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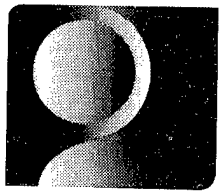
systems

# ENERGY SURVEY OF ARMY DINING FACILITIES FORT BRAGG, NC



## EXECUTIVE SUMMARY

**Contract #DACA21-86-C-0059**
**April 8, 1988**

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**Final Report Submitted to:**

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## EXECUTIVE SUMMARY

1. Introduction

1.1 Scope of Work

IES Engineers was contracted by the Savannah District of the US Army Corps of Engineers in July 1986 to perform a complete energy audit and analysis of forty-three dining facilities at Fort Bragg, North Carolina. The essential elements of the Scope of Work (SOW) are listed below. The majority of the buildings are permanent structures with a remaining useful life of over 25 years. Five of the buildings are temporary structures which are expected to remain in use for at least ten years.

BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:

1. Perform a complete energy Audit and Analysis of the dining facilities.

2. Identify all Energy Conservation Opportunities (ECOs) including low cost/no cost ECOs and perform complete evaluations of each.

3. Prepare programming documentation [DD 1391, Life Cycle Cost Analysis Summary Sheet with backup calculations and Project Development Brochure (PDB)] for any Energy Conservation Investment Program (ECIP) projects.

4. Prepare implementation documentation for all justifiable energy conservation opportunities.

5. List and prioritize all recommended Energy Conservation Opportunities.

6. Prepare a comprehensive report which will document the work accomplisned, the results and recommendations.

The project consisted of detailed audits of twenty dining facilities and "walk-through" audits of the remaining twenty-three buildings. The buildings are listed by number in Table 1-1. Per the SOW, the Building Loads Analysis and Systems Thermodynamics (BLAST) computer program was used to simulate existing energy consumption and to evaluate energy conservation opportunities (ECOs) in the buildings receiving detailed audits. "Walk-through" audits were then performed on the remaining buildings in order to determine which of the previously identified ECOs could be duplicated.

In addition to the energy audits, the SOW also called for the testing of solar domestic hot water systems in buildings C-4122 and H-5718, and ventilation studies in all of the "C" buildings.

Table 1-1. List of Dining Facilities Audited

Buildings Included in Detailed Audit

| Building | Sq ft | Building | Sq ft |
|---|---|---|---|
| C-4122 | 4,850 | O-9013 | 4,800 |
| C-4422 | 4,850 | P-3042 | 7,857 |
| C-6432 | 4,850 | I-1242 | 3,168 |
| C-8344 | 4,850 | 4-1437 | 7,500 |
| C-8750 | 5,050 | A-3275 | 5,608 |
| C-9349 | 5,050 | AT-4622 | 2,800 |
| C-7236 | 4,850 | AT-4632 | 2,800 |
| D-2626 | 11,313 | AT-4686 | 2,800 |
| D-3404 | 9,346 | MT-6115 | 2,375 |
| H-5718 | 14,920 | 8T-3849 | 13,400 |

Buildings Receiving Walk-through Audits

| Building | Sq ft | Building | Sq ft |
|---|---|---|---|
| C-3020 | 4,850 | C-7433 | 4,850 |
| C-3027 | 4,850 | C-7634 | 4,850 |
| C-3321 | 4,850 | C-8339 | 4,850 |
| C-4120 | 4,850 | C-8541 | 4,850 |
| C-4125 | 4,850 | C-6726 | 4,850 |
| C-4424 | 4,850 | C-8438 | 4,850 |
| C-4426 | 4,850 | D-2105 | 11,313 |
| C-4428 | 4,850 | D-3039 | 11,313 |
| C-5528 | 4,850 | D-3055 | 11,313 |
| C-5725 | 4,850 | H-4842 | 14,920 |
| C-6525 | 4,850 | 2-1105 | 3,168 |
| | | 2-1138 | 3,168 |

## 1.2 General Description of the Facilities

Refer to Table 1-1 for a listing of all of the facilities. The "C area" buildings (buildings with the C prefix) are all similar concrete block structures consisting of a dining facility connected to a three story barracks. The barracks portion of each building was not included in the SOW of this study. The buildings are of two types; type 64 and type 121, with the only difference being slight variations in the floor plan.

The "D" buildings are dining facilities serving the "D area barracks". The barracks portion of each building was not included in the SOW of this study. All of the buildings are identical brick and block with the exception of D-3404. The floor plan and interior equipment of building D-3404 is slightly different from the other buildings.

Buildings H-4842 and H-5718 are relatively new dining facilities. The two buildings are similar brick and block buildings with slight variations in floor plans.

Building 0-9013 is a prefabricated metal building which serves as a classroom and dining facility at the Mott Lake Training Center. The classroom portion of the building was not included in the SOW of this study.

Building P-3042 is a concrete block structure which houses a warehouse and dining facility for Simmons Army Airfield. The warehouse portion of the building was not included in the SOW of this study.

Buildings 1-1242, 2-1105, and 2-1138 are three story brick and block structures which serve as military police barracks. Each building houses a kitchen and dining facility on the ground floor. The SOW of this study included only the dining area portion of the building.

Building 4-1437 is a relatively new brick and block structure, half of which serves as a dining facility and the remaining half as storage and offices. The storage and offices are not part of the dining facility and were not included in the SOW of this study.

Buildings AT-4622, AT-4632, and AT-4686 are identical temporary wood frame dining facilities. The buildings have recently been covered with wall insulation and metal siding. Building MT-6115 is similar to these buildings with the only difference being a slight variation in size and the absence of new insulation and metal siding.

Building 8T-3849 is a large temporary wood frame structure serving as a dining facility. One dining room wing of the structure is currently used only periodically as a classroom, but was surveyed under this contract.

## 1.3 Present Energy Consumption

### 1.3.1 Total Annual Energy Used

The total estimated energy consumption of the detailed buildings audited,as predicted by the BLAST computer model is shown in Figure 1-1. The total energy cost including demand charges is estimated at $495,716. This assumes completion of all planned or ongoing projects. Figure 1-2 shows the total energy cost by fuel type.

### 1.3.2 Energy Consumption by Building

Table 1-2 lists the energy consumption and cost by fuel type for all detailed buildings audited. These costs include electric demand costs.

## 1.4 Energy Conservation Analysis

### 1.4.1 ECOs Investigated

All of the ECOs shown in the sample checklist (Table 1-3) on the following pages were investigated for each building in the SOW. Similar checklists for each building appear in the respective chapter for that building. 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 SOW checklist and each of the building lists will show that many additional ECOs were investigated.

All of the ECOs were evaluated relative to the base case building simulations on BLAST. The BLAST runs were run interactively, i.e., assuming implementation of previously analyzed ECOs. The order of the BLAST runs is shown in Table 1-4. This order is based on the assumption that ECO's which will reduce the load on the HVAC equipment should be implemented before HVAC ECO's are implemented.

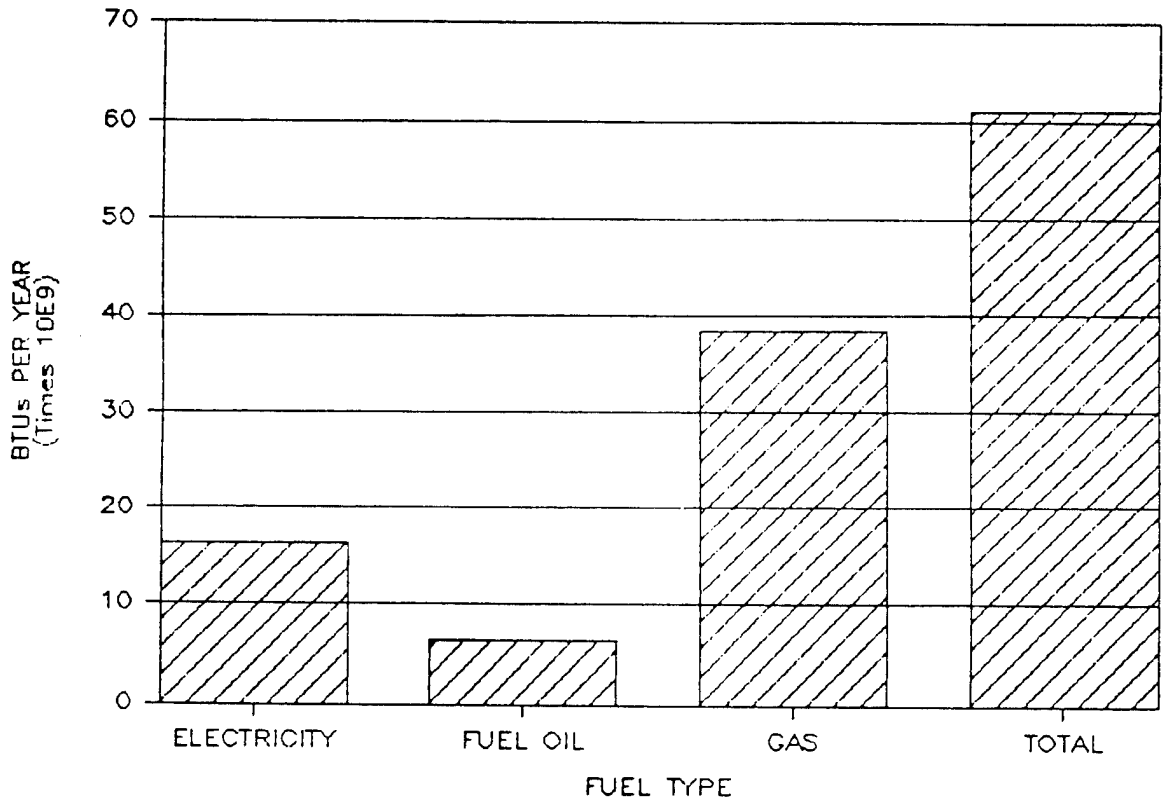
### 1.4.2 ECOs Recommended

Table 1-5 lists all ECOs recommended for the detailed and walk-through buildings in order of SIR. As indicated, the total installed cost is estimated to be $261,975 with a total annual savings of $110,880 for a payback of 2.4 years.

