In Table 1-4 the estimated consumption by fuel type is shown. The costs of electricity and gas are about equal. Table 1-5 shows the breakdown of energy use for heating, cooling, fans and pumps, and other in each Support Facility. Heating energy, including central plant losses, accounts for over 50% of the total use unlike MACH where cooling dominates. All the values in Tables 1-4 and 1-5 are based on estimated energy consumption using the Carrier E20-II program.



TOTAL $137,500/YR.

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FIGURE 1–3: BREAKDOWN OF CURRENT ENERGY COSTS, MEDDAC SUPPORT FAC.

Table 1-4. Estimated Energy Consumption by Type, MEDDAC Support Facilities

	ELECTRICITY			NATURAL GAS			TOTALS	
BLDG NO.	KWH	$	MBTU @ 11600	THERMS	$	MBTU	$	MBTU
2822	17105	770	198	5415	2686	541.5	3456	740
9052	141446	6366	1641	11702	5804	1170.2	12170	2811
9240	871518	39225	10110	33419	16576	3341.9	55801	13452
2828	322502	14515	3741	25435	12616	2543.5	27131	6285
322	75733	3409	879	9146	4536	914.6	7945	1793
323	126182	5679	1464	18738	9294	1873.8	14973	3338
324	57299	2579	665	8357	4145	835.7	6724	1500
316	32379	1457	376	10064	4992	1006.4	6449	1382
392	7800	351	90	5078	2519	507.8	2870	598
TOTALS	1,651,964	74,352	19,163	127,354	63,168	12,735.4	137,519	31,898

Table 1-5. Energy Use Breakdown in MBTU, MEDDAC Support Facilities

BLDG NO.	HEATING	COOLING	FANS & PUMP	OTHER	TOTAL
2822	73	46	32	589	740
9052	933	191	270	1417	2811
9240	3149	2207	3301	4793	13451
2828	2489	1086	279	2430	6284
322	873	153	35	734	1795
323	1810	545	81	903	3339
324	814	179	37	470	1500
316	999	50	40	294	1383
392	507	40	22	30	598
TOTALS	11,648	4,497	4,096	11,660	31,900

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1.3 Energy Conservation Analysis

1 3.1 ECOs Investigated

All of the ECOs shown in the checklist in Annex A (SOW) were investigated for each building in the SOW. The checklist for MACH is shown in pages 3-3 to 3-8. Similar checklists for each support building appear in the respective chapter for that building (Chapters 12-20). A "Yes" means that the ECO seemed feasible in the field and was considered further. All those marked "Yes" are described in this report, although after further analysis some resulted in not being recommended. A "No" on the checklist indicates that the ECO was unfeasible as explained. A comparison of the Annex A checklist and each of the building lists will show that many additional ECOs were investigated.

All of the ECOs at MACH were evaluated relative to the base case simulation on BLAST. The simple, non-interactive ECOs were analyzed manually while complicated ones, such as HVAC controls, were simulated by iterative BLAST runs. The BLAST runs were prepared interactively, ie assuming implementation of previously analyzed ECOs. Thus the order of the BLAST runs was as follows:

1) base case: to analyze consumption exactly as found during the field visits;
2) implementation of planned projects (eg. replacement of room induction units) lighting, envelope, and misc. equipment ECOs
3) modify HVAC controls
4) all of the above plus utility ECOs

Since the EMCS expansion is now planned, and in order to compare it to conventional controls. both types of controls were analyzed assuming existing utility equipment (ie chillers & boilers).

1.3.2 ECOs Recommended

All the ECOs recommended for MACH are listed in Table 1-6. A total of 29 ECOs are recommended. In Table 1-7 the ECOs for MACH are summarized with and without EMCS. As indicated, the energy savings is nearly as great with conventional controls as with EMCS. This does not, however take into account the following advantages of an EMCS

1) demand savings
2) preventive maintenance
3) reliability
4) more accurate, less tendency to drift
5) ease of changing setpoints and schedule
6) easily expandable
7) metering and recordkeeping

Therefore, we recommend that MACH be connected to the basewide EMCS with an intelligent terminal at MACH and all control in the hands of MACH personnel.

The ECOs for the Support Facilities are summarized by type in Table 1-8. As indicated, the vast majority of the savings comes from HVAC projects in the Support Facilities. Recommended ECOs for each Support Facility are shown in Tables 1-9 to 1-17.

Table 1-6. ECOs Recommended, MACH

ECO	AND DESCRIPTION	INSTALLED COST	$ SAVINGS*	PAYBACK YRS	SIR	ELEC MBTU	GAS MBTU
A-1	Shut off AHUs when when possible	4,604	3,423	1.35	10.1	654	179
A-2	Reduce outside air	148	26,953	<1.	2888.2	0	5 434
A-3	Reduce supply air	10,949	13,271	<1	17.8	1,343	1 625
A-5	Reduce stairwell htg	2,491	3,527	<1	22.5	0	711
A-7	Reduce humidification	0	6,929	immed.	NA	0	1 397
A-8	Reduce cond'sr water temp	744	6,013	0.12	126.2	159	1,088
A-11,14,17	Renovate controls	13,157	87,938	0.15	107.8	0	18,043
A-12	Repair steam leaks	~~3,583~~ 3,087	9,211	0.39 4	40.9	0	1,857
A-13	Dampers and motors	20,232	32,117	0 63	24.4	1,672	5,257
A-15, A-39	Raise chilled water temp & Valve off inoperative chillers	0	11,620	Immed.	N/A	0	2 342
A-19	Exhaust air energy recovery	16,421	3,362	4.88	3.2	86	622
A-19	Double bundle chiller for heat recovery	24,772	~~5,822~~ 5,526	4 25	3.7	0	1,144
A-20	Variable CW pump	58,774	36,158	1.63	7.9	9,319	0
A-34	Return air ductwork	3,489	5,089	0.69	23.2	0	1,026
A-35	Outside air ductwork	2,245	293	7.65	2.1	0	63
A-36	Reduce exhaust air	59	8,536	<1	2995.8	0	1,721
A-38	Prioritize chillers and pumps	0	21.500	Immed.	N/A	-4,307	7,674
A-41	Replace steam chillers	428,386	369,293	1.16	14	-9,935	82,226

(continued on next page)

Table 1-6. ECOs Recommended, MACH
(continued)

ECO AND DESCRIPTION	INSTALLED COST	$ SAVINGS	PAYBACK YRS	SIR	ELEC MBTU	GAS MBTU
B-1 Reduce steam pressure & B-3A Replace boilers	208,716	~~109,552~~ 124,029	~~1.91~~ 1.68	8.3	904	21,380
B-3B Boiler tune-up	6,316	20,336	0.31	3.6	0	4,100
B-7 Boiler air preheater	5,333	681	7.83	2.1	24	156
C-1 Improve lighting cntrls	4,138	1,537	2.7	4.7	396	0
C-2 Delamping	1,158	3,342	0.35	39.6	573	215
C-4 Convert to eff. fixtrs	14,637	5,457	2.7	4.8	1,406	0
D-4 Loading dock seals	2,263	240	9.4	1.7	2.4	47
E-1 Elevator controls	58	10,771	0.01	2368.8	2,776	0
H-9 Refrig. heat recovery	1,450	4,171	0.35	45.8	0	841
H-10 Insulate pot sink	204	199	1.03	12.4	51	0
I-2 Expanded Base EMCS	~~165,851~~ 192,387	137,996	1.20	~~NA~~ 10.7	10,396	19,548
Totals	~~1,000,178~~ 1,026,218	~~945,337~~ 959,518	~~1.06~~ 1.07	NA	~~15,709~~ 15,471	178,696

*includes non energy

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Table 1-7. Summary of MACH ECOs (Bldgs. 9200, 9201, 9202)

A. WITH EMCS	INSTALLED COST*	$ SAVINGS	PAYBACK YRS	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Utility	674,267	~~544,817~~ 558,998	1.24	-13,203	119,210
HVAC	~~136,822~~ 135,656	~~237,010~~ 236,807	0.58	13,074	37,935
Envelope	2,263	240	9.41	2.4	46.6
Lighting	19,933	10,336	1.93	2,375	215
Miscellaneous	1,712	15,141	0.11	2,827	841
EMCS	~~165,851~~ 192,387	137,996	1.20	10,396	19,548
Totals	~~1,000,848~~ 1,026,218	~~945,540~~ 959,518	1.06	15,471	177,796

B. WITHOUT EMCS	INSTALLED COST*	$ SAVINGS	PAYBACK YRS	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Utility	674,267	~~544,817~~ 558,998	1.24	-13,203	119,210
HVAC	143,399	364,226	0.40	20,948	57,453
Envelope	2,263	240	9.41	2.4	46.6
Lighting	19,933	10,336	1.93	2,375	215
Miscellaneous	1,712	15,141	0.11	2,827	841
Totals	841,574	~~934,760~~ 948,941	0.90	12,949	177,766

*includes 10% design, 6% SIOH

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Table 1-8. Summary of Recommended ECO Costs and Savings by Type, MEDDAC Support Facilities*

	HVAC		ENVELOPE		LIGHTING		OTHER		TOTAL		
BLDG NO.	COSTS	SAVINGS	COSTS	SAVINGS	COSTS	SAVINGS	COSTS	SAVINGS	COSTS	SAVINGS	PAYBACK
2822	1634	1841	430	74	3	16	403	347	2470	2278	1.08
9052	8166	4744			1282	309			9448	5053	1.87
9240	11188	20883							11188	13935	0.80
2828	7231	16425			304	77			7535	16502	0.46
322	5503	3569	5420	511	5069	1249			15992	5329	3.00
323	12538	5960	20226	1867	691	1124			33455	8951	3.74
324	5622	2294	8956	850	4285	335			18863	3479	5.42
316	4383	2919	5747	951	342	172			10472	4042	2.59
392	3115	1641	4351	456					7466	2097	3.56
TOTALS	59,380	60,276	45,130	4,709	11,976	3,282	403	347	116,889	61,666	1.90

*includes non-energy cost/savings; all in 1984 $

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Table 1-9. Recommended ECOs, Building 2822

ECO NUMBER AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Repair steam pipe and condensate leak	1,634	0	371.25	1,841	0.8	17.9
2. Insulate steam, condensate, and DHW pipes and DHW tank	403	0	70.00	347	1.2	13.7
3. Lighting modifications	3	4	0	16	0.2	65.9
4. Weatherstripping and caulking	430	3	12.5	74	5.6	5.8
Totals	2,470	7	453.75	2,278	1.1	--

Table 1-10. Recommended ECOs, Building 9052

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1.-2. Dual setpoint thermostats reset DHW temperature, night setback, and unoccupied period controls.	8166	391.0	673.0	4744	1.7	8.74
3. Lighting modifications	1282	66.5	-4.6	309**	4.1	2.87
Totals	9448	457.5	668.4	5053	1.9	--

*combined ECO, see Section 13.4
**includes non-energy savings

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Table 1-11. Recommended ECOs, Building 9240

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Dual setpoint thermostats, reset DHW temperature	6,836	653.7	742.7	6,243	1.1	13.4
2. Night setback and unoccupied period controls	556	1609.0	0	6,243	0.1	143.3
3. Chilled water reset controls	1,444	47.8	0	185	7.8	1.6
4. Outside air AHU economizer controls	2,352	325.9	0	1,264	1.9	4.1
Totals	11,188	2636.4	742.4	13,935	0.8	--

Table 1-12. Recommended ECOs, Building 2828

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Deadband t-stats and setback controls	2,608	1140.5	1644.3	12,525	0.2	71.19
2. Pipe insulation	183	0	18.8	93	1.2	8.10
3. Lighting modifications	304	14.8	-0.6	77*	3.9	3.02
4. AHU modifications and OA economizer	2,668	118.3	525.6	3,066	0.9	17.74
5. Chilled water and hot deck reset controls	1,772	190.9	0	741	2.4	5.33
Totals	7,535	1464.5	2188.1	165029	0.5	--

*includes non-energy savings

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Table 1-13. Recommended ECOs, Building 322

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	ENERGY SAVINGS MBTU/YR NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Thermostatic radiator valves, reset DHW temp.	2,103	36.7	158.8	930	2.3	6.82
2. Night setback controls, other unoccupied period controls,t-static rad. values - 2nd floor	3,355	17.5	514.0	2,561	1.3	12.18
3. Pipe insulation	45	0	15.8	78	0.5	27.56
4. Exterior light replacement and control	4,835	222.0	0	861	5.6	2.27
5. Window blocking/double glazing	5,420	4.1	99.9	511	10.6	1.49
6. Lighting modifications	234	106.6	-9.8	388*	0.6	20.20
Totals	15,992	386.9	778.7	5,329	3.0	--

*includes non-energy savings

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Table 1-14. Recommended ECOs, Building 323

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Thermostatic radiator valves, reset DHW temperature	10,479	78.9	614.9	3,356	3.1	5.00
2. Night setback controls, other unoccupied period controls	2,059	32.3	427.1	2,604	0.8	20.70
3. Window blocking/double glazing	20,226	43.3	342.5	1,867	10.8	1.44
4. Lighting modifications	691	275.0	-10.3	1,124*	0.61	20.13
Totals	33,455	429.5	1374.2	8,951	3.70	--

*includes non-energy savings

Table 1-15. Recommended ECOs, Building 324

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Thermostatic radiator valves, reset DHW temperature	4,192	42.3	141.1	864	4.9	3.16
2. Night setback controls, other unoccupied period controls	1,430	17.5	285.9	1,430	1.0	15.99
3. Exterior light replacement and control	4,285	86.3	0	335	12.8	1.00
4. Window blocking/double glazing	7,590	16.2	124.8	682	11.1	1.40
5. Floor insulation	1,366	-6.5	38.9	168	8.2	2.01
Totals	18,863	155.8	590.7	3,479	5.4	--

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Table 1-16. Recommended ECOs, Building 316

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Thermostatic radiator valves, reset DHW temperature	3,095	-2.5	180.9	888	3.5	4.57
2. Night setback controls, other unoccupied period controls	1,288	17.5	407.1	2031	0.6	25.18
3. Window blocking	1,996	7.1	67.5	362	5.5	2.82
4. Floor insulation	3,751	-.2	118.8	589	6.4	2.52
5. Lighting modifications	342	53.0	-6.8	172	2.0	6.31
Totals	10,472	74.9	767.5	4042	2.6	--

Table 1-17. Recommended ECOs, Building 392

ECO NO. AND DESCRIPTION	PROJECT COST ($)	ENERGY SAVINGS MBTU/YR ELEC	NAT GAS	COST SAVINGS ($)	PAYBACK (YR)	SIR
1. Thermostatic radiator valves, reset DHW temperature	1,883	-3.9	181.6	886	2.13	7.51
2. Unoccupied period and night setback controls	1,232	17.9	149.5	755*	1.52	9.84
3. Window blocking and double glazing	3,047	16.1	46.1	291	10.47	1.46
4. Floor insulation	1,304	-0.2	33.5	165	7.88	2.02
Totals	7,466	29.9	410.7	2097	3.60	--

*includes labor cost

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1.3.3 Projects Developed

Tables 1-18 and 1-19 list all projects, by funding group, with and without EMCS. These include work in MACH and the MEDDAC Support Facilities. Each type of project and the individual ECOs contained in it are described in more detail in Section 1.5. The total estimated cost is $1.2 million, while the annual dollar savings exceeds $1.1 million.

At the prefinal meeting we were told that the EMCS for MACH had already been funded, therefore no DD1391 and PDB were needed. Given this fact, the projects in Table 1-19 should be implemented. The project documentation in Appendix 1 was prepared assuming that the MACH EMCS would be installed.

Table 1-18

Summary of Projects Developed Without EMCS, all MEDDAC, Ft Benning GA

Type	Description	Cost (1)	SAVINGS (2) El MBTU	Gas MBTU	$	SIR	Payback	Impl D
No Cost		0	-4307	11413	40049	N/A	Immed	198
QRIP #1	Misc in 9200	1509	2776	841	14942	135 12	.1	198
QRIP #2	Boiler Chil'r Tune	12393	135	5344	27030	12.65	46	198
QRIP #3	Repair Steam Sys.	5558	51	2333	11769	33.58	47	198
OSDPIF(3)	Renovate HVAC Sys.	137894	16362	60847	363244		.35	198
PECIP	Modify Lighting	31909	3204	182	13338	5 54	2.3	198
Low Cost		42217	84	934	4949	1.65	9.5	198
ECIP #1	Replace Chillers & Boilers	659000	288	104750	535006	11.69	1.4	198
	Totals	890480	18593	186644	1010327		0.89	

(1) All costs include design except ECIP #1
(2) Analyzed at Oct 84 costs of $4.96/MBTU gas, $3.88/MBTU Electricity
(2) No project documentation developed since EMCS is confirmed go, see Table 1-19

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Table 1-19

Summary of Projects Developed With EMCS, all MEDDAC, Ft. Benning, GA

Type	Description	Cost (1)	SAVINGS (2) El MBTU	Gas MBTU	$ (2)	SIR	Payback	Impl Dt
No Cost		0	-4307	11413	40049	N/A	Immed	1985
QRIP #1	Misc in 9200	1509	2776	841	14942	135.12	.1	1985
QRIP #2	Boiler Chil'r Tune	12393	135	5344	27030	12.65	.46	1985
QRIP #3	Repair Steam Sys.	5558	51	2333	11769	33.58	.47	1985
OSDPIF(2)	Renovate HVAC Sys.	131317	8488	41433	237427	27.99	.5	1987
PECIP	Modify Lighting	31909	3204	182	13618	5.54	2.3	1986
Low Cost		42217	84	934	4949	1.65	9.5	1986
ECIP #1	Replace Chillers & Boilers	659000	288	104750	520825	11.69	1.4	1988
ECIP #2	Install EMCS (3)	193679	11156	19548	140945		1.37	
	Totals	1077582	21875	186778	1011554	N/A	1.06	

(1) All costs include design except ECIP #1
(2) Analyzed at Oct 84 costs of $4.96/MBTU gas, $3.88/MBTU Electricity, includes non energy
(3) Includes non-energy

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1.4 Projected Energy Costs

1 4.1 MACH

Table 1-20 shows the BLAST estimates of current and projected energy consumption and cost for MACH As indicated, elimination of the absorber and the steam turbines will save about $1.1 million per year. HVAC and boiler ECOs will reduce heating costs by $125,000, while the impact of the electricity saved by the various ECOs will more than offset the increased consumption by the new electric chillers. Thus, electricity costs will drop by $70,000. The overall impact of the ECOs in MACH is an energy savings of $1.3 million or 67%, or a reduction from about $6/sqft to about $2/sqft/yr.

A two-thirds reduction in energy costs is astounding. We normally see 25-33%. As shown in Fig 1-2, however, the current cooling systems based on natural gas are extraordinarily inefficient. Simply converting these to electric with no other ECOs would save nearly $1 million. The fact that the savings from ECOs A-38 and A-41 on Table 1-6 is not $1 million is explained by the fact that all planned projects and envelope, lighting, and HVAC ECOs were "implemented" prior to the utility measures.

Table 1-20. Estimated Current and Projected Energy Use, MACH

FUEL	CURRENT MBTU	$	PROJECTED MBTU	$
gas	273,340	$ 1,356,000	36,254	$ 179,800
electricity	148,000	573,000	130,000	504,300
Total	421,340	$ 1,929,000	166,254	$ 684,100

Referring to Figure 1-1, natural gas consumption is expected to drop from 828 to 110 KBTU/sqft. Electricity will go from 448 to 394 KBTU for a total of 504 KBTU/sqft. Recognizing that all of the values in Figure 1-1 are before conservation. electricity consumption at MACH will be in line with the other hospitals, while gas use will be about one-half of the others, rather than two to four times the others as it is now.

Note that the total savings shown in Table 1-6 for all ECOs is $945,000 while the savings in Table 1-20 is $1,245,000. There are three reasons for this discrepancy:

1) Table 1-20 is based on the final BLAST run which includes all ECOs identified in this report plus all planned projects. The planned projects shown in Table 4-1 will have a significant effect particularily: duct cleaning, re-roofing and adding insulation, caulking, boiler economizer, and replacement of 344 induction units and thermostats. All analyses in this report assume the

implementation of these projects so the savings does not show in the ECOs, but does in the before and after BLAST runs.

2) Table 1-6 includes increased maintenance ($2.500) costs, Table 1-20 does not.

3) Each ECO was evaluated assuming that previous ECOs were implemented. The net effect of numerous conservative engineering assumptions was to underestimate the total savings when all projects were combined for the final BLAST run.

Despite that, as clearly shown in Table 1-16, all ECOs developed show excellent paybacks and SIRs using the more conservative calculations. The combined impact of the ECOs and the planned projects is projected to decrease consumption by over $1.2 million as shown in Table 1-20.

1.4.2 MEDDAC Support Facilities

In Table 1-21 energy costs by fuel type before and after conservation are shown. As indicated, energy costs are projected to decrease by about $61,500. As at MACH, the majority of the cost savings is from reduced gas consumption. Much of this will come from eliminating steam leaks and unoccupied heating.

Table 1-21. Energy Costs Before and After ECOs, MEDDAC Support Facilities*

	ELECTRICITY		NATURAL GAS		TOTAL	
BLDG NO.	$ BEFORE	$ AFTER	$ BEFORE	$ AFTER	$ BEFORE	$ AFTER
2822	770	743	2686	434	3456	1177
9052	6366	4589	5804	2491	12170	7080
9240	39225	28997	16576	12896	55801	41893
2828	14515	8831	12616	1764	27131	10594
322	3409	1907	4536	672	7945	2580
323	5679	4011	9294	2479	14973	6490
324	2579	1974	4145	1214	6724	3187
316	1457	1166	4992	1183	6449	2349
392	351	235	2519	480	2870	715
TOTALS	74,351	52,452	63,168	23,612	137,519	76,064

*not including non-energy costs/savings; all in 1984 $

1.4.3 All MEDDAC

Table 1-22 shows the current and projected energy costs for all MEDDAC (MACH and Support) Facilities. As shown, the projected energy savings is over $1.1 million in 1984 dollars.

Figure 1-4 shows the projected electricity and gas costs for all MEDDAC Facilities with and without implementation of the ECOs recommended in this report. Without conservation total energy costs are expected to increase from $2.1 million in 1984 to $3.6 million in 1988. With conservation the costs in 1988 are expected to be $1.5 million, for an avoided cost in 1988 dollars of $2.1 million. The projected energy costs are based on "Regional Projections of End Use Energy Consumption and Prices through, 1995," US Energy Information Agency, 1985.

Table 1-22. Current and Projected Energy Costs, All MEDDAC, Fort Benning, GA*

	GAS	ELECTRICITY	TOTAL
Current Costs:			
MACH	1,356,000	573 200	1,929,200
Support Facilities	63,000	74,350	137,550
Total	1,419,200	647,550	2,066,750
After Implementation of ECOs:			
MACH	179,800	504.300	684.100
Support Facilities	41,300	34,800	76,100
Total	221,100	539,100	760,200
SAVINGS	$1,198,100	$ 108,450	$1,306,550

*not including non-energy costs/savings; all in 1984 $

1.5 Energy Plan

The No Cost projects listed in Table 1-23 should be implemented immediately. Likewise, QRIPs in Tables 1-24. 1-25, and 1-26 should also be done as soon as possible using current year funds since they all have paybacks <1 year.

Tables 1-27 and 1-28 show OSD PIF and PECIP projects respectively. The HVAC work will have a payback of less than six months. As discussed previously, the HVAC conrol projects in the OSDPIF are based on the assumption that some sort of EMCS will be installed soon. Thus, there are no duplications of controls between the OSD PIF and the EMCS point lists inppendix 2. The lighting PECIP has a payback of just over 2 years. The Low Cost projects in Table 1-29 are primarily envelope improvements with relatively long paybacks, although they all do have an SIR >1.0.

Finally then, will come the ECIP projects shown in Tables 1-30 and 1-31. We have assumed these projects will be operational in 1988.

Figure 1-4 shows the impact on energy costs in MEDDAC Facilities that can be achieved by applying the plan developed in this report. The proposed energy plan is clearly an excellent investment.

Table 1-23. No Cost Improvements, Description and Location, Fort Benning

ECO AND DESCRIPTION	$ SAVINGS	ELEC MBTU	GAS MBTU	CHAPTER
A-7 Reduce humidification	6,929	0	1,397	7
A-15 Raise CW temp by valving off inoperative chillers	11,620	0	2,342	6
A-38 Prioritize chiller and pump operation	21,500	-4,307	7,674	6
TOTAL	40,049	-4,307	11,413	

Table 1-24. QRIP Project #1: Miscellaneous, Fort Benning, 1987

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SAVINGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9200							
E-1 Switch off elevators and reset timers	58	10,771	0	0.01	2368.77	2,776	0
H-9 Refrigeration	1,450	4,171	0	0.35	45.77	0	841
Totals	1,508	14,942	0	0.10	135.12	2,776	841

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Table 1-25. QRIP Project #2: Minor Work on Boilers and Chillers, Fort Benning, 1985

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SAVINGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9201							
A-8 Reduce condensor water temperature	743	6,013	0	0.12	126.16	159	1,088
Building 9202							
B-3B Boiler tune-up	6,317	20,336	0	0.31	3.6	0	4,100
B-7 Install air preheater	5,333	681	0	8.53	2.1	-24	156
Totals	12,393	27,030	0	0.46	12.65	135	5,344

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Table 1-26. QRIP Project #3: Repair/Replace Leaky Pipes, Valves, Traps and Insulate Pipes, Fort Benning, 1985

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SAVINGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9200							
A-12 Steam repairs	3,087	9,211	0	0.34	40.90	0	1,857
H-10 Insulate pot sink	205	199	0	1.03	12.42	51	0
Building 2822							
1 Repair steam pipes	1,635	1,841	0	0.89	17.9	0	371
2 Insulate pipes and DHW	403	347	0	1.16	13.7	0	70
Building 2828							
2 Pipe insulation	183	93	0	1.97	8.10	0	19
Building 322							
3 Pipe insulation	45	78	0	0.57	27.56	0	16
Totals	5,558	11,769	0	0.47	33.58	51	2,333

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Table 1-27. OSD PIF Project: Renovate HVAC Controls, Fort Benning, 1987

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SAVINGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9200							
A-1 Time-of-day controls	4,604	3,423		1.35	10.09	654	179
A-2 Reduce OA	149	26,953	0	0.01	2888.24	0	5,434
A-3 Reduce SA	10,949	13,271	0	0.83	17.78	1,343	1,625
A-5 Reduce stairwell htg	2,491	3,527	0	0.71	22.53	0	711
A-11,14,17 Renovate contrls	13,157	88,493	-555	0.15	107.80	0	18,043
A-13 Dampers and motors	20,232	32,561	-445	0.63	24.37	1,672	5,257
A-19 Energy recovery	16,421	3,418	- 56	4.88	3.21	86	622
A-34 Return air ductwork	3,489	5,089	0	0.69	23.21	0	1,026
A-35 Outside air ductwork	2,245	312	- 19	7.66	2.13	0	63
A-36 Reduce exhaust air	59	8,536	0	0.01	2995.80	0	1,721
Subtotal MACH	73,796	185,584	-1075	0.40	39.46	3,755	34,681
Building 9052							
1-2 Dual setpt t-stats, night setback	8,166	4,855	-111	1.72	8.74	391	673
Building 9240							
1 Dual setpt t-stats	6,836	6,243	0	1.09	13.4	654	747
2 Night setback	556	6,243	0	0.09	143.3	1,609	0
3 Chilled water reset	1,445	185	0	7.81	1.6	48	0
4 OA economizer	2,353	1,264	0	1.86	6.86	326	0
Building 2828							
1 Deadband t-stats	2,608	12,581	- 56	0.21	71.19	1,141	1,644
4 AHU mod/OA economizer	2,668	3,066	0	0.87	17.74	118	526
5 Hot & cold deck reset	1,773	741	0	2.39	5.33	191	0
Building 322							
1 T-stat radiator valves	2,103	930	0	2.26	6.82	37	159
2 Night setback controls	3,355	2,561	- 56	1.31	12.18	18	514

Table 1-27. OSD PIF Project: Renovate HVAC Controls, Fort Benning, 1987 (continued)

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SAVINGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 323							
1 T-stat radiator valves	10,479	3,356	0	3.12	5.00	79	615
2 Night setback controls	2,060	2,740	- 56	0.77	20.70	32	527
Building 324							
1 T-stat radiator valves	4,192	864	0	4.85	3.16	42	141
2 Night setback controls	1,430	1,486	- 56	1.00	15.99	18	286
Building 316							
1 T-stat radiator valves	3,095	888	0	3.49	4.57	-3	181
2 Night setback controls	1,288	2,087	- 56	0.63	25.18	18	407
Building 392							
1 T-stat radiator valves	1,882	886	0	2.12	7.51	-4	182
2 Night setback controls	1,232	811	- 56	1.61	9.84	18	150
Subtotal Support Facilities	57,521	51,843	-392	1.12	13.27	4,733	6,752
Total MACH and Support Facilities	131,317	237,427	-1467	0.56	27.99	8,488	41,433

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Table 1-28. PECIP Project: Modify Lighting, Fort Benning, 1987

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SVGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9200							
C-1 Occupancy sensors	4,138	1,537	0	2.7	4.74	396	0
C-2 Delamping	1,158	3,290	52	0.3	39.61	573	215
C-4 Replace incand. ltg.	14,636	5,457	0	2.7	4.76	1,406	0
Building 2822							
3 Ltg. modifications	3	16	0	0.2	65.9	4	0
Building 9052							
3 Ltg. modifications	1,282	235	74	4.1	2.87	67	-5
Building 2828							
3 Ltg. modifications	304	54	23	3.9	3.02	15	-.6
Building 322							
4 Exterior light replacement and control	4,835	861	0	5.6	2.27	222	0
6 Ltg. modifications	234	365	23	0.6	20.20	107	-10
Building 323							
4 Ltg. modifications	691	1,016	108	0.6	20.13	275	-10
Building 324							
3 Exterior light replacement and control	4,285	335	0	12.8	1.00	86	0
Building 316							
5 Ltg. modifications	343	172	108	1.2	6.10	53	-7
Totals	31,909	13,338	388	2.3	5.54	3,204	182

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Table 1-29. Low Cost Project: Upgrade Building Envelopes, Fort Benning, 1987

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SAVINGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9200							
D-4 Plastic strip doors	2,087	240	0	8.7	1.68	2	47
Building 2822							
4 Weatherstrip and caulk	430	74	0	5.8	2.6	3	13
Building 322							
5 Window blocking/ double glazing	5,419	511	0	10.6	1.49	4	100
Building 323							
3 Window blocking/ double glazing	20,226	1,867	0	10.8	1.44	43	343
Building 324							
4 Window blocking/ double glazing	7,590	682	0	11.1	1.40	16	125
5 Floor insulation	1,367	168	0	8.1	2.01	-7	39
Building 316							
3 Window blocking/ double glazing	1,996	362	0	5.5	2.82	7	68
4 Floor insulation	3,751	589	0	6.4	2.52	-.2	119
Building 392							
3 Window blocking/ double glazing	3,048	291	0	10.5	1.46	16	46
4 Floor insulation	1,303	165	0	7.9	2.02	-.2	34
Totals	42,217	4,949	0	9.5	1.65	84	934

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Table 1-30. ECIP Project #1: Replace Boilers and Chillers, MACH, 1987

ECO AND DESCRIPTION	INSTALLED COST	ENERGY SAVINGS	NON-ENERGY SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9201, AC Plant							
A-19 Double bundle chiller for heat recovery	24,772	5,674	-148	4.25	3.7	0	1,144
A-20 Variable CW pumping	58,774	36,158	0	1.63	7.85	9,319	0
A-41 Replace steam turbine chillers	428,386	369,293	0	1.16	14.00	-9,935	82,226
Building 9202, Boiler Plant							
B-3A Replace boilers	208,717	109,552	14,477	1.68	8.3	904	21,380
Totals	720,649	520,677	14,329	1.35	11.69	288	104,750

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Table 1-31. ECIP Project #2: Expand Basewide EMCS, Fort Benning, 1987

ECO AND DESCRIPTION	INSTALLED COST*	$ SAVINGS	PAYBACK YRS	SIR	SAVINGS ELEC MBTU	SAVINGS GAS MBTU
Building 9200						
I-2 Expand base EMCS to MACH**	192,387	137,966	1.2	10.69	10,396	19,548
Buildings 9052 and 2828						
I-2 Shut off various pumps & compressors	1,292	2,949	0.4	29.11	760	0
Total MACH and Support Facilities	193,679	140,945	1.4	NA	11,156	19,548

*includes design and base SIOH
**no 1391 and PDB submitted since funds already allocated

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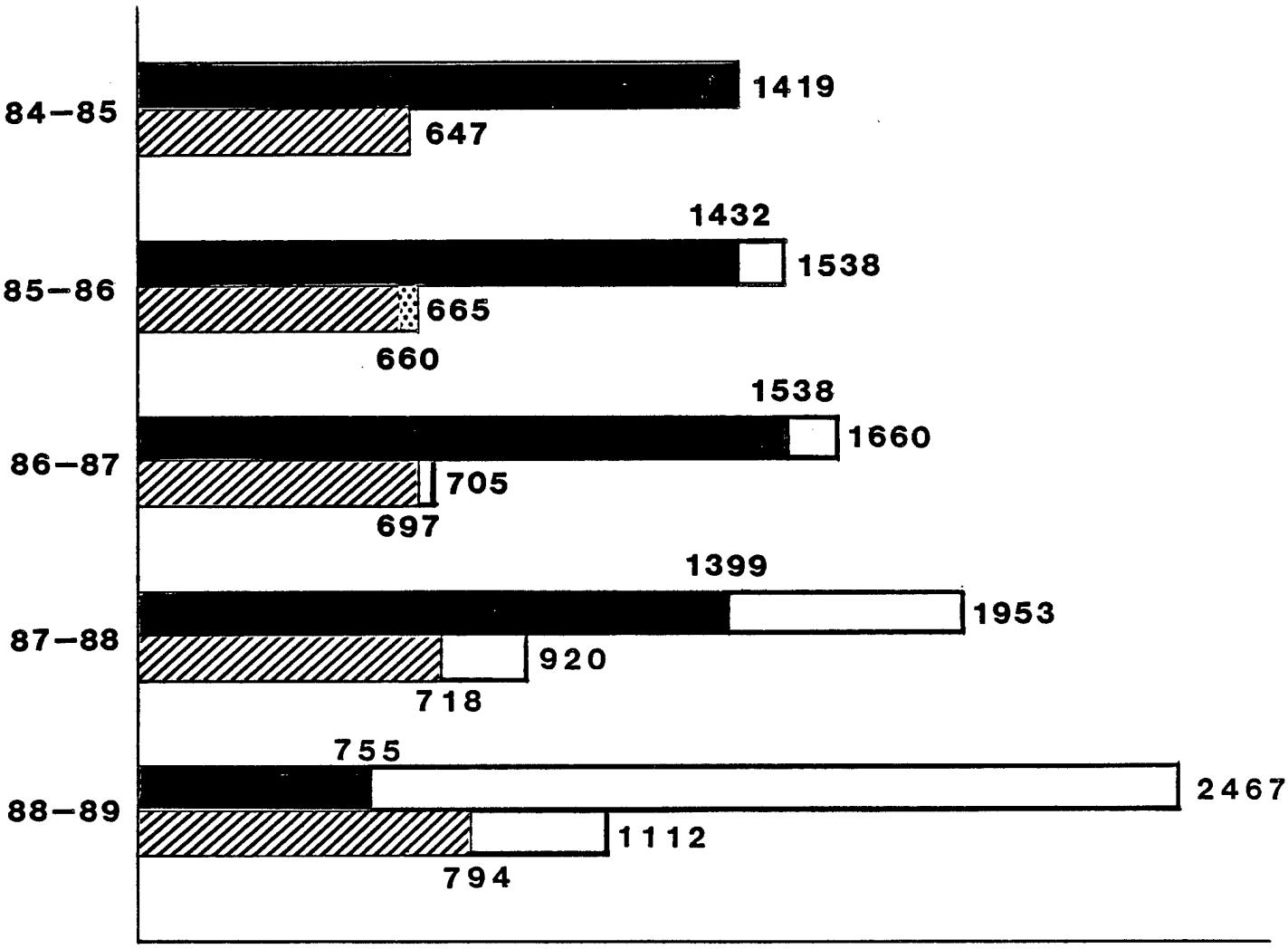

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FIGURE 1–4: ENERGY COSTS W/ & W/O CONSERVATION, ALL MEDDAC