ENERGY ENGINEERING
ANALYSIS PROGRAM

AT

AAFES POST EXCHANGE

BUILDINGS 62, 63 -
QUARTER MASTER KASERNE
AND
BUILDING 106 - SHERIDAN KASERNE
AUGSBURG MILITARY COMMUNITY
AUGSBURG, WEST GERMANY

US ARMY ENGINEER DIVISION,
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: Mr. Robert Yust (Master Planning)

Abbreviations

The following abbreviations are used throughout this report.

A	Area
AHU	Air handling unit
cfh	Cubic feet per hour
cfm	Cubic feet per minute
COP	Coefficient of performance
CWE	Current working estimate
ECIP	Energy conservation investment program
ECO	Energy conservation opportunities
EEAP	Energy Engineering Analysis Program
EEI	Energy Engineering, Inc.
DHW	Domestic hot water
DM	German marks
DoD	Department of Defense
FY	Fiscal year
gsf	Gross square footage
Htf	Heat transmission factor (U x A)
H&V	Heating and ventilating
HVAC	Heating ventilating and air conditioning
HP	Horsepower
Inf	Infiltration
Kw	Kilowatt
kWh	Kilowatt hour
MBtu	Million British thermal units
OA	Outside air
O&M	Operating and maintenance
PM	Preventive maintenance
PX	Post exchange
SBC	Single building controller also referred to an energy management and control system
SF	Square feet
SIOH	Government supervision, inspection and overhead
SIR	Savings to investment ration
U	Heat transfer coefficient
Vent	Ventilation

I. Purpose of Report

This document is the final submittal for the energy conservation study conducted for Buildings 62, 63 and 106, the post exchange facilities. This study is being funded through the Energy Engineering Analysis Program (EEAP). The Energy Engineering Analysis Program is an Army-wide program that studies energy conservation. This study is being conducted at the Augsburg Military Community in West Germany.

The EEAP has been authorized by the United States Department of the Army, European Division, Corps of Engineers, headquartered in Frankfurt, West Germany, under Contract No. DACA90-86-C-0106.

The purpose of this report is twofold:

1) Provide specific energy conservation recommendations for Buildings 62, and 63 in Quarter Master Kaserne and Building 106 in Sheridan Kaserne;

2) Provide general energy conservation recommendations for post exchange facilities.

II. EXECUTIVE SUMMARY

A. Discussion

The potential to cost effectively reduce energy costs at the post exchange facilities in Augsburg, West Germany is outstanding. Three (3) buildings were analyzed in this report: buildings 62 (Exchange and Warehouse) and 63 (Main Post Exchange) at Quarter Master Kaserne and building 106 (Retail Store and Pizza Parlor) at Sheridan Kaserne. A reduction in total energy costs of 51% is projected to result from the simultaneous implementation of all recommended projects, for a combined cost savings of $103,315 per year.

The thirteen (13) recommended energy conservation opportunities (ECOs) have been developed into two projects: facility modifications, and HVAC lighting and weatherization modifications. The implementation cost for all the recommended projects is estimated to total $284,671. The combined simple payback (i.e., implementation costs divided by cost savings) for the recommendations in this survey is 2.76 years. A list of projects, savings to investment ratios (SIRs), simple payback periods, implementation costs, annual cost savings, and annual energy savings can be found in Table I on the following page.

Minor modifications to the study buildings have been packaged for OMA funding as project 1. These modifications include reducing domestic hot water (DHW) temperature, installing a timer on the DHW heater, increasing freezer temperatures, and cycling the anti-condensate heaters. Annual cost savings of $421 are anticipated at implementation costs totaling $549. An SIR of 10.96 and a simple payback period of 1.30 years are expected.

Undoubtedly, the greatest cost savings will result from the installation of Single Building Controllers (SBCs). Annual cost savings of $74,824 (or 72% of the total projected savings) is projected to result from the SBC installation. This component of project 2 is clearly the single most important item recommended in this report. Estimated implementation costs are $150,967.

Modifications to the interior and exterior lighting systems will result in annual energy cost savings of $21,358 (accounting for 55% of the total electrical savings). Additionally, annual maintenance savings of $4,094 can be expected. These modifications include low cost/no cost Energy Conservation Opportunities (ECOs) such as delamping excessively lit areas and changing existing lighting practices. ECOs requiring capital expenditures include: installing devices to automatically de-energize lights such as motion sensors, photocells, and timers; retrofitting incandescent lamps and fixtures with fluorescent lamps and fixtures; replacing exterior fixtures with more efficient high intensity discharge fixtures; and modifying the fluorescent display lighting. Implementation costs for this portion of project 2 are estimated to total $49,485.

Anticipated cost savings of $6,715 can be achieved through the addition of insulation to pipes, valves, and structural building components and also the weatherstripping of windows and doors. A total implementation cost of $83,670 is estimated.

TABLE I

Project	Project Title	SIR	Simple Payback Period (Years)	Implementation Costs	Annual Cost Savings	Annual Energy Savings (MBtu)
1.	Facility Modifications	10.96	1.30	$ 549	$ 421	23
2.	HVAC, Lighting Modifications & Weatherization	4.40	2.76	$284,122	$102,894*	8,334
	Totals			$284,671	$103,315	8,357

Combined simple payback period:

$$\frac{\$284,671}{\$103,315} = 2.76 \text{ years.}$$

*Includes demand savings.

Major improvements are needed to the operating and maintenance (O&M) practices in the buildings studied by EEI. Most of the maintenance deficiencies were concentrated in building 63 and primarily involved the upkeep of the air handling units.

Highlights of the O&M practices included excellent refrigeration maintenance; clean mechanical rooms; good lighting system maintenance; and adequate structural maintenance.

The O&M practices are of particular concern with the recommendation of an SBC. Although an SBC is an exceedingly valuable, versatile tool in the control and monitoring of energy consumption, the system will require increased maintenance of both the SBC and the equipment which the SBC monitors and controls. Accordingly, it should be anticipated that additional responsibilities will result from the installation of a building control system. Specifically, a responsible individual must be committed to the daily monitoring and analyzing of system alarms, building conditions, and energy consumption. It is not the intention for the post exchange personnel to monitor and program the SBC. It will be the responsibility of the plant maintenance engineer to oversee the proper operation of the building controller. However, the post exchange management should be briefed on the operations of the building systems. On an average, one-half hour per day is needed to review alarms and building conditions. As the system expands more time will be required for the daily routine monitoring of the SBC. Additionally, routine electrical/ mechanical maintenance will be required to satisfactorily maintain system components. Accordingly, it is emphasized that cost savings are estimated based on an operable and well-maintained building control system -- invariably, a poorly operated and monitored system will produce limited cost savings.

B. Building Description and Fuel Costs

The buildings studied in this report consist of buildings 62 and 63 in Quarter Master Kaserne and building 106 in Sheridan Kaserne. A brief description of functional use, gross square footage, and building equipment is described below.

Building 62 - Quarter Master Kaserne: Building 62 is a 61,646 square foot, six story structure utilized as a post exchange and storage facility. The present steam radiation heating system is budgeted for replacement with a hydronic heating system. The primary electrical consumer is interior lighting.

Building 63 - Quarter Master Kaserne: Building 63 is an 86,905 square foot, six story structure with an attached two story addition. The facility is utilized as the main post exchange. The building heating systems have recently been renovated. Heating and ventilation is provided to the building by a system of eight (8) air handling units and perimeter radiation. The primary electrical consumers are interior lighting and heating and ventilating equipment.

Building 106 - Sheridan Kaserne: Building 106 is a 32,402 square foot, two story structure utilized as a retail store, pizza parlor, and offices. The building's heating and lighting systems are presently under renovation. The present steam radiation heating system is being replaced with a hydronic system. The primary electrical consumers are kitchen equipment and interior lighting.

Fuel Costs

The fuel costs used throughout the report are:

Electricity: $0.08248/kWh: $24.166/MBtu;

Thermal (district heat): $9.360/MBtu.

Electric costs were obtained by taking the average cost for Quarter Master, Reese and Sheridan Kasernes during fiscal year 1986.

The thermal cost used was that projected for district heat by USAREUR and EUD.

C. Present Energy Consumption

EEI calculated present energy usage through the use of an EEI computer program used in more than 300 previous energy studies. Specific algorithms utilized are detailed in the Methods of Analysis section of this report. Calculated electrical consumption projections were first compared to the electrical metered data to assure the reasonableness of EEI's assumptions. Thereafter, projected consumption for buildings 62, 63 and 106 were compared to similar buildings to further validate the electrical energy consumption calculations. Similar measures were taken to ensure the accuracy of the calculated thermal consumption.

Having established a current consumtion model, EEI examined and incorporated any pending construction project which would effect building utility consumption into a new energy consumption model.

The following pages detail current and projected energy consumption models for buildings 62, 63 and 106.

CALCULATION OF AN ENERGY BALANCE FOR THE PERIOD OCT 85 - SEPT 86

BUILDING 62 - QUARTER MASTER KASERNE

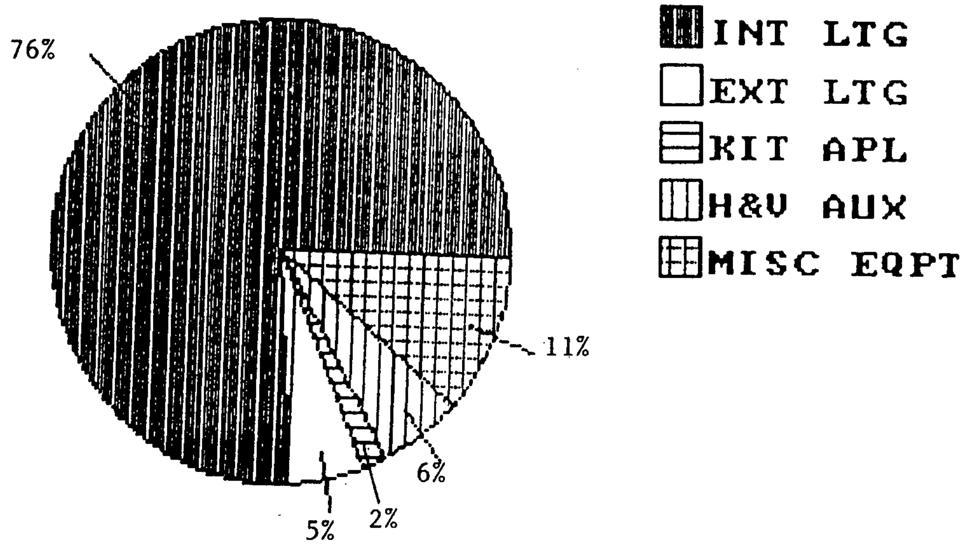
Regarding present electrical consumption in building 62, the following table summarizes annual kWh totals for each category listed:

Energy Consuming Equipment	Annual kWh	Real Costs ($)	Btu/SF
Interior Lighting (INT LTG)	65,471	$5,400	3,625
Exterior Lighting (EXT LTG)	4,577	$ 377	253
Kitchen Appliances (KIT APL)	1,602	$ 132	89
H&V Auxiliaries (H&V AUX)	4,877	$ 402	270
Miscellaneous Equipment (MISC EQPT)	9,637	$ 795	534
Total	86,164	$7,106	4,771
Actual*	85,121	$7,021	4,713
% deviation from actual	1.2%	1.2%	1.2%

* Electrical consumption was estimated from a two week metering period and then adjusted for seasonal variations in equipment usage and building occupancy to obtain an annual consumption rate.

Graphically, electrical consumption in kWh can be portrayed as follows:

BUILDING 62 - QUARTER MASTER KASERNE - PRESENT kWh



The electrical consumption rate is very low in comparison to other buildings of this type. Approximately 80% of the gross floor area, however, is used for storage and receives only limited usage. Taking this factor into consideration, the total electrical consumption rate is comparable to that of other buildings. Interior lighting constitutes the greatest electrical load. Miscellaneous equipment, particularly the elevator, is also a large consumer of electricity.

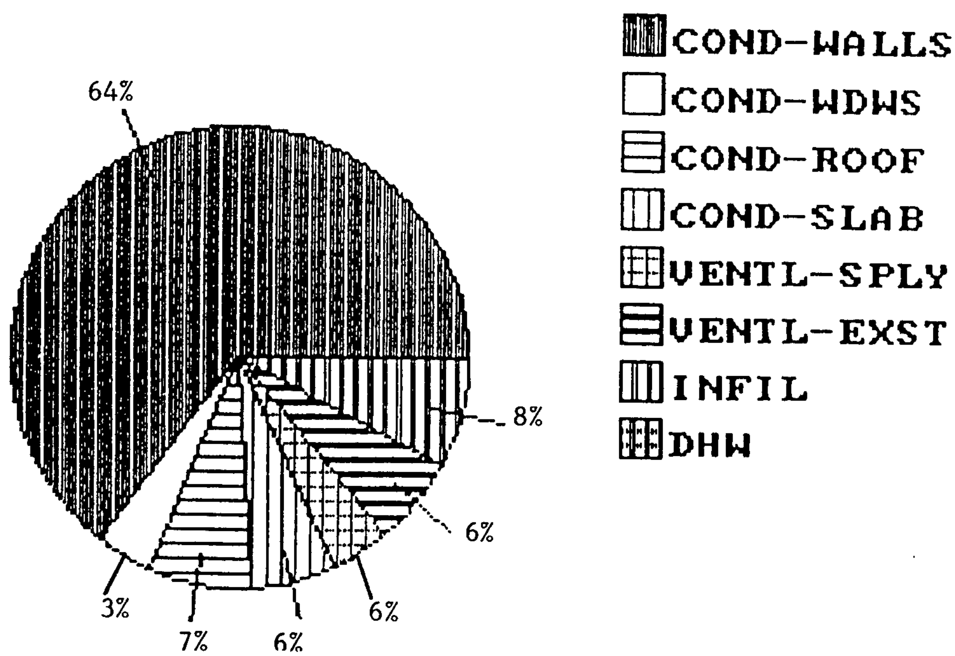
A thermal consumption rate of 66,989 Btu/SF is particularly high when considering that 80% of the building has minimal occupancy. Conduction accounts for 82% of the total thermal consumption. Ventilation losses constitute only 10% of the total thermal energy used; it is, however, noteworthy that given the large unoccupied areas, the consumption due to ventilation is at an above average level.

Thermal Load Component	Annual MBtu's	Real Costs ($)*	Btu/SF*
Conduction - Walls (COND-WALLS)	1,477.05	$12,757	22,109
- Windows (COND-WDWS)	95.26	$ 823	1,426
- Roof (COND-ROOF)	166.18	$1,435	2,487
- Slab (COND-SLAB)	135.38	$ 1,170	2,028
Ventilation - Supply (VENTL-SPLY)	99.25	$ 857	1,486
Ventilation - Exhaust (VENTL-EXST)	139.81	$ 1,207	2,093
Infiltration (INFIL)	176.42	$ 1,524	2,641
Domestic Hot Water (DHW)	1.33	$ 12	20
Less electrical heat gain to space	(177.02)	--	--
Total	2,113.66	$19,785	34,290

* The cost and Btu/SF rate for each load component has been corrected to account for the contribution from electrical heat gain to space.

Graphically, thermal consumption in MBtu's can be portrayed as follows:

BUILDING 62 - QUARTER MASTER KASERNE HEATING - MBtu's

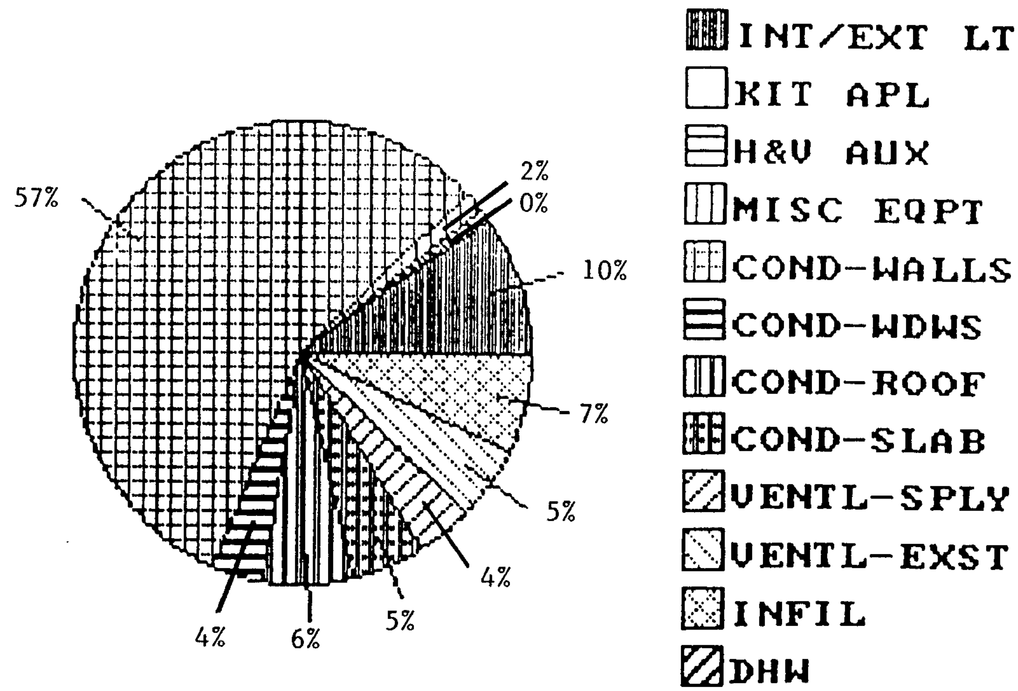


Finally, the following table and the two graphs on the next page depict the relative proportions of all energy users in building 62. The first graph details relative consumption amounts for each category listed, while the second graph details relative costs. Relative proportions of energy costs clearly indicate where the greatest potential for savings might be found. From this table, it is clear that conduction losses and interior lighting constitute the most costly energy expenditures in building 62.

Energy Consumption Classification	Annual MBtu's	Real Costs ($)	Btu/SF
Interior Lighting (INT LTG)	223.45	$ 5,400	3,625
Exterior Lighting (EXT LTG)	15.62	$ 377	253
Kitchen Appliances (KIT APL)	5.47	$ 132	89
H&V Auxiliaries (H&V AUX)	16.65	$ 402	270
Miscellaneous Equipment (MISC EQPT)	32.89	$ 795	534
Conduction - Walls (COND-WALLS)	1,362.91	$12,757	22,109
- Windows (COND-WDWS)	87.89	$ 823	1,426
- Roof (COND-ROOF)	153.34	$ 1,435	2,487
- Slab (COND-SLAB)	125.01	$ 1,170	2,028
Ventilation - Supply (VENTL-SPLY)	91.58	$ 857	1,486
Ventilation - Exhaust (VENTL-EXST)	129.00	$ 1,207	2,093
Infiltration (INFIL)	162.78	$ 1,524	2,641
Domestic Hot Water (DHW)	1.23	$ 12	20
Total	2,407.82	$26,891	39,061

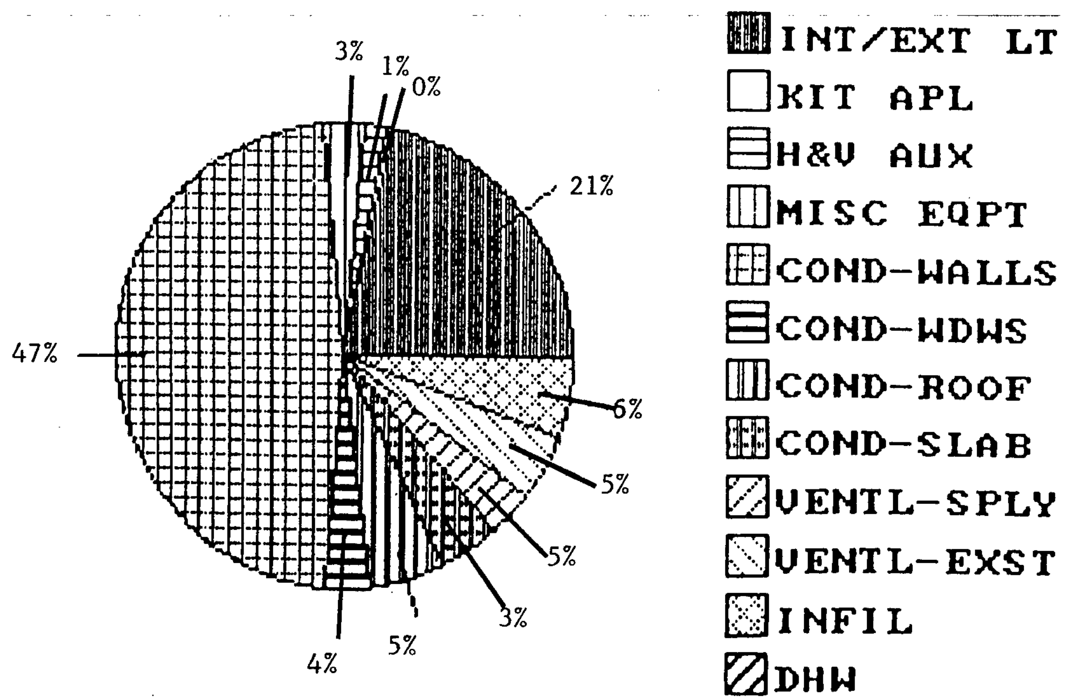
BUILDING 62 - QUARTER MASTER KASERNE ENERGY MBtu's

ELECTRICITY AND THERMAL



BUILDING 62 - QUARTER MASTER KASERNE ENERGY COSTS

ELECTRICITY AND THERMAL



CALCULATION OF AN ENERGY BALANCE AFTER RENOVATIONS

BUILDING 62 - QUARTER MASTER KASERNE - NEW

Renovations to the existing heating plant as contained in specification CR01262, call for the conversion of the present steam system to a hydronic heating system. Three (3) circulation pumps will be employed for the distribution of hot water to the building's heating components. The new alterations also call for the installation of unit heaters on the fourth and fifth floors and in the attic. It is assumed that: 1) the heating water circulation pumps will operate twenty-four (24) hours per day throughout the thirty-one (31) week heating season; 2) the unit heater fan motors operate for an average of eight (8) hours per day throughout the heating season; and 3) space temperatures will remain unchanged from those that existed at the time of the site visit (based on zoning for the upper floors and the heat flow patterns dictated by building structure).

Renovations to the lighting systems are minor and confined to the storage areas. These changes involve the installation of additional fluorescent fixtures using 40-watt fluorescent lamps along with preheat starter ballasts. The hours of operation for the lighting system are assumed to be unchanged.

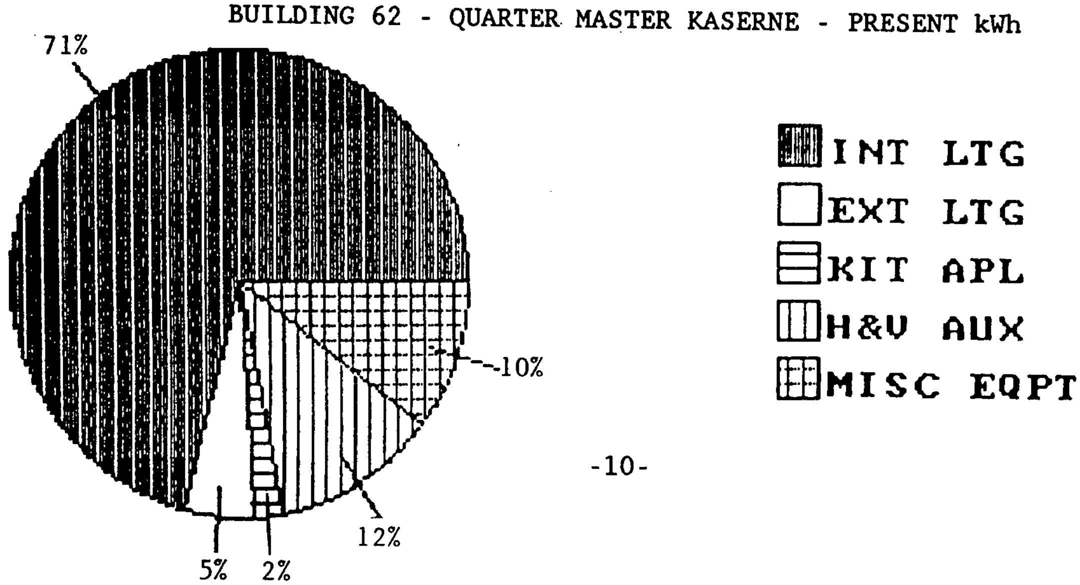
Electrical consumption will be increased by 8.5% after the implementation of these changes. The rise in consumption is due primarily to the use of the circulation pumps and the unit heater fan motors.

Regarding electrical consumption in building 62 after renovations, the following table summarizes annual kWh totals for each category listed:

Energy Consuming Equipment	Annual kWh	Real Costs ($)	Btu/SF
Interior Lighting (INT LTG)	65,502	$5,403	3,626
Exterior Lighting (EXT LTG)	4,577	$ 377	253
Kitchen Appliances (KIT APL)	1,894	$ 156	105
H&V Auxiliaries (H&V AUX)	10,745	$ 886	595
Miscellaneous Equipment (MISC EQPT)	9,637	$ 795	534
Total	92,355	$7,617	5,113
Actual	85,121	$7,021	4,713
% deviation from actual	8.5%	8.5%	8.5%

Graphically, electrical consumption in kWh can be portrayed as follows:

BUILDING 62 - QUARTER MASTER KASERNE - PRESENT kWh



Interior lighting remains the largest electrical consumer in the building. Consumption due to H&V auxiliaries has been substantially increased due to the proposed heating renovations.

Thermal consumption is expected to remain essentially unchanged after implementing the revisions to the building. The following table details the new consumption levels due to each thermal load component.

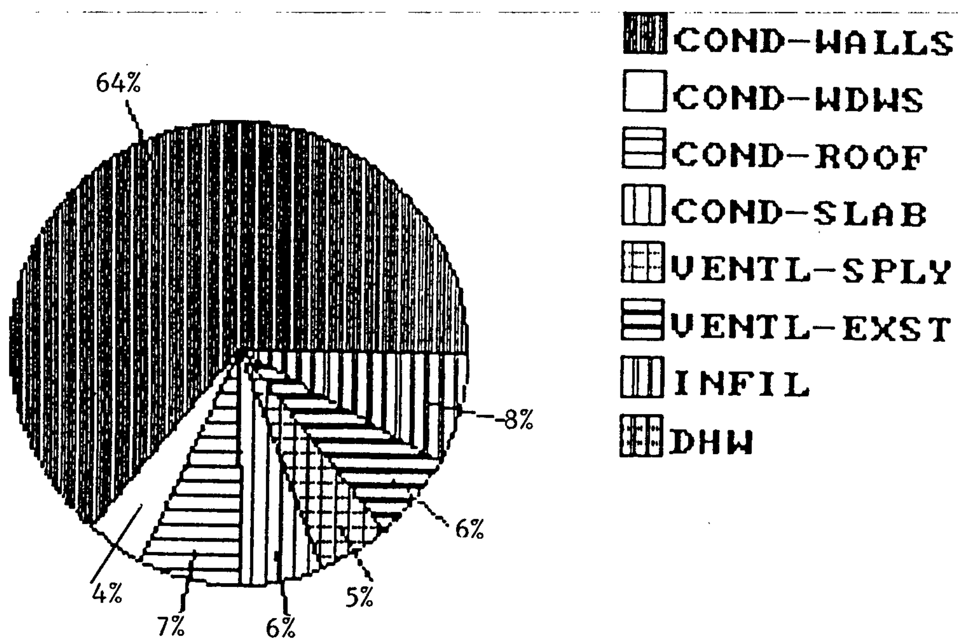
Thermal Load Component	Annual MBtu's	Real Costs ($)*	Btu/SF*
Conduction - Walls (COND-WALLS)	1,477.10	$12,703	22,015
- Windows (COND-WDWS)	95.34	$ 820	1,421
- Roof (COND-ROOF)	166.18	$ 1,429	2,477
- Slab (COND-SLAB)	135.43	$ 1,165	2,018
Ventilation - Supply (VENTL-SPLY)	117.79	$ 1,013	1,756
Ventilation - Exhaust (VENTL-EXST)	139.81	$ 1,202	2,084
Infiltration (INFIL)	176.34	$ 1,517	2,628
Domestic Hot Water (DWH)	1.33	$ 11	20
Less electrical heat gain to space	(187.51)	--	--
Total	2,121.81	$19,860	34,419
Actual**	2,113.66	$19,784	34,287
% deviation from actual	0.4%	0.4%	0.4%

* The cost and Btu/SF rate for each load component has been corrected to account for the contribution from electrical heat gain to space.

** Actual thermal consumption is from the energy balance before building renovations.

Graphically, thermal consumption in MBtu's can be portrayed as follows:

BUILDING 62 - QUARTER MASTER KASERNE HEATING - MBtu's



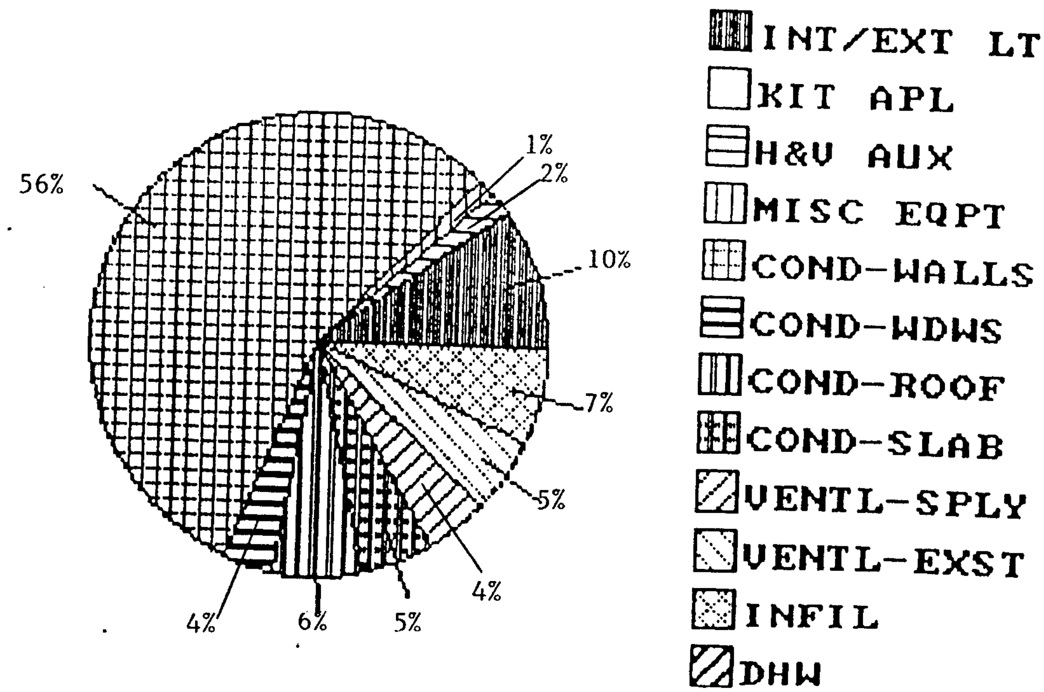
Finally, the following table and the two graphs on the next page depict the relative proportions of all energy users in building 62. The first graph details relative consumption amounts for each category listed, while the second graph details relative costs. Relative proportions of energy costs clearly indicate where the greatest potential for savings might be found. Comparison of the two (2) summary tables reveals no substantial change in the proportion of energy cost attributed to each energy using component.

Energy Consumption Classification	Annual MBtu's	Real Costs ($)	Btu/SF
Interior Lighting (INT LTG)	223.56	$ 5,403	3,626
Exterior Lighting (EXT LTG)	15.62	$ 377	253
Kitchen Appliances (KIT APL)	6.46	$ 156	105
H&V Auxiliaries (H&V AUX)	36.67	$ 886	595
Miscellaneous Equipment (MISC EQPT)	32.89	$ 795	534
Conduction - Walls (COND-WALLS)	1,357.16	$12,703	22,015
- Windows (COND-WDWS)	87.60	$ 820	1,421
- Roof (COND-ROOF)	152.69	$ 1,429	2,477
- Slab (COND-SLAB)	124.43	$ 1,165	2,018
Ventilation - Supply (VENTL-SPLY)	108.23	$ 1,013	1,756
Ventilation - Exhaust (VENTL-EXST)	128.46	$ 1,202	2,084
Infiltration (INFIL)	162.03	$ 1,517	2,628
Domestic Hot Water (DHW)	1.23	$ 11	20
Total	2,437.02	$27,478	39,532
Actual*	2,407.82	$26,891	39,061
% deviation from actual	1.2%	2.2%	1.2%

* Actual total energy consumption is from energy balance one; before building modification.

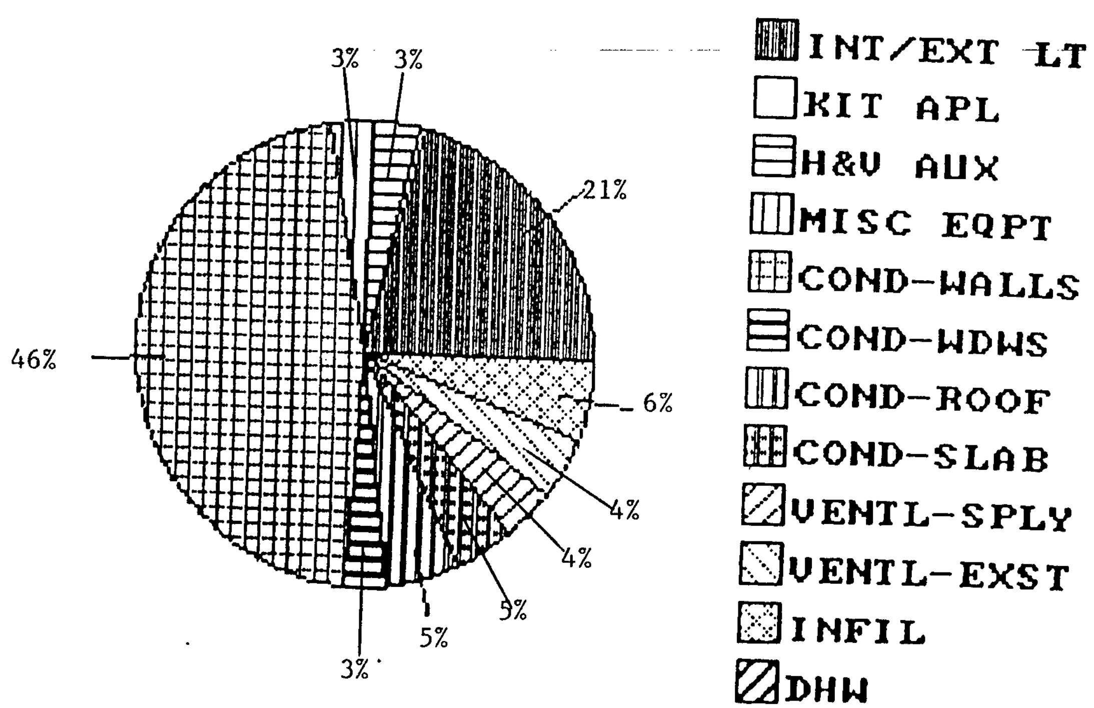
BUILDING 62 - QUARTER MASTER KASERNE ENERGY MBtu's

ELECTRICITY AND THERMAL



BUILDING 62 - QUARTER MASTER KASERNE ENERGY COSTS

ELECTRICITY AND THERMAL



CALCULATION OF AN ENERGY BALANCE FOR THE PERIOD OCT 85 - SEPT 86

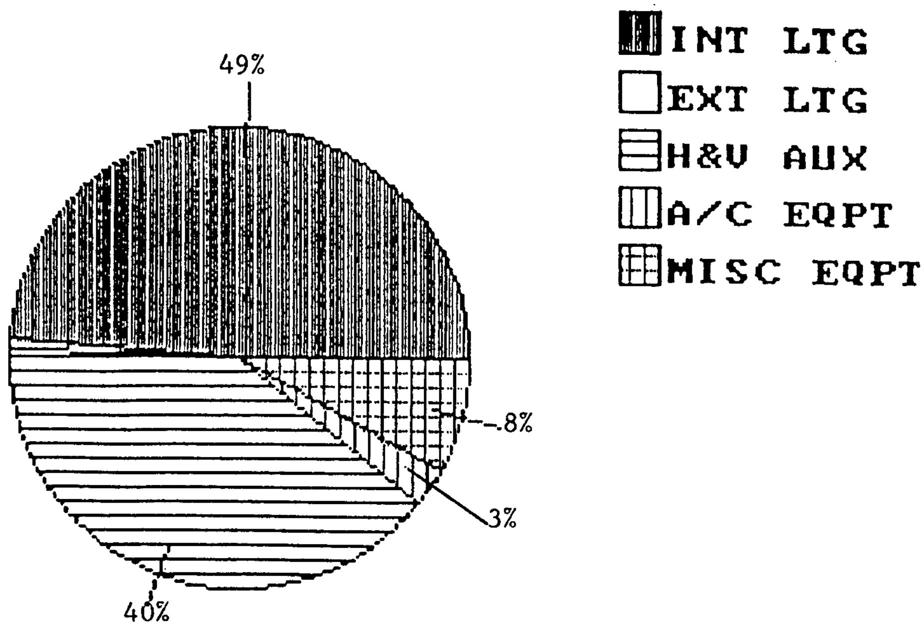
BUILDING 63 - QUARTER MASTER KASERNE

Regarding present electrical consumption in building 63, the following table summarizes annual kWh totals for each category listed:

Energy Consuming Equipment	Annual kWh	Real Costs($)	Btu/SF
Interior Lighting (INT LTG)	424,783	$35,036	16,682
Exterior Lighting (EXT LTG)	4,852	$ 400	191
H&V Auxiliaries (H&V AUX)	346,762	$28,601	13,618
A/C Equipment (A/C EQPT)	21,989	$ 1,814	864
Miscellaneous Equipment (MISC EQPT)	71,203	$ 5,873	2,796
Total	869,590	$71,724	34,151

Graphically, electrical consumption in kWh can be portrayed as follows:

BUILDING 63 - QUARTER MASTER KASERNE - PRESENT kWh



The electrical consumption at building 63 is about average in comparison to other government PX buildings studied by EEI, with a rate of 34,151 Btu/SF. Interior lighting accounts for 49% of the total electrical consumption. Long lighting hours of operation and incandescent display lamps significantly contribute to the large lighting component. Heating and ventilating equipment are the second largest electrical components primarily due to long operational hours.

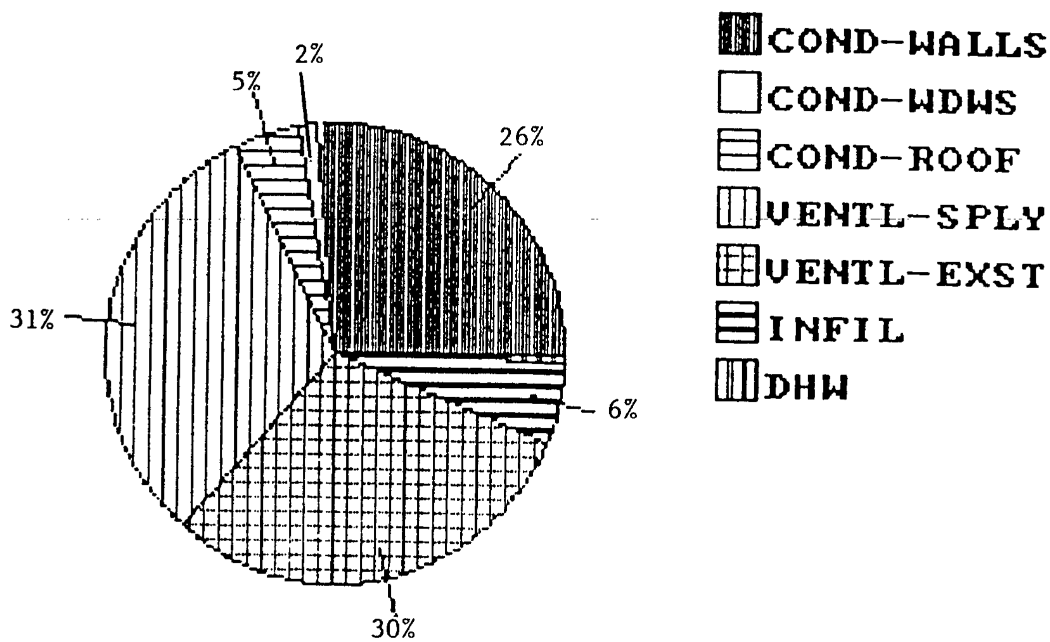
Regarding thermal consumption, ventilation supply and exhaust accounts for 61% of the total thermal energy. The majority of the ventilation load occurs because excessive amounts of outside air are heated by the air handling systems. Other elements of thermal consumption are conductive losses, infiltration, and generation and consumption of domestic hot water.

Thermal Load Component	Annual MBtu's	Real Costs ($)*	Btu/SF*
Conduction - Walls (COND-WALLS)	2,044.76	$14,463	17,781
- Windows (COND-WDWS)	111.85	$ 791	973
- Roof (COND-ROOF)	359.09	$ 2,540	3,123
Ventilation - Supply (VENTL-SPLY)	2,417.11	$17,097	21,018
Ventilation - Exhaust (VENTL-EXST)	2,346.85	$16,600	20,408
Infiltration (INFIL)	438.48	$ 3,102	3,813
Domestic Hot Water (DHW)	35.58	$ 252	309
Less electrical heat gain to space	(1,894.23)	--	--
Total	5,859.49	$54,845	67,424

* The cost and Btu/SF rate for each load component has been corrected to account for the contribution from electrical heat gain to space.

The relative proportions of these thermal load components are detailed in the following pie chart.

BUILDING 63 - QUARTER MASTER KASERNE HEATING - MBtu's



Finally, the following table and the two graphs on the next page depict the relative proportions of all energy users in building 63. The first graph details relative consumption amounts for each category listed, while the second graph details relative costs. Relative proportions of energy costs clearly indicate where the greatest potential for savings might be found. For building 63, the cost expenditures for interior lighting, heating and ventilating auxiliaries, and ventilation imply where the greatest potential for savings might be found.

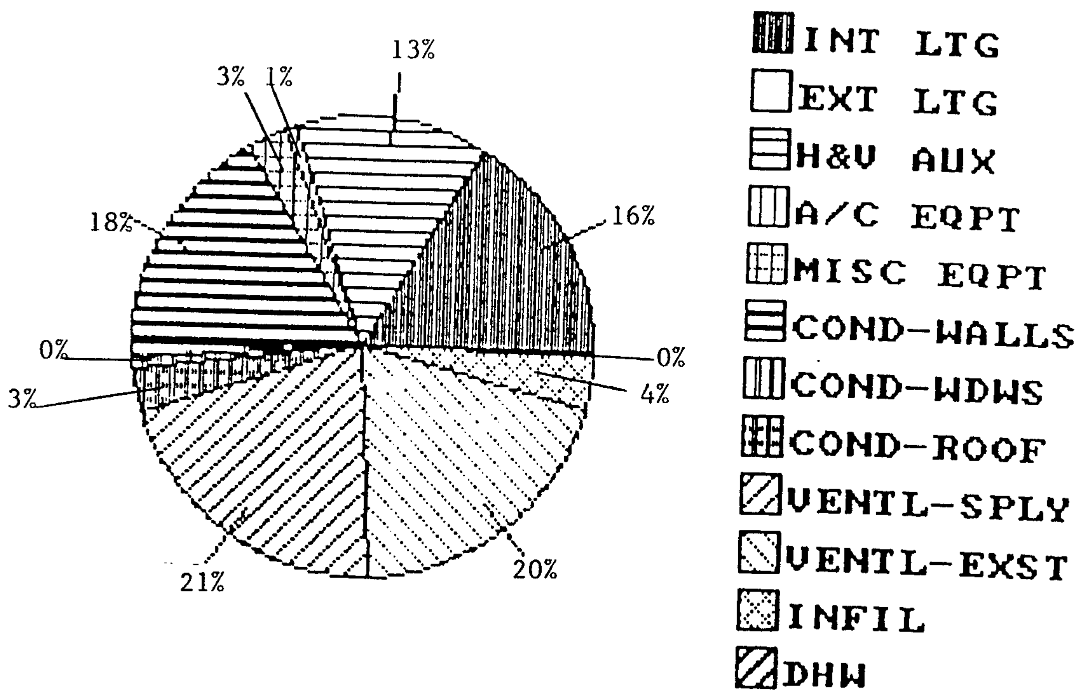
Energy Consumption Classification	Annual MBtu's	Real Costs ($)	Btu/SF
Interior Lighting (INT LTG)	1,449.78	$ 35,036	16,682
Exterior Lighting (EXT LTG)	16.56	$ 400	191
H&V Auxiliaries (H&V AUX)	1,183.50	$ 28,601	13,618
A/C Equipment (A/C EQPT)	75.05	$ 1,814	864
Miscellaneous Equipment (MISC EQPT)	243.02	$ 5,873	2,796
Conduction - Walls (COND-WALLS)	1,545.23	$ 14,463	17,781
- Windows (COND-WDWS)	84.52	$ 791	973
- Roof (COND-ROOF)	271.36	$ 2,540	3,123
Ventilation - Supply (VENTL-SPLY)	1,826.61	$ 17,097	21,018
Ventilation - Exhaust (VENTL-EXST)	1,773.52	$ 16,600	20,408
Infiltration (INFIL)	331.36	$ 3,102	3,813
Domestic Hot Water (DHW)	26.89	$ 252	309
Total	8,827.40	$126,569	101,575

Note: A new energy balance was not performed for this building because budgeted construction project #C101263 - Replacing the Steam Heating System, was already implemented at the time of the site survey; therefore, all modifications to building systems are included in the energy balance calculations.

It should further be noted that the energy consumption of the cafeteria was not evaluated because the contract excludes the cafeteria from the energy study. EEI's experience suggests that the cafeteria consumes approximately 18% of the total building consumption.

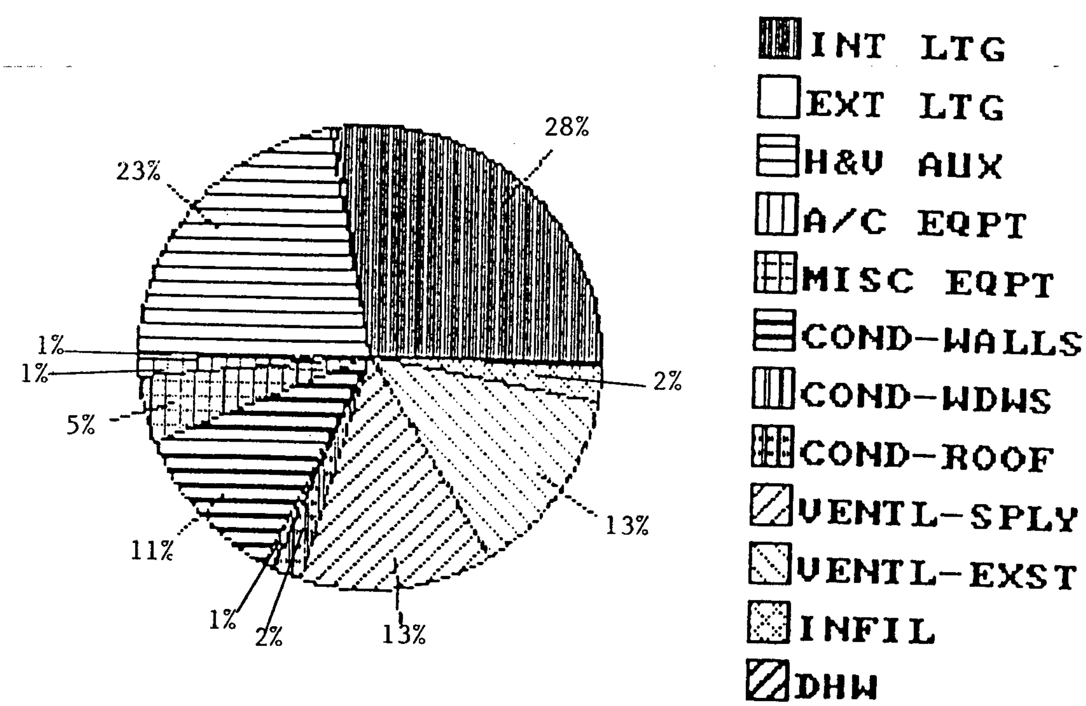
BUILDING 63 QUARTER MASTER KASERNE ENERGY MBtu's

ELECTRICITY AND THERMAL



BUILDING 63 - QUARTER MASTER KASERNE ENERGY COSTS

ELECTRICITY AND THERMAL



CALCULATION OF AN ENERGY BALANCE FOR THE PERIOD OCT 85 - SEPT 86

BUILDING 106 - SHERIDEN KASERNE

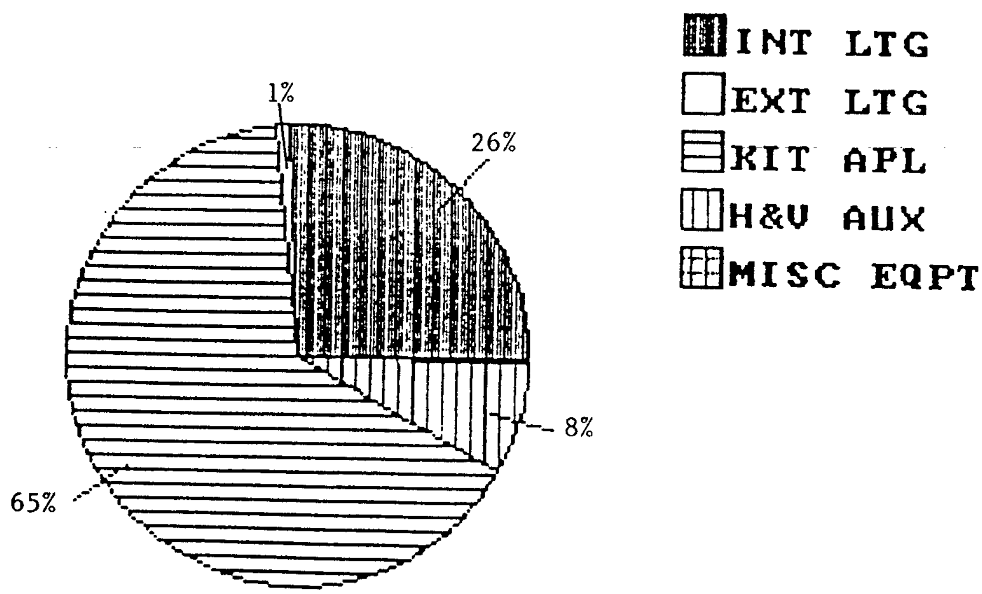
Regarding present electrical consumption in building 106, the following table summarizes annual kWh totals for each category listed:

Energy Consuming Equipment	Annual kWh	Real Costs($)	Btu/SF
Interior Lighting (INT LTG)	101,663	$ 8,385	10,708
Exterior Lighting (EXT LTG)	4,275	$ 353	450
Kitchen Appliances (KIT APL)	256,652	$21,169	27,034
H&V Auxiliaries (H&V AUX)	30,800	$ 2,540	3,244
Miscellaneous Equipment (MISC EQPT)	1,164	$ 96	123
Total	394,554	$32,543	41,560
Actual*	391,489	$32,290	41,237
% deviation from actual	0.8%	0.8%	0.8%

* Electrical consumption was obtained from a two week metering period and then adjusted for variations throughout the year to obtain an annual consumption rate. For more specific details on the treatment of meter data refer to Section III, Methods of Analysis.

Graphically, electrical consumption in kWh can be portrayed as follows:

BUILDING 106 - SHERIDAN KASERNE - PRESENT kWh



All electrical load components are at a lower than average level when compared to other buildings with similar functions. Interior lighting is substantially lower than average while electrial consumption due to kitchen equipment is the largest consumer of electricity, as expected for a food service facility.

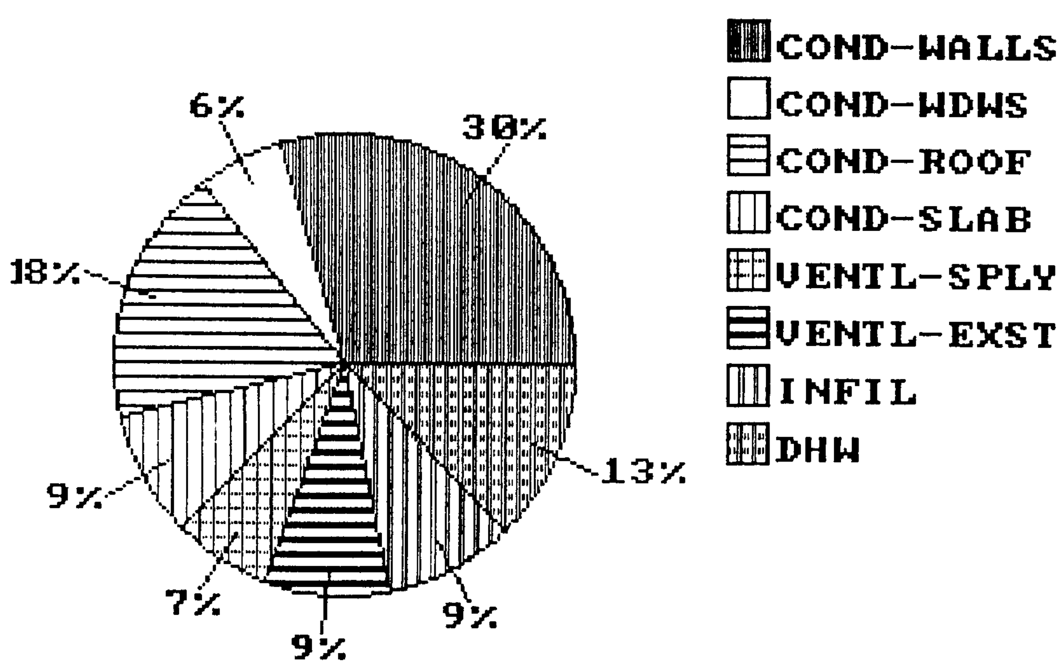
The annual thermal consumption rate of 33,687 Btu/SF is at a lower level than typical for buildings of this type. Conduction losses amount to nearly two-thirds of the total consumption. Ventilation, at a combined rate of 5,317 Btu/SF, is at an average level when compared to other buildings of this type; however, higher levels are not uncommon. Consumption due to domestic hot water is extraordinarily high which is again typical for a food service facility.

Thermal Load Component	Annual MBtu's	Real Costs ($)*	Btu/SF*
Conduction - Walls (COND-WALLS)	551.07	$ 3,021	9,962
- Windows (COND-WDWS)	113.75	$ 624	2,056
- Roof (COND-ROOF)	335.36	$ 1,839	6,062
- Slab (COND-SLAB)	163.78	$ 898	2,961
Ventilation - Supply (VENTL-SPLY)	128.28	$ 703	2,319
Ventilation - Exhaust (VENTL-EXST)	165.85	$ 909	2,998
Infiltration (INFIL)	168.75	$ 925	3,050
Domestic Hot Water (DHW)	236.71	$ 1,298	4,279
Less electrical heat gain to space	(772.02)	--	--
Total	1,091.53	$10,217	33,687

* The cost and Btu/SF rate for each load component has been corrected to account for the contribution from electrical heat gain to space.

The relative proportions of these thermal load components is detailed in the following pie chart.

BUILDING 106 - SHERIDAN KASERNE HEATING - MBtu's

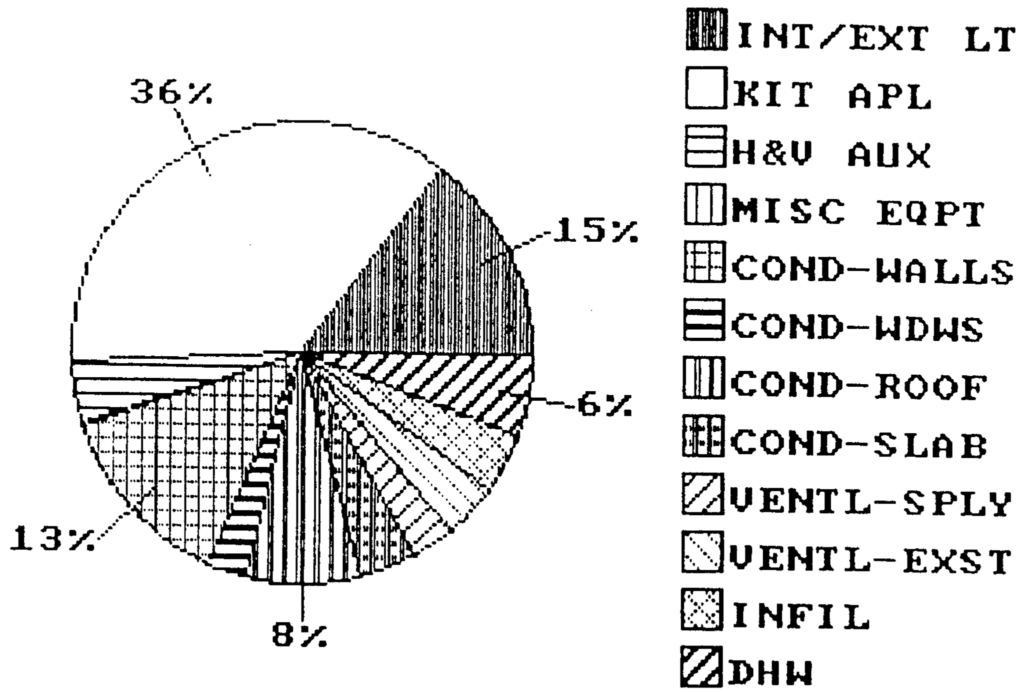


Finally, the following table and the two graphs on the next page depict the relative proportions of all energy users in building 106. The first graph details relative consumption amounts for each category listed, while the second graph details relative costs. Relative proportions of energy costs clearly indicate where the greatest potential for savings might be found. It is of great significance that all of the large components share a common cause: extraordinarily long hours of operation.

Energy Consumption Classification	Annual MBtu's	Real Costs ($)	Btu/SF
Interior Lighting (INT LTG)	346.98	$ 8,385	10,708
Exterior Lighting (EXT LTG)	14.59	$ 353	450
Kitchen Appliances (KIT APL)	875.95	$21,169	27,034
H&V Auxiliaries (H&V AUX)	105.12	$ 2,540	3,244
Miscellaneous Equipment (MISC EQPT)	3.97	$ 96	123
Conduction - Walls (COND-WALLS)	322.78	$ 3,021	9,962
- Windows (COND-WDWS)	66.63	$ 624	2,056
- Roof (COND-ROOF)	196.43	$ 1,839	6,062
- Slab (COND-SLAB)	95.93	$ 898	2,961
Ventilation - Supply (VENTL-SPLY)	75.14	$ 703	2,319
Ventilation - Exhaust (VENTL-EXST)	97.14	$ 909	2,998
Infiltration (INFIL)	98.84	$ 925	3,050
Domestic Hot Water (DHW)	138.65	$ 1,298	4,279
Total	2,438.14	$42,760	75,247

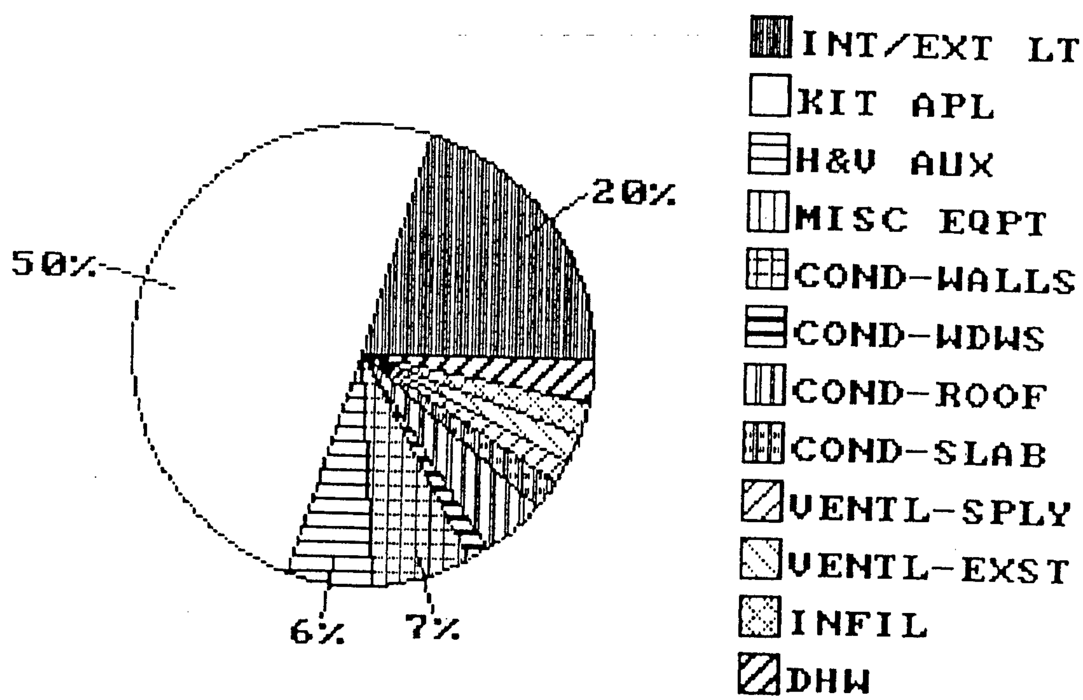
BUILDING 106 - SHERIDAN KASERNE ENERGY MBtu's

ELECTRICITY AND THERMAL



BUILDING 106 - SHERIDAN KASERNE ENERGY COSTS

ELECTRICITY AND THERMAL



D. Historical Energy Consumption

Individual building meters do not exist in the buildings studied by EEI. Therefore, historical energy consumption could not be addressed for the individual buildings. However, base wide energy consumption was available and is addressed in this section. The consumption information listed in Tables II and III was provided by VII Corps Headquarters in Stuttgart and the DEH-Energy Conservation Office in Augsburg, West Germany.

Table II: Annual Energy Consumption (MBtu)

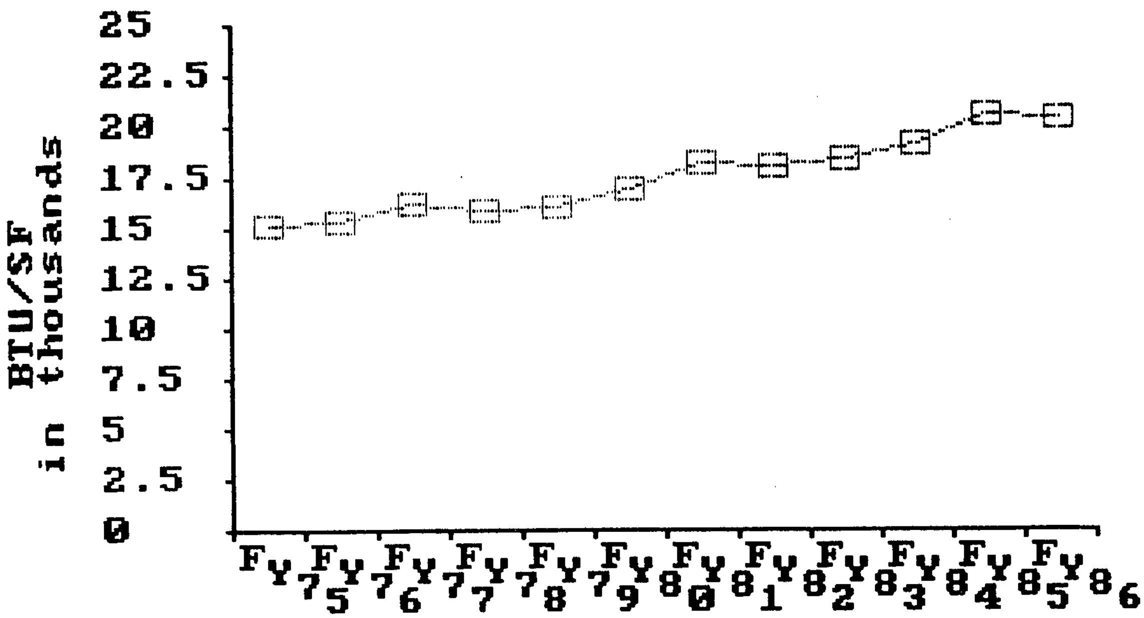
Fiscal Year	Electric	% Annual Change	Thermal	% Annual Change	Total	% Annual Change
1975	142,053	---	1,212,948	---	1,355,001	---
1976	143,786	1.2%	1,133,809	-7.0%	1,277,595	-6.1%
1977	152,435	5.7%	1,153,830	1.7%	1,306,265	2.2%
1978	149,039	-2.3%	1,141,001	-1.1%	1,290,040	-1.3%
1979	150,732	1.1%	1,229,549	7.2%	1,380,281	6.5%
1980	159,302	5.4%	1,148,036	-7.1%	1,307,338	-5.6%
1981	170,090	6.3%	1,099,015	-4.5%	1,269,105	-3.0%
1982	169,360	-0.4%	1,121,712	2.0%	1,291,072	1.7%
1983	172,732	2.0%	1,018,326	-10.2%	1,191,058	-8.4%
1984	179,196	3.6%	993,205	-2.5%	1,172,401	-1.6%
1985	189,186	5.3%	985,901	-0.7%	1,175,087	0.2%
1986	187,018	-1.2%	982,162	-0.4%	1,169,180	-0.5%
% Change from 1975 to 1986		31.7%		-19.0%		-13.7%

Table III: Annual Energy Use Index (Btu/sq ft)

Fiscal Year	Electric	% Annual Change	Thermal	% Annual Change	Total	% Annual Change
1975	15,238	---	130,117	---	145,355	---
1976	15,424	1.2%	121,627	-7.0%	137,052	-6.1%
1977	16,352	5.7%	123,775	1.7%	140,127	2.2%
1978	15,988	-2.3%	122,399	-1.1%	138,387	-1.3%
1979	16,169	1.1%	131,898	7.2%	148,067	6.5%
1980	17,089	5.4%	123,153	-7.1%	140,242	-5.6%
1981	18,246	6.3%	117,895	-4.5%	136,141	-3.0%
1982	18,168	-0.4%	120,330	2.0%	138,497	1.7%
1983	18,529	2.0%	109,239	-10.2%	127,768	-8.4%
1984	19,223	3.6%	106,544	-2.5%	125,767	-1.6%
1985	20,586	6.6%	107,280	0.7%	127,866	1.6%
1986	20,372	-1.0%	106,989	-0.3%	127,362	-0.4%
% Change from 1975 to 1986		33.7%		-17.8%		-12.4%

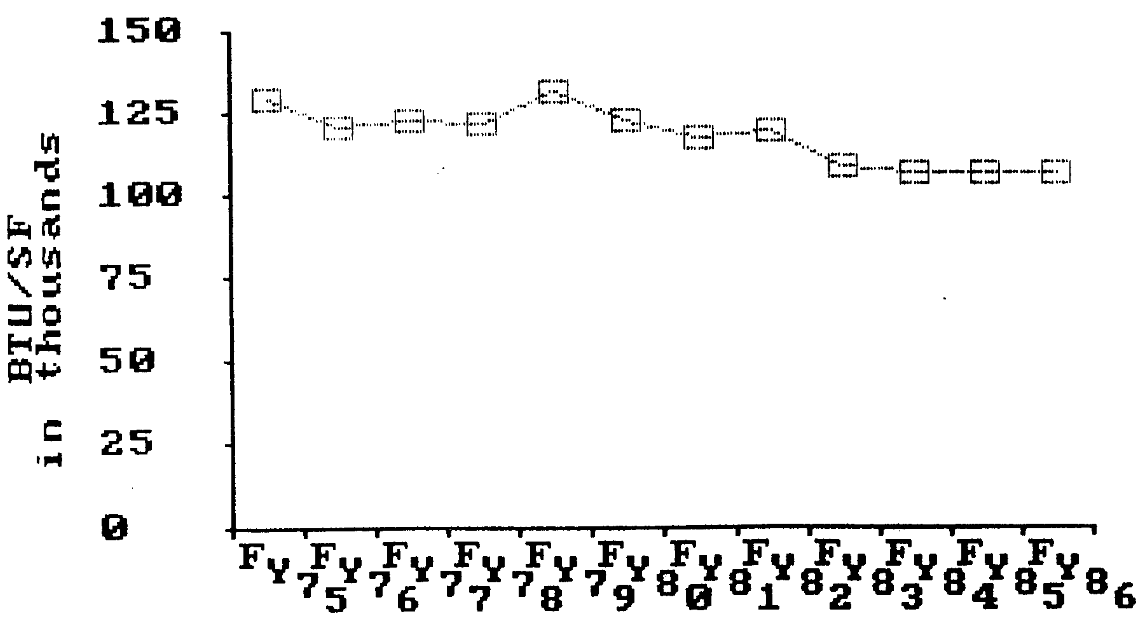
A wealth of information can be derived by examining annual consumption trends for the Augsburg Military Community. While Table II examines the annual energy consumption since FY 1975, a better measure for analyzing the energy use is provided in Table III. Table III depicts the energy use index since FY 1975 measured in Btus per square foot. The square feet for the Augsburg Community remained constant from 1975 to 1981 at 9,322,000 square feet; in 1985 the community possessed 9,190,000 square feet and 9,180,000 square feet in 1986. However, there was no change in the post exchange gross square footages.

Figure 1: Annual Electrical Use Index (Btu/SF)



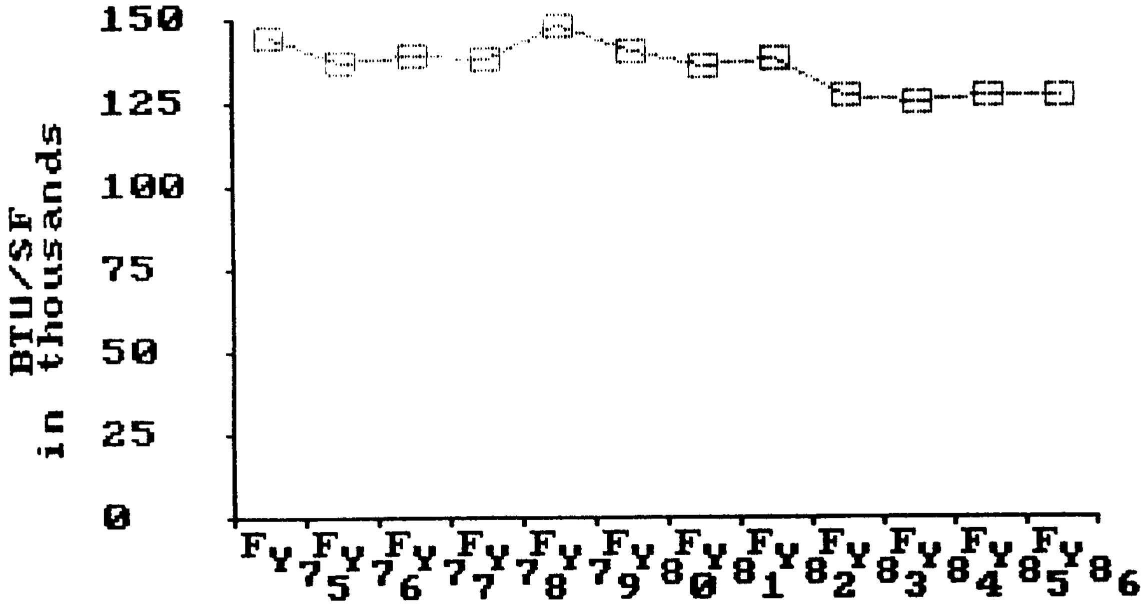
The annual electrical consumption has steadily increased from FY 1975 to FY 1986 except for slight decreases in FY 1978, FY 1982, and FY 1986. A total increase in the electrical consumption rate of 33.7% was experienced from FY 1975 to FY 1983. The most notable reasons for these increases can be attributed to the increased use of computers on base and the conditioning of computer spaces particularly in Reese and Sheridan Kasernes.

Figure 2: Annual Thermal Use Index (Btu/SF)



Regarding thermal consumption, annual trends depict a decline in energy consumption. The thermal consumption peaked in FY 1979 at approximately 132,000 Btu/SF to a low of 106,544 Btu/SF in FY 1984. Overall the thermal consumption rate has been reduced 17.8% from FY 1975 to FY 1986.

Figure 3: Total Energy Use Index (Btu/SF)



Finally, the analysis of total energy consumption reveals a 12.4% decrease from FY 1975 to FY 1986. This reduction in the total energy consumption rate can be attributed to the energy conservation efforts implemented by the community. The following section details these efforts. Furthermore, the reduction in total energy consumption falls short of the mandate established by the Department of the Army to reduce overall energy consumption by 20% from the FY 1975 levels; the primary causes of this shortfall is the substantial increase in electrical consumption.

Energy Conservation Efforts

Upon entering the