Figure 1-1.

# TOTAL ANNUAL ENERGY CONSUMPTION OF DETAILED BUILDINGS

## BASED ON BLAST ANALYSIS




Buildings Included in Detailed Audit

| Building | Sq ft | Building | Sq ft |
|---|---|---|---|
| C-4122 | 4,850 | 0-9013 | 4,800 |
| C-4422 | 4,850 | P-3042 | 7,857 |
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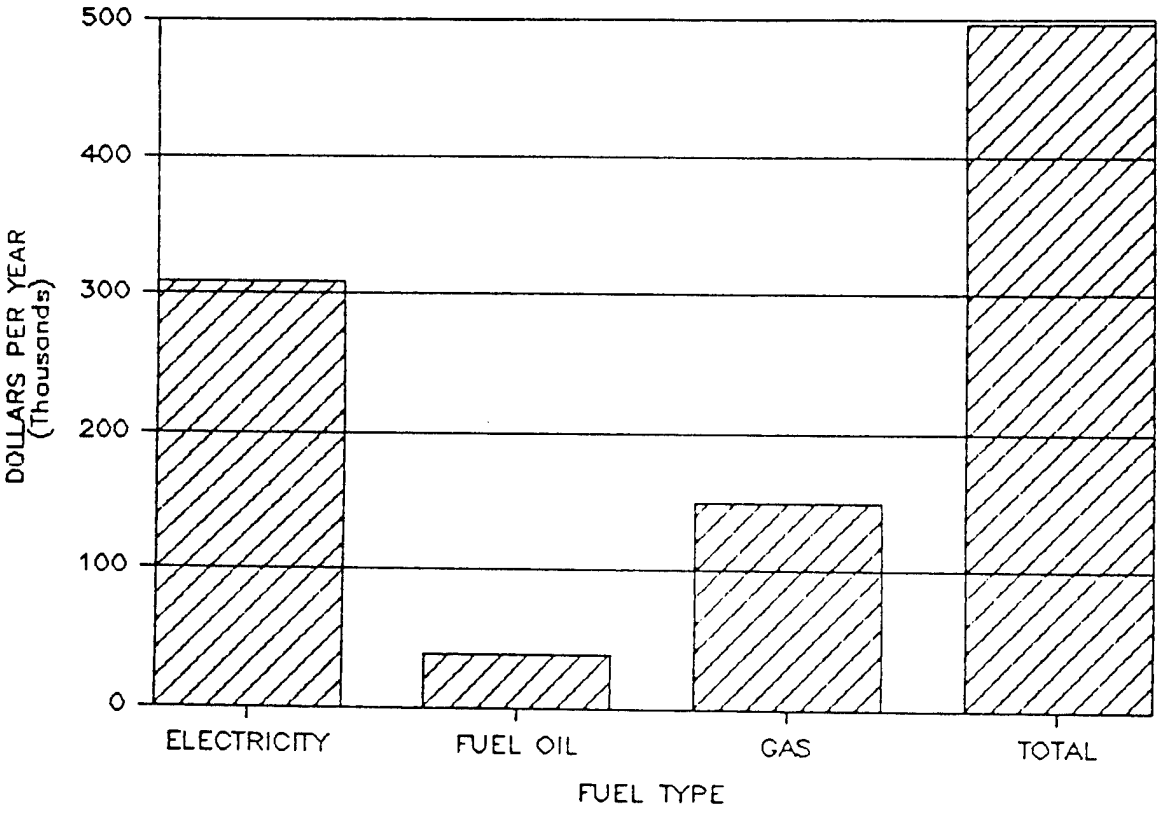
| C-8344 | 4,850 | 4-1437 | 7,500 |
| C-8750 | 5,050 | A-3275 | 5,608 |
| C-9349 | 5,050 | AT-4622 | 2,800 |
| C-7236 | 4,850 | AT-4632 | 2,800 |
| D-2626 | 11,313 | AT-4686 | 2,800 |
| D-3404 | 9,346 | MT-6115 | 2,375 |
| H-5718 | 14,920 | 8T-3849 | 13,400 |

Figure 1-2.

# CALCULATED ANNUAL ENERGY COST 1987 OF DETAILED BUILDINGS
## BASED ON BLAST ANALYSIS




Buildings Included in Detailed Audit

| Building | Sq ft | Building | Sq ft |
|---|---|---|---|
| C-4122 | 4,850 | 0-9013 | 4,800 |
| C-4422 | 4,850 | P-3042 | 7,857 |
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| C-8750 | 5,050 | A-3275 | 5,608 |
| C-9349 | 5,050 | AT-4622 | 2,800 |
| C-7236 | 4,850 | AT-4632 | 2,800 |
| D-2626 | 11,313 | AT-4686 | 2,800 |
| D-3404 | 9,346 | MT-6115 | 2,375 |
| H-5718 | 14,920 | 8T-3849 | 13,400 |

Table 1-2. Esti.ated Building Energy Consumption and Cost

| Building | Electricity KWH | KW | MBTU | Cost | Fuel OiL GAL | MBTU | $ | GAS THERMS | MBTU | $ | TOTAL MBTU | $ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C-4122 | 361236 | 113.3 | 1232.9 | 20244 | 0 | 0.0 | 0 | 15063 | 1506.3 | 5634 | 2739.2 | 25877 |
| C-4422 | 324905 | 110.4 | 1108.9 | 18793 | 0 | 0.0 | 0 | 18287 | 1828.7 | 6839 | 2937.6 | 25633 |
| C-6432 | 343246 | 112.9 | 1171.5 | 19597 | 0 | 0.0 | 0 | 17541 | 1754.1 | 6560 | 2925.6 | 26158 |
| C-8344 | 336947 | 110.8 | 1150.0 | 19230 | 0 | 0.0 | 0 | 15119 | 1511.9 | 5655 | 2661.9 | 24884 |
| C-8750 | 306680 | 105.8 | 1046.7 | 17846 | 0 | 0.0 | 0 | 19753 | 1975.3 | 7388 | 3022.0 | 25234 |
| C-9349 | 311691 | 106.2 | 1063.8 | 18045 | 0 | 0.0 | 0 | 19686 | 1968.6 | 7363 | 3032.4 | 25408 |
| C-7236 | 297158 | 76.2 | 1014.2 | 15481 | 0 | 0.0 | 0 | 31448 | 3144.8 | 11762 | 4159.0 | 27243 |
| D-2626 | 267682 | 81.4 | 913.6 | 14824 | 0 | 0.0 | 0 | 48679 | 4867.9 | 18206 | 5781.5 | 33030 |
| D-3404 | 247612 | 51.9 | 845.1 | 12100 | 0 | 0.0 | 0 | 29206 | 2920.6 | 10923 | 3765.7 | 23023 |
| H-5718 | 761764 | 217.5 | 2599.9 | 41207 | 0 | 0.0 | 0 | 59887 | 5988.7 | 22398 | 8588.6 | 63604 |
| O-9013 | 54439 | 39.4 | 185.8 | 4593 | 1665 | 231.0 | 1365 | 1651 | 165.1 | 617 | 581.9 | 6575 |
| P-3042 | 139672 | 27.4 | 476.7 | 6693 | 10917 | 1514.2 | 8949 | 12020 | 1202.0 | 5289 | 3192.9 | 20931 |
| 1-1242 | 212716 | 106.6 | 726.0 | 24147 | 11576 | 1605.6 | 9489 | 0 | 0.0 | 0 | 2331.6 | 33637 |
| 4-1437 | 235130 | 100.0 | 802.5 | 23612 | 0 | 0.0 | 0 | 35371 | 3537.1 | 13229 | 4339.6 | 36841 |
| A-3275 | 162028 | 41.9 | 553.0 | 11626 | 0 | 0.0 | 0 | 17000 | 1700.0 | 7480 | 2253.0 | 19106 |
| AT-4622 | 65280 | 38.3 | 222.8 | 8377 | 0 | 0.0 | 0 | 10282 | 1028.2 | 4524 | 1251.0 | 12901 |
| AT-4632 | 63493 | 37.8 | 216.7 | 8242 | 0 | 0.0 | 0 | 9217 | 921.7 | 4055 | 1138.4 | 12297 |
| AT-4686 | 63375 | 37.8 | 216.3 | 8239 | 0 | 0.0 | 0 | 9671 | 967.1 | 4255 | 1183.4 | 12494 |
| MT-6115 | 60973 | 36.7 | 208.1 | 7983 | 0 | 0.0 | 0 | 9223 | 922.3 | 4058 | 1130.4 | 12041 |
| 8T-3849 | 162291 | 39.9 | 553.9 | 8337 | 22433 | 3111.5 | 18389 | 4708 | 470.8 | 2072 | 4136.2 | 28798 |
| | 4778318 | 1592.5 | 16308.4 | 309218 | 46592 | 6462.3 | 38192 | 383812 | 38381.2 | 148306 | 61151.9 | 495716 |

Table 1-3. Sample ECO Checklist

FACILITY: Fort Bragg, NC

Building No: 4122
Date collected:
IES Inc., Chapel Hill, NC

**ENERGY ANALYSIS CHECKLIST**, page 1 of 6

| ENERGY CONSERVATIUN OPPORTUNITIES (ECOs) | YES | NO | EXPLANATION |
|---|---|---|---|
| **A. Heating, ventilating, and air conditioning** | | | |
| 1. Night setback/setup, shut off AHUs when possible | | X | E EMCS |
| 2. Reduce OA intake when air must be heated or cooled before use. | | X | E already at minimum |
| 3. Reduce supply and/or exhaust air flows | | X | E already at minimum |
| 4. Shut off/reduce speed of room fan coils | | X | NA no fan coil units |
| 5. Shut off/reduce stairwell or vestibule heating | | X | NA vestibule not heated |
| 6. Shut off unneeded circulating pumps | | X | E no unneeded pumps |
| 7. Reduce humidification to minimum requirements | | X | NA no humidification exists |
| 8. Reduce condenser water temperature | | X | NA central chiller plant |
| 9. Cycle fans and pumps | | X | E EMCS |
| 10. Reduce pumping flow | | X | E already at minimum |
| 11. Maintain authorized temperatures | X | | See A-29 |
| 12. Use damper controls to shut off air to unoccupied areas | | X | NA no unoccupied areas |
| 13. Repair and maintain steam lines and traps | | X | E good condition |
| 14. Reset hot and cold deck temperatures based on areas with the greatest need | | X | NA single zone system |
| 15. Raise chilled water temperature | | X | NA central chiller plant |
| 16. Shed loads during peak electrical use periods | | X | No available loads |
| 17. Use OA for dry bulb economizer cycle | X | | |
| 18. Reduce reheating of cooled air | | X | NA not a reheat system |
| 19. Recover heating/cooling energy with energy recovery units | X | | See G-3 and G-4 |
| 20. Reduce chilled water circulated during light cooling loads | | X | NCE small system |

E - existing
NCE - not cost effective
NA - not applicable/does not exist/not appropriate

FACILITY: Fort Bragg, NC

Building No: 4122
Date collected:
IES Inc., Chapel Hill, NC

**ENERGY ANALYSIS CHECKLIST**, page 2 of 6

| ENERGY CONSERVATION OPPORTUNITIES (ECOs) | YES | NO | EXPLANATION |
|---|---|---|---|
| **A. Heating, ventilating, and air conditioning (continued)** | | | |
| 21. Install minimum sized motor to meet loads | | X | E already minimum size |
| 22. Install infrared heating systems | | X | NCE efficient system exists |
| 23. Convert to variable air volume system | | X | NCE small system |
| 24. Common manifolding of chillers | | X | NA central chiller plant |
| 25. Insulate ducts and piping | | X | E insulation exists |
| 26. Eliminate simultaneous heating and cooling | | X | E no simultaneous heating and cooling |
| 27. Clean coils | X | | See maintenance items |
| 28. Maintain filters | X | | See maintenance items |
| 29. Repair and/or maintain AHU controls | X | | |
| 30. Water treatment or prevent tube fouling | | X | NA central boiler/chiller plant |
| 31. Multispd/variable spd cooling tower fans | | X | NA central chiller plant |
| 32. Provide a separate cooling system | | X | NA no areas with diff. schedule |
| 33. Provide return air ductwork | | X | E system has return ducts |
| 34. Reduce leakage of SA at AHU | | X | E does not leak |
| 35. Reduce static pressure | | X | E already at minimum |
| 36. Install destratification fans | | X | E dining room has ceiling fans |
| 37. Balance airflows | | X | E system is balanced |
| 38. Install make-up air systems in kitchen | | X | E exhaust has integral make-up |
| 39. Use thermal storage systems | | X | NCE small system |
| 40. Shut off exhaust systems when not in use | | X | E systems are shut off between meals |
| 41. Install computerized energy monitoring and control system | | X | E planned project |

FACILITY: Fort Bragg, NC

Building No: 4122
Date collected:
IES Inc., Chapel Hill, NC

**ENERGY ANALYSIS CHECKLIST**, page 3 of 6

| ENERGY CONSERVATION OPPORTUNITIES (ECOs) | YES | NO | EXPLANATION |
|---|---|---|---|
| **B. Boiler plant** | | | |
| 1. Reduce steam distribution pressure | | X | NA central boiler plant |
| 2. Increase boiler efficiency | | X | NA central boiler plant |
| 3. Repair, replace or install condensate return system. | | X | NA central boiler plant |
| 4. Insulate boiler and/or piping | | X | NA central boiler plant |
| 5. Install boiler economizer | | X | NA central boiler plant |
| 6. Install air pre-heater | | X | NA central boiler plant |
| 7. Check boiler water chemistry program. | | X | NA central boiler plant |
| 8. Clean boiler tubes | | X | NA central boiler plant |
| 9. Blowdown controls | | X | NA central boiler plant |
| 10. Modify boiler controls | | X | NA central boiler plant |
| 11. Install smaller boiler | | X | NA central boiler plant |
| **C. Lighting** | | | |
| 1. Shut off lights when not needed | | X | E lights are off between meals |
| 2. Reduce lighting levels | | X | E already at minimum |
| 3. Revise cleaning schedules | | X | E fixtures are clean |
| 4. Convert to energy efficient systems | X | | Dining hall |

FACILITY: Fort Bragg, NC

Building No: 4122
Date collected:
IES Inc., Chapel Hill, NC

**ENERGY ANALYSIS CHECKLIST**, page 4 of 6

| ENERGY CONSERVATION OPPORTUNITIES (ECOs) | YES | NO | EXPLANATION |
|---|---|---|---|
| **D. Building Envelope** | | | |
| 1. Reduce infiltration by caulking and weatherstripping | X | | |
| 2. Install double pane windows | | X | E double pane windows recently installed |
| 3. Install roof insulation | | X | E retrofit insulation installed |
| 4. Install loading dock seals | | X | NCE usage too low |
| 5. Install vestibules on entrances | | X | E main entrance is through barracks |
| 6. Install solar shading, films, screening, curtains, for blinds | | X | E tinted windows |
| 7. Install insulation in walls | | X | E planned project |
| 8. Install floor insulation | | X | NA floor over hot pipe chase |
| 9. Install plastic strips at personnel entrances | | X | NA not practical for kitchen |
| 10. Install insulating panels over windows | | X | E top panels are insulated |
| **E. Electrical Equipment** | | | |
| 1. Use emergency generator to reduce peak demand | | X | NA no emergency generator |
| 2. Shed/cycle elect loads to reduce peak demand | | X | NA no loads which can be cycled |
| 3. Convert to energy efficient motors | | X | NCE small motors |
| 4. Improve power factor | | X | NA no current penalty charge |
| 5. Shut off electric equipment when not needed | | X | E personnel turn off unneeded equipment |

FACILITY: Fort Bragg, NC

Building No: 4122
Date collected:
IES Inc., Chapel Hill, NC

**ENERGY ANALYSIS CHECKLIST**, page 5 of 6

| ENERGY CONSERVATION OPPORTUNITIES (ECOs) | YES | NO | EXPLANATION |
|---|---|---|---|
| **F. Plumbing** | | | |
| 1. Reduce domestic hot water temperature | | X | E already at minimum |
| 2. Repair and/or install water heater and hot water piping insulation | | X | E good condition |
| 3. Install flow restrictors | | X | NA not practical for kitchen |
| 4. Install faucets which automatically shut off water flow | | X | NA not practical for kitchen |
| 5. Decentralize hot water heating | | X | NA kitchen uses majority of DHW |
| 6. Use booster heaters on dishwashing equipment | X | | Convert to steam |
| 7. Recover heat from hot wastewater | X | | |
| 8. Install heat pump water heaters to provide hot water and cool the dining area | X | | |
| 9. Improve water heater efficiency | | X | E good efficiency |
| 10. Shut off water heater during unoccupied period | | X | NA needed for barracks |

FACILITY: Fort Bragg, NC

Building No: 4122
Date collected:
IES Inc., Chapel Hill, NC

**ENERGY ANALYSIS CHECKLIST**, page 6 of 6

| ENERGY CONSERVATION OPPORTUNITIES (ECOs) | YES | NO | EXPLANATION |
|---|---|---|---|
| **G. Kitchen** | | | |
| 1. Shut off range hood exhaust when possible and install dampers | | X | E personnel turn off hoods |
| 2. Shut off equipment and appliances whenever possible | | X | E personnel turn off unneeded equipment |
| 3. Recover heat from refrigeration equipment | X | | |
| 4. Install exhaust heat recovery systems | X | | |
| 5. Install automatic pilot lights | | X | Electric equipment |
| 6. Install low temperature chemical rinse dishwashing equipment | X | | |
| 7. Optimize kitchen operational procedures | | X | E see Chapter 1 |
| 8. Operate dishwashers only with full loads | | X | E dishwashers used only for full loads |
| 9. Preheat only the equipment that will be used | | X | E already done |
| 10. Preheat equipment just before using | | X | E already done |
| 11. Avoid use of hot water for dish scraping | | X | E used only when necessary |
| 12. Clean refrigeration coils | | X | E coils are clean |
| 13. Cook with lids in place | | X | E lids are used |
| 14. Thaw frozen food in refrigerated compartments | X | | |
| 15. Direct cooling fans away from cooking equipment | | X | NA no ceiling fans in kitchen |
| 16. Use kitchen exhaust only when needed | | X | E personnel turn off between meals |
| 17. Clean exhaust hood grease filters | | X | E filters were clean |
| 18. Provide direct exhaust hood make-up air supply | | X | E direct supply exists |
| 19. Match pots to burner size so that pots completely cover burner | | X | E large pots are used |
| 20. Steam vegetables in lieu of boiling when possible | | X | E steamer is used when possible |
| 21. De-energize booster water heaters at night | | X | E units are turned off at night |
| 22. Use microwave cooking equipment in lieu of conventional equipment when possible | X | | |

Table 1-4. Order of Computer Runs to Account for Interaction

1) base case as observed during field investigation (including planned projects)
2) implement envelope ECOs
3) implement lighting ECOs
4) implement ECOs to miscellaneous equipment
5) implement HVAC ECOs

Table 1-5, Recommended ECOs,Ranked by SIR, All Buildings

| ECO AND DESCRIPTION | | INSTALLED COST | FIRST YEAR $ SAVINGS ENERGY | FIRST YEAR $ SAVINGS NON-ENERGY | PAYBACK YRS | SIR | ANNUAL SAVINGS ELEC MBTU | ANNUAL SAVINGS GAS MBTU | ANNUAL SAVINGS #2 OIL MBTU |
|---|---|---|---|---|---|---|---|---|---|
| B-8-8T-3849 | Clean Boiler Tubes | 201 | 1918 | -130 | 0.1 | 84.25 | 0.0 | 0.0 | 324.6 |
| A-29-AT-4686 | Repair Controls | 153 | 332 | 0 | 0.5 | 23.14 | 0.0 | 75.5 | 0.0 |
| F-6-4-1437 | Steam Booster Heater | 3506 | 254 | 6026 | 0.6 | 16.98 | 113.9 | -175.2 | 0.0 |
| C-4-AT-4622 | Fluorescent Lighting | 52 | 53 | 52 | 0.5 | 14.55 | 8.2 | -2.9 | 0.0 |
| C-4-AT-4632 | Fluorescent Lighting | 52 | 51 | 52 | 0.5 | 14.28 | 8.2 | -3.2 | 0.0 |
| A-1-A-3275 | Night Setback Controls | 1266.0 | 1334.0 | -37.0 | 1.0 | 10.63 | 20.0 | 270.0 | 0.0 |
| F-6-C-4424 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-4122 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-4120 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-8339 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-3321 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-7433 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-3027 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-6432 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-3020 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-5528 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-8541 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-4426 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-8750 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-4422 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-4125 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-8344 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-4428 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-5725 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-6525 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-9349 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.18 | 122.6 | -188.7 | 0.0 |
| F-6-C-7634 | Steam Booster Heater | 3030 | 530 | 2655 | 1.0 | 9.17 | 122.6 | -188.7 | 0.0 |
| D-1-0-9013 | Weatherstripping | 307 | 137 | 0 | 2.2 | 8.86 | 0.0 | 0.0 | 23.2 |
| C-4-P-3042 | Fluorescent Lighting | 90 | 51 | 10 | 1.5 | 8.57 | 5.1 | 0.0 | 0.0 |
| A-1-0-9013 | Night Setback Thermostat | 506 | 274 | 0 | 1.8 | 7.24 | 0.0 | 0.0 | 46.4 |
| C-4-8T-3849 | Fluorescent Lighting | 104 | 66 | 0 | 1.6 | 6.46 | 11.7 | 0.0 | -8.8 |
| D-1-P-3042 | Weatherstripping | 221 | 219 | 0 | 1.0 | 4.82 | 1.0 | 0.0 | 35.3 |
| A-1-MT-6115 | Night Setback | 786 | 349 | -25 | 2.4 | 4.28 | 6.3 | 67.9 | 0.0 |
| D-1-C-6726 | Weatherstripping | 90 | 65 | 0 | 1.4 | 3.72 | 1.2 | 14.1 | 0.0 |

Table 1-5, Recommended ECOs,Ranked by SIR, All Buildings (Continued)

| ECO AND DESCRIPTION | | INSTALLED COST | FIRST YEAR $ SAVINGS ENERGY | FIRST YEAR $ SAVINGS NON-ENERGY | PAYBACK YRS | SIR | ANNUAL SAVINGS ELEC MBTU | ANNUAL SAVINGS GAS MBTU | ANNUAL SAVINGS #2 OIL MBTU |
|---|---|---|---|---|---|---|---|---|---|
| D-1-C-8438 | Weatherstripping | 90 | 65 | 0 | 1.4 | 3.72 | 1.2 | 14.1 | 0.0 |
| D-1-C-7236 | Weatherstripping | 90 | 65 | 0 | 1.4 | 3.72 | 1.2 | 14.1 | 0.0 |
| D-7-8T-3849 | Wall Insulation | 1730 | 669 | 0 | 2.6 | 3.63 | -0.6 | 0.0 | 114.3 |
| D-1-C-5528 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-4426 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-5725 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| C-4-C-4122 | Fluorescent Lighting | 2759 | 580 | 238 | 3.4 | 3.41 | 65.6 | -21.8 | 0.0 |
| D-1-C-7634 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-4428 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-3020 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-8339 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-6525 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-4424 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-7433 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-4125 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-3321 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-3027 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| D-1-C-4120 | Weatherstripping | 90 | 63 | 0 | 1.4 | 3.41 | 2.9 | 8.9 | 0.0 |
| F-2-AT-4622 | Insulate Storage Tank | 218 | 64 | 0 | 3.4 | 3.14 | 0.0 | 14.6 | 0.0 |
| C-4-0-9013 | Fluorescent Lighting | 1341 | 249 | 90 | 4.0 | 3.02 | 27.7 | 0.0 | -5.1 |
| G-5-AT-4622 | Automatic Pilot Lights | 545 | 156 | 0 | 3.5 | 3.02 | 0.7 | 34.2 | 0.0 |
| B-11-8T-3849 | Install Smaller Boiler | 6374 | 2145 | -130 | 3.2 | 2.99 | 0.0 | 0.0 | 363.0 |
| G-5-AT-4686 | Automatic Pilot Lights | 545 | 153 | 0 | 3.6 | 2.96 | 0.8 | 33.4 | 0.0 |
| D-3-8T-3849 | Attic Insulation | 5052 | 1551 | 0 | 3.3 | 2.94 | -18.0 | 0.0 | 293.2 |
| D-1-C-6432 | Weatherstripping | 90 | 52 | 0 | 1.7 | 2.93 | 1.4 | 10.1 | 0.0 |
| D-7-MT-6115 | Wall Insulation | 618 | 162 | 0 | 3.8 | 2.88 | -2.2 | 40.7 | 0.0 |
| G-5-MT-6115 | Automatic Pilot Lights | 545 | 141 | 0 | 3.9 | 2.69 | 1.6 | 29.2 | 0.0 |
| D-1-C-4122 | Weatherstripping | 90 | 47 | 0 | 1.9 | 2.67 | 1.0 | 9.8 | 0.0 |
| C-4-C-3020 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-6525 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-3027 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-7433 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-5725 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |

Table 1-5, Recommended ECOs,Ranked by SIR, All Buildings (Continued)

| ECO AND DESCRIPTION | | INSTALLED COST | FIRST YEAR $ SAVINGS ENERGY | FIRST YEAR $ SAVINGS NON-ENERGY | PAYBACK YRS | SIR | ANNUAL SAVINGS ELEC MBTU | ANNUAL SAVINGS GAS MBTU | ANNUAL SAVINGS #2 OIL MBTU |
|---|---|---|---|---|---|---|---|---|---|
| C-4-C-3321 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-4120 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-4428 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-8339 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-4125 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-4424 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-7634 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-4426 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| C-4-C-5528 | Fluorescent Lighting | 2759 | 371 | 238 | 4.5 | 2.62 | 41.0 | -11.4 | 0.0 |
| A-17-C-6432 | Dry Bulb Economizer | 612 | 180 | -16 | 3.7 | 2.58 | 17.9 | 0.0 | 0.0 |
| C-4-C-4422 | Fluorescent Lighting | 2759 | 300 | 238 | 5.1 | 2.42 | 31.0 | -3.3 | 0.0 |
| C-4-C-8541 | Fluorescent Lighting | 2759 | 293 | 238 | 5.2 | 2.40 | 30.1 | -2.7 | 0.0 |
| C-4-C-8344 | Fluorescent Lighting | 2759 | 293 | 238 | 5.2 | 2.40 | 30.1 | -2.7 | 0.0 |
| A-17-C-4122 | Dry Bulb Economizer | 612 | 167 | -16 | 4.1 | 2.37 | 16.6 | 0.0 | 0.0 |
| C-4-C-8750 | Fluorescent Lighting | 3471 | 310 | 306 | 5.6 | 2.19 | 32.9 | -5.8 | 0.0 |
| C-4-C-9349 | Fluorescent Lighting | 3471 | 307 | 306 | 5.7 | 2.17 | 32.8 | -6.2 | 0.0 |
| A-17-C-8541 | Dry Bulb Economizer | 612 | 153 | -16 | 4.5 | 2.15 | 15.2 | 0.0 | 0.0 |
| A-17-C-8344 | Dry Bulb Economizer | 612 | 153 | -16 | 4.5 | 2.15 | 15.2 | 0.0 | 0.0 |
| C-4-C-7236 | Fluorescent Lighting | 2759 | 232 | 238 | 5.9 | 2.11 | 24.4 | -3.6 | 0.0 |
| C-4-C-8438 | Fluorescent Lighting | 2759 | 232 | 238 | 5.9 | 2.11 | 24.4 | -3.6 | 0.0 |
| C-4-C-6726 | Fluorescent Lighting | 2759 | 232 | 238 | 5.9 | 2.11 | 24.4 | -3.6 | 0.0 |
| C-4-C-6432 | Fluorescent Lighting | 2759 | 233 | 238 | 5.9 | 2.03 | 26.5 | -9.1 | 0.0 |
| A-17-C-4426 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-3027 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-4428 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-3321 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-7634 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-4120 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-6525 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-5528 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-3020 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-4125 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |

Table 1-5, Recommended ECOs,Ranked by SIR, All Buildings (Continued)

| ECO AND DESCRIPTION | | INSTALLED COST | FIRST YEAR $ SAVINGS ENERGY | FIRST YEAR $ SAVINGS NON-ENERGY | PAYBACK YRS | SIR | ANNUAL SAVINGS ELEC MBTU | ANNUAL SAVINGS GAS MBTU | ANNUAL SAVINGS #2 OIL MBTU |
|---|---|---|---|---|---|---|---|---|---|
| A-17-C-7433 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-8339 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-5725 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| A-17-C-4424 | Dry Bulb Economizer | 612 | 143 | -16 | 4.8 | 1.99 | 14.2 | 0.0 | 0.0 |
| D-1-C-8344 | Weatherstripping | 90 | 32 | 0 | 2.8 | 1.83 | 0.7 | 6.7 | 0.0 |
| D-1-C-8541 | Weatherstripping | 90 | 32 | 0 | 2.8 | 1.83 | 0.7 | 6.7 | 0.0 |
| D-1-C-4422 | Weatherstripping | 90 | 30 | 0 | 3.0 | 1.75 | 0.5 | 6.8 | 0.0 |
| D-9-8T-3849 | Floor Insulation | 7469 | 1329 | 0 | 5.6 | 1.68 | -4.4 | 0.0 | 232.4 |
| A-17-C-6726 | Dry Bulb Economizer | 612 | 123 | -16 | 5.7 | 1.67 | 12.2 | 0.0 | 0.0 |
| A-17-C-7236 | Dry Bulb Economizer | 612 | 123 | -16 | 5.7 | 1.67 | 12.2 | 0.0 | 0.0 |
| A-17-C-8438 | Dry Bulb Economizer | 612 | 123 | -16 | 5.7 | 1.67 | 12.2 | 0.0 | 0.0 |
| D-1-AT-4686 | Weatherstripping | 339 | 103 | 0 | 3.3 | 1.62 | 0.0 | 23.5 | 0.0 |
| D-1-MT-6115 | Weatherstripping | 441 | 117 | 0 | 3.8 | 1.42 | -0.2 | 27.0 | 0.0 |
| D-1-AT-4632 | Weatherstripping | 339 | 89 | 0 | 3.8 | 1.40 | 0.1 | 20.1 | 0.0 |
| D-1-8T-3849 | Replace Door Weatherstr. | 624 | 177 | 0 | 3.5 | 1.39 | 0.0 | 0.0 | 30.0 |
| D-1-AT-4622 | Weatherstripping | 339 | 86 | 0 | 3.9 | 1.34 | 0.1 | 19.3 | 0.0 |
| A-29-C-6432 | Repair Controls | 2823 | 291 | 0 | 9.7 | 1.27 | 16.0 | 34.8 | 0.0 |
| D-1-C-9349 | Weatherstripping | 180 | 42 | 0 | 4.3 | 1.21 | 0.7 | 9.4 | 0.0 |
| D-1-C-8750 | Weatherstripping | 180 | 40 | 0 | 4.5 | 1.16 | 0.6 | 9.1 | 0.0 |
| A-29-H-5718 | Repair Controls | 1375 | 163 | 0 | 8.4 | 1.15 | 16.2 | 0.0 | 0.0 |
| A-29-C-3321 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-5725 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-6525 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-3027 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-3020 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-4120 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-8339 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-4125 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-4424 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-4426 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-7433 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-4428 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |

Table 1-5, Recommended ECOs,Ranked by SIR, All Buildings (Continued)

| ECO AND DESCRIPTION | | INSTALLED COST | FIRST YEAR $ SAVINGS ENERGY | FIRST YEAR $ SAVINGS NON-ENERGY | PAYBACK YRS | SIR | ANNUAL SAVINGS ELEC MBTU | ANNUAL SAVINGS GAS MBTU | ANNUAL SAVINGS #2 OIL MBTU |
|---|---|---|---|---|---|---|---|---|---|
| A-29-C-7634 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-5528 | Repair Controls | 2823 | 265 | 0 | 10.7 | 1.12 | 16.2 | 27.3 | 0.0 |
| A-29-C-8750 | Repair Controls | 2823 | 254 | 0 | 11.1 | 1.09 | 14.8 | 28.1 | 0.0 |
| A-29-C-4422 | Repair Controls | 2823 | 262 | 0 | 10.8 | 1.09 | 16.8 | 24.7 | 0.0 |
| A-29-C-9349 | Repair Controls | 2926 | 252 | 0 | 11.6 | 1.04 | 14.6 | 27.9 | 0.0 |
| A-17-C-4422 | Dry Bulb Economizer | 612 | 82 | -16 | 9.3 | 1.02 | 8.1 | 0.0 | 0.0 |
| A-1-8T-3849 | Night Setback Controls | 11908 | 1409 | -74 | 8.9 | 1.01 | 32.1 | 0.0 | 183.6 |
| A-29-C-8344 | Repair Controls | 2823 | 245 | 0 | 11.5 | 1.01 | 16.0 | 22.3 | 0.0 |
| A-29-C-8541 | Repair Controls | 2823 | 245 | 0 | 11.5 | 1.01 | 16.0 | 22.3 | 0.0 |
| A-29-C-6726 | Repair Controls | 2823 | 233 | 0 | 12.1 | 1.00 | 13.4 | 26.2 | 0.0 |
| A-29-C-8438 | Repair Controls | 2823 | 233 | 0 | 12.1 | 1.00 | 13.4 | 26.2 | 0.0 |
| A-29-C-7236 | Repair Controls | 2823 | 233 | 0 | 12.1 | 1.00 | 13.4 | 26.2 | 0.0 |
| A-29-C-4122 | Repair Controls | 2823 | 242 | 0 | 11.7 | 1.00 | 15.7 | 22.4 | 0.0 |
| T O T A L S | | 261975 | 3942 | 67085 | 3.7 | | 4434.2 | -2841.8 | 1632.1 |

### 1.4.3 ECOs Considered but not Recommended

Table 1-6 is a list of typical ECOs which were analyzed but were not found to be cost effective.

Table 1-6. Typical ECOs Not Recommended

| ECO | Title | Reason Rejected |
|---|---|---|
| F-7 | Waste Water Heat Recovery | SIR < 1.0 |
| F-8 | Heat Pump Water Heater | SIR < 1.0 |
| G-3 | Refrigerant Heat Recovery | SIR < 1.0 |
| G-4 | Exhaust Heat Recovery | SIR < 1.0 |
| D-1 | Double Pane Replacement Windows | SIR < 1.0 |
| A-32 | Replace HVAC System | SIR < 1.0 |

## 1.5 Energy and Cost Savings

Table 1-7 summarizes the ECO cost and dollar savings by type of building. As noted, the total cost of implementation is $261,975, with an energy savings of $43,795 and a non-energy savings of $67,085, for a payback of 2.4 years.

Table 1-8 summarizes the total annual energy cost and consumption by fuel type for the detailed buildings before and after energy conservation. Figures 1-3 and 1-4 also show energy cost and consumption before and after energy conservation for the detailed buildings.

Table 1-9 shows the energy consumption and cost per meal and per square foot for the detailed building. The consumption and cost per square foot data was extrapolated to similar walk-thru buildings to form Table 1-10. Figure 1-5 combines the calculated energy cost for the detailed buildings and the extrapolated cost for the walk-thru buildings to show the total energy cost before and after energy conservation.

## 1.6 Projects Developed

Table 1-11 summarizes the projects developed. Many ECOs listed in the ECO summary table (Table 1-5) have not been programmed; thus the totals for Table 1-9 are less than Table 1-5. These ECOs were not programmed because it was discovered at the Interim Presentation that they have been included in other ongoing projects or are no longer applicable.

Table 1-7, Recommended ECOs, By Building Category

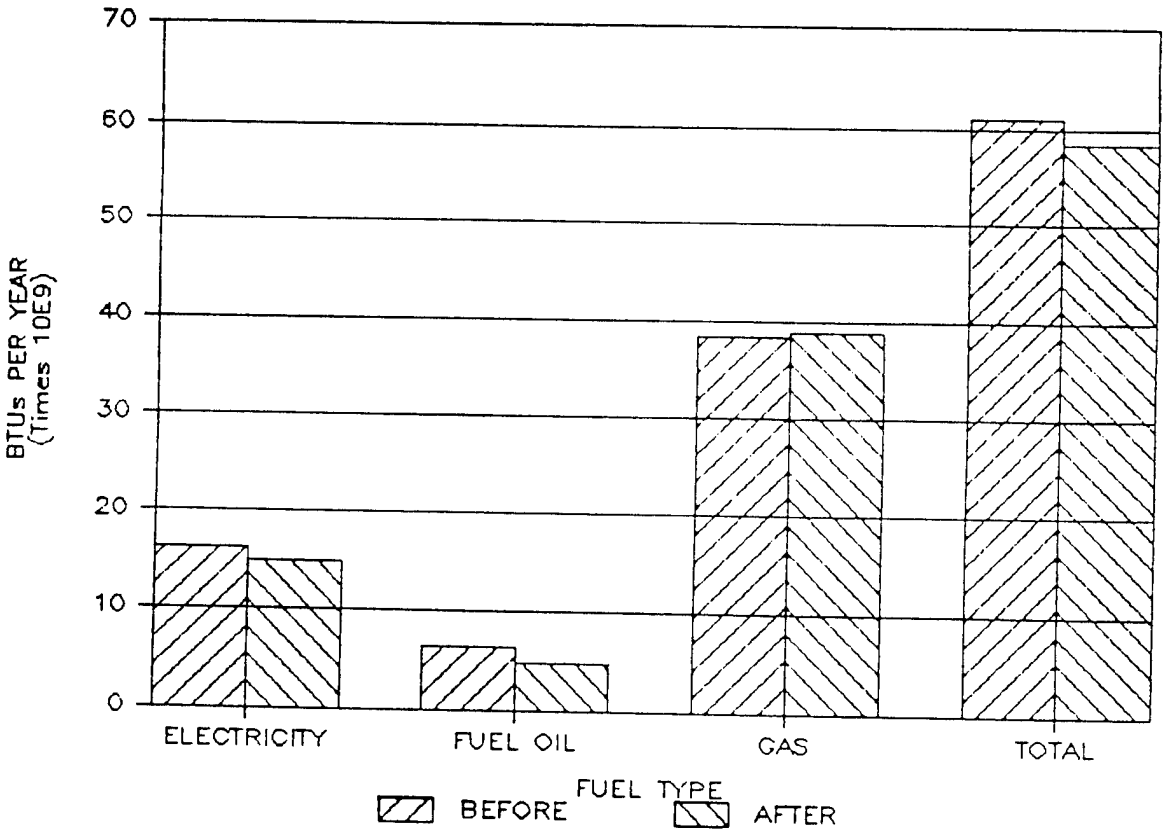
| Building Type & Category | INSTALLED COST | $ SAVINGS ENERGY | $ SAVINGS NON-ENERGY | PAYBACK YRS | SAVINGS ELEC MBTU | SAVINGS GAS MBTU | SAVINGS #2 OIL MBTU |
|---|---|---|---|---|---|---|---|
| Category 1,Type 64, C Buildings | 158338 | 23264 | 48909 | 2.2 | 3342.0 | -2786.0 | 0.0 |
| Category 2,Type 64A, C Buildings | 18628 | 2506 | 5754 | 2.3 | 369.2 | -324.8 | 3264.2 |
| Category 3,Type 121, C Buildings | 9504 | 1134 | 2961 | 2.3 | 170.9 | -157.3 | 0.0 |
| Category 4,Type 121, C Buildings | 9607 | 1131 | 2961 | 2.3 | 170.7 | -157.6 | 0.0 |
| Category 5,Type 64, C Buildings | 18852 | 1959 | 666 | 7.2 | 153.6 | 110.1 | 0.0 |
| Category 8, H Buildings | 1375 | 163 | 0 | 8.4 | 16.2 | 0.0 | 0.0 |
| Category 9, O Buildings | 2154 | 660 | 90 | 2.9 | 27.7 | 0.0 | 64.5 |
| Category 10, P Buildings | 311 | 270 | 10 | 1.1 | 6.1 | 0.0 | 35.3 |
| Category 12, (4) Buildings | 3506 | 254 | 6026 | 0.6 | 113.8 | -175.2 | 0.0 |
| Temporary Buildings,Types (AT,MT,8T) | 38434 | 11120 | -255 | 3.5 | 44.0 | 379.0 | 1532.3 |
| Building A-1-A-3275 | 1266.0 | 1334.0 | -37.0 | 1.0 | 20.0 | 270.0 | 0.0 |
| T O T A L S | 261975 | 43795 | 67085 | 2.4 | 4434.2 | -2841.8 | 4896.3 |

Table 1-8. Total Energy Cost and Consumption, Before and After Conservation (Detailed Buildings)

| | Before Conservation | | | | After Conservation | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Gas | Oil | Elec | Total | Gas | Oil | Elec | Total | Total % Reduction |
| $ Cost | 148,306 | 38,192 | 309,218 | 495,716 | 149,590 | 28,546 | 271,590 | 449,726 | 10.2 |
| Consumption (MBTUs) | 38,381.2 | 6,462.3 | 16,308.4 | 61,151.9 | 38,839.4 | 4,830.2 | 14,917.8 | 58,587.4 | 4.4 |

Figure 1-3.

## ENERGY CONSUMPTION BEFORE & AFTER OF DETAILED BUILDINGS

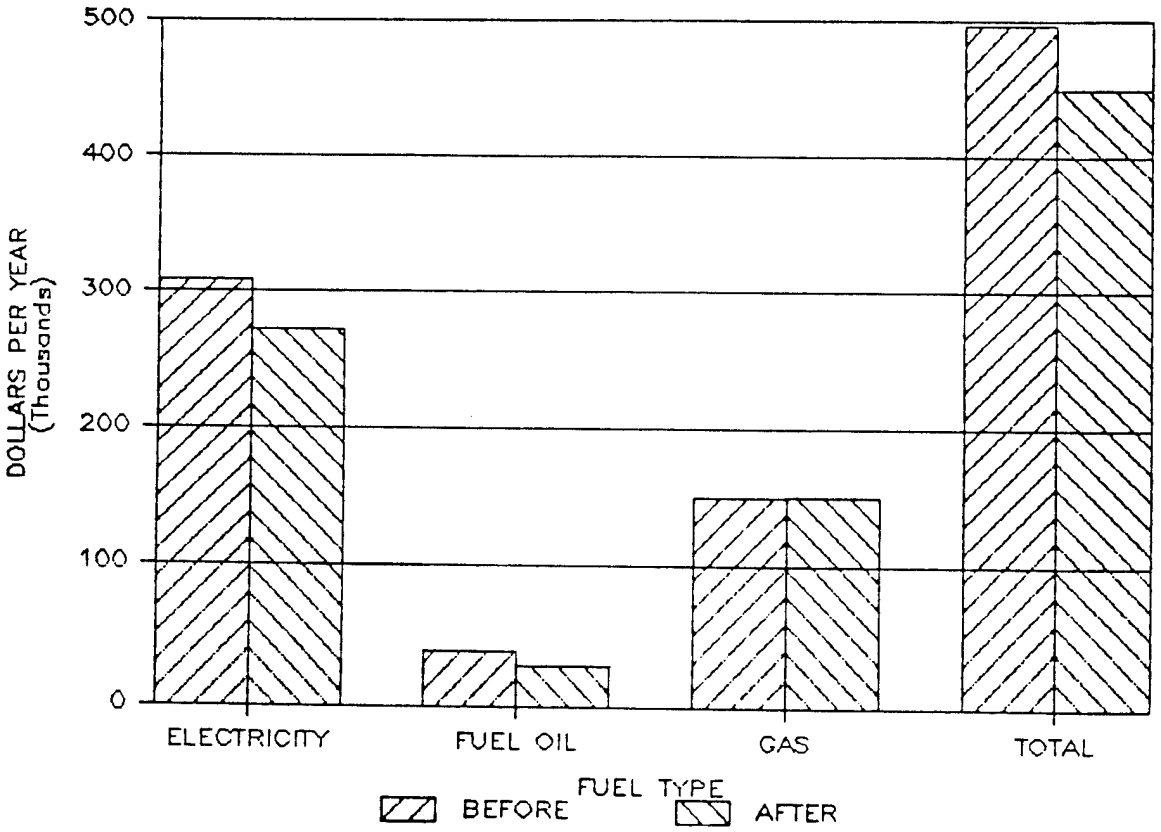



Buildings Included in Detailed Audit

| Building | Sq ft | Building | Sq ft |
|---|---|---|---|
| C-4122 | 4,850 | 0-9013 | 4,800 |
| C-4422 | 4,850 | P-3042 | 7,857 |
| C-6432 | 4,850 | I-1242 | 3,168 |
| C-8344 | 4,850 | 4-1437 | 7,500 |
| C-8750 | 5,050 | A-3275 | 5,608 |
| C-9349 | 5,050 | AT-4622 | 2,800 |
| C-7236 | 4,850 | AT-4632 | 2,800 |
| D-2626 | 11,313 | AT-4686 | 2,800 |
| D-3404 | 9,346 | MT-6115 | 2,375 |
| H-5718 | 14,920 | 8T-3849 | 13,400 |

Figure 1-4.

## ENERGY COST BEFORE & AFTER OF DETAILED BUILDINGS




Buildings Included in Detailed Audit

| Building | Sq ft | Building | Sq ft |
|---|---|---|---|
| C-4122 | 4,850 | 0-9013 | 4,800 |
| C-4422 | 4,850 | P-3042 | 7,857 |
| C-6432 | 4,850 | I-1242 | 3,168 |
| C-8344 | 4,850 | 4-1437 | 7,500 |
| C-8750 | 5,050 | A-3275 | 5,608 |
| C-9349 | 5,050 | AT-4622 | 2,800 |
| C-7236 | 4,850 | AT-4632 | 2,800 |
| D-2626 | 11,313 | AT-4686 | 2,800 |
| D-3404 | 9,346 | MT-6115 | 2,375 |
| H-5718 | 14,920 | 8T-3849 | 13,400 |

Table 1-9. Energy Summary Data, Detailed Buildings

| | | BEFORE CONSERVATION | | | | | | | AFTER CONSERVATION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BUILDING | AREA | MBTU | COST | MEALS/ YEAR | MBTU/ SQ FT | MBTU/ MEAL | COST/ SQ FT | COST/ MEAL | MBTU | COST | MBTU/ SQ FT | MBTU/ MEAL | COST/ SQ FT | COST/ MEAL |
| C-4122 | 4,850 | 2,739.2 | $25,877 | 234,000 | 0.5648 | 0.0117 | $5.34 | $0.11 | 2,696.0 | $21,428 | 0.5559 | 0.0115 | $4.42 | $0.09 |
| C-4422 | 4,850 | 2,937.6 | $25,633 | 234,000 | 0.6057 | 0.0126 | $5.29 | $0.11 | 2,919.1 | $21,536 | 0.6019 | 0.0125 | $4.44 | $0.09 |
| C-6432 | 4,850 | 2,925.6 | $26,158 | 234,000 | 0.6032 | 0.0125 | $5.39 | $0.11 | 2,894.1 | $21,979 | 0.5967 | 0.0124 | $4.53 | $0.09 |
| C-8344 | 4,850 | 2,661.9 | $24,884 | 234,000 | 0.5488 | 0.0114 | $5.13 | $0.11 | 2,639.7 | $20,738 | 0.5443 | 0.0113 | $4.28 | $0.09 |
| C-8750 | 5,050 | 3,022.0 | $25,234 | 234,000 | 0.5984 | 0.0129 | $5.00 | $0.11 | 3,008.4 | $21,139 | 0.5957 | 0.0129 | $4.19 | $0.09 |
| C-9349 | 5,050 | 3,032.4 | $25,408 | 234,000 | 0.6005 | 0.0130 | $5.03 | $0.11 | 3,019.3 | $21,316 | 0.5979 | 0.0129 | $4.22 | $0.09 |
| C-7236 | 4,850 | 4,159.0 | $27,243 | 234,000 | 0.8575 | 0.0178 | $5.62 | $0.12 | 4,071.1 | $26,352 | 0.8394 | 0.0174 | $5.43 | $0.11 |
| D-2626 | 11,313 | 5,781.5 | $33,030 | 352,300 | 0.5110 | 0.0164 | $2.92 | $0.09 | 5,781.5 | $33,030 | 0.5110 | 0.0164 | $2.92 | $0.09 |
| D-3404 | 9,346 | 3,765.7 | $23,023 | 255,500 | 0.4029 | 0.0147 | $2.46 | $0.09 | 3,765.7 | $23,023 | 0.4029 | 0.0147 | $2.46 | $0.09 |
| H-5718 | 14,920 | 8,588.6 | $63,604 | 730,000 | 0.5756 | 0.0118 | $4.26 | $0.09 | 8,572.4 | $63,441 | 0.5746 | 0.0117 | $4.25 | $0.09 |
| O-9013 | 4,800 | 581.9 | $6,575 | 16,640 | 0.1212 | 0.0350 | $1.37 | $0.40 | 489.7 | $5,825 | 0.1020 | 0.0294 | $1.21 | $0.35 |
| P-3042 | 7,857 | 3,192.9 | $20,931 | 100,375 | 0.4064 | 0.0318 | $2.66 | $0.21 | 3,151.5 | $20,651 | 0.4011 | 0.0314 | $2.63 | $0.21 |
| I-1242 | 3,168 | 2,331.6 | $33,637 | 240,900 | 0.7360 | 0.0097 | $10.62 | $0.14 | 2,331.6 | $33,637 | 0.7360 | 0.0097 | $10.62 | $0.14 |
| 4-1437 | 7,500 | 4,339.6 | $36,841 | 236,600 | 0.5786 | 0.0183 | $4.91 | $0.16 | 4,400.9 | $30,561 | 0.5868 | 0.0186 | $4.07 | $0.13 |
| A-3275 | 5,608 | 2,253.0 | $19,106 | 164,250 | 0.4017 | 0.0137 | $3.41 | $0.12 | 1,963.0 | $17,772 | 0.3500 | 0.0120 | $3.17 | $0.11 |
| AT-4622 | 2,800 | 1,251.0 | $12,901 | 73,000 | 0.4468 | 0.0171 | $4.61 | $0.18 | 1,176.8 | $12,490 | 0.4203 | 0.0161 | $4.46 | $0.17 |
| AT-4632 | 2,800 | 1,138.4 | $12,297 | 73,000 | 0.4066 | 0.0156 | $4.39 | $0.17 | 1,113.2 | $12,105 | 0.3976 | 0.0152 | $4.32 | $0.17 |
| AT-4686 | 2,800 | 1,183.4 | $12,494 | 73,000 | 0.4226 | 0.0162 | $4.46 | $0.17 | 1,050.2 | $11,906 | 0.3751 | 0.0144 | $4.25 | $0.16 |
| MT-6115 | 2,375 | 1,130.4 | $12,041 | 73,000 | 0.4760 | 0.0155 | $5.07 | $0.16 | 960.1 | $11,272 | 0.4043 | 0.0132 | $4.75 | $0.15 |
| 8T-3849 | 13,400 | 4,136.2 | $28,798 | 119,600 | 0.3087 | 0.0346 | $2.15 | $0.24 | 2,583.1 | $19,868 | 0.1928 | 0.0216 | $1.48 | $0.17 |
| TOTALS | 123,037 | 61,151.9 | $495,715 | 4,146,165 | 10.1731 | 0.3422 | $90.09 | $2.98 | 58,587.4 | $450,069 | 9.7862 | 0.3153 | $82.11 | $2.68 |

Table 1-10. Extrapolated Energy Data, Walk-thru Buildings

| | | BEFORE CONSERVATION | | | | AFTER CONSERVATION | | | |
|---|---|---|---|---|---|---|---|---|---|
| BUILDING | AREA | MBTU | COST | MBTU/ SQ FT | COST/ SQ FT | MBTU | COST | MBTU/ SQ FT | COST/ SQ FT |
| C-3020 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-3027 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-3321 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-4120 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-4125 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-4424 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-4426 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-4428 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-5528 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-5725 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-6525 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-7433 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-7634 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-8339 | 4,850 | 2,867.5 | $25,889 | 0.5912 | $5.34 | 2,836.4 | $21,648 | 0.5848 | $4.46 |
| C-8541 | 4,850 | 2,661.9 | $24,884 | 0.5488 | $5.13 | 2,639.7 | $20,738 | 0.5443 | $4.28 |
| C-6726 | 4,850 | 4,159.0 | $27,243 | 0.8575 | $5.62 | 4,071.1 | $26,352 | 0.8394 | $5.43 |
| C-8438 | 4,850 | 4,159.0 | $27,243 | 0.8575 | $5.62 | 4,071.1 | $26,352 | 0.8394 | $5.43 |
| D-2105 | 11,313 | 5,781.5 | $33,030 | 0.5110 | $2.92 | 5,781.5 | $33,030 | 0.5110 | $2.92 |
| D-3039 | 11,313 | 5,781.5 | $33,030 | 0.5110 | $2.92 | 5,781.5 | $33,030 | 0.5110 | $2.92 |
| D-3055 | 11,313 | 5,781.5 | $33,030 | 0.5110 | $2.92 | 5,781.5 | $33,030 | 0.5110 | $2.92 |
| H-4842 | 14,920 | 8,588.6 | $63,604 | 0.5756 | $4.26 | 8,572.4 | $63,441 | 0.5746 | $4.25 |
| 2-1105 | 3,168 | 2,331.6 | $33,637 | 0.7360 | $10.62 | 2,331.6 | $33,637 | 0.7360 | $10.62 |
| 2-1138 | 3,168 | 2,331.6 | $33,637 | 0.7360 | $10.62 | 2,331.6 | $33,637 | 0.7360 | $10.62 |
| TOTALS | 137,645 | 81,721.2 | $671,789 | 14.1220 | $125.35 | 81,071.6 | $606,314 | 13.9903 | $111.88 |

Table 1-11. Project Summary Totals

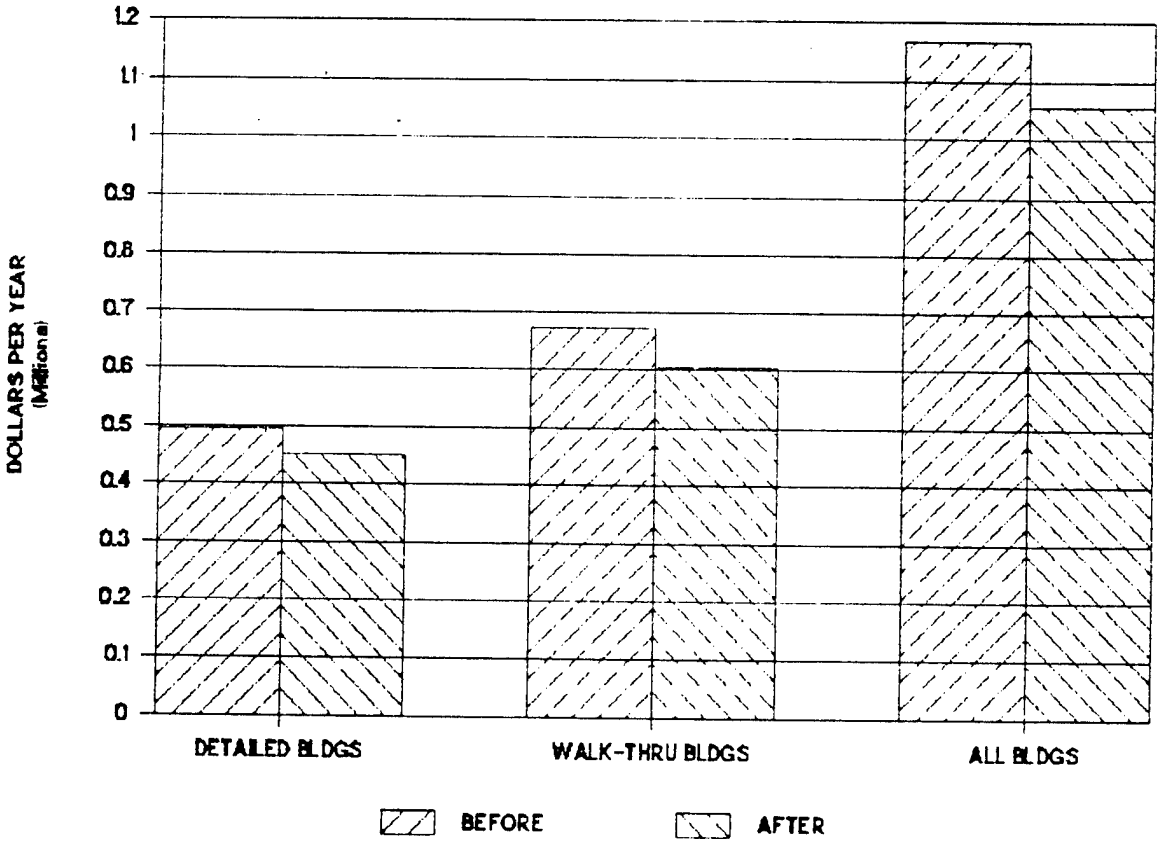
| ECO AND DESCRIPTION | | TOTAL INSTALLED COST | TOTAL $ SAVINGS ENERGY | TOTAL $ SAVINGS NON-ENERGY | TOTAL PAYBACK YRS | TOTAL SIR | ELEC MBTU | TOTAL SAVINGS GAS MBTU | #2 OIL MBTU |
|---|---|---|---|---|---|---|---|---|---|
| Project # 1 | Low Cost/No Cost ECO's | 419 | 1982 | -130 | 0.2 | 42.02 | 0.0 | 14.6 | 324.6 |
| Project # 2 | Install Steam Booster Heaters | 67136 | 11384 | 61781 | 0.9 | 9.18 | 2688.5 | -4137.9 | 0.0 |
| Project # 3 | Weatherstripping | 1119 | 309 | 0 | 3.6 | 1.47 | -0.1 | 70.6 | 0.0 |
| Project # 4 | Wall Insulation | 618 | 162 | 0 | 3.8 | 2.88 | -2.2 | 40.7 | 0.0 |
| Project # 5 | Fluorescent Lighting | 69279 | 8676 | 6088 | 4.7 | 2.55 | 957.1 | -228.1 | -13.9 |
| Project # 6 | Controls ECO's | 2711 | 2289 | -62 | 1.2 | 8.49 | 26.3 | 413.4 | 46.4 |
| Project # 7 | Dry Bulb Economizers | 13464 | 3106 | -352 | 4.9 | 1.96 | 308.4 | 0.0 | 0.0 |
| GRAND TOTALS | | 154746* | 27908 | 67325 | 1.6 | | 3978.0 | -3826.7 | 357.1 |

Note: Projects #2-7 are assumed to be implemented in 1989; Project #1 in 1988.

* Does not include ECOs which have been programmed or determined not applicable due to demolition subsequent to the initiation of this study.

Figure 1-5.

# ENERGY COST BEFORE & AFTER
## (Includes All Buildings)




Notes

1) Data for Detailed Buildings was based on BLAST Analysis.
2) Data for Walk-thru Buildings was extrapolated for similar detailed buildings.

Project #1 consists of Low Cost/No Cost ECOs. These are ECOs which will be completed with DEH funds, scheduled for 1988.

Project #2 has been programmed as a QRIP project for 1989.

Projects #3-7 do not qualify for any of the funding categories listed in the SOW (ECIP, QRIP, PECIP, OSD/PIF). Programming documentation similar to QRIP documents was completed for these projects for 1989, at the request of base personnel. These projects will be funded under other military programs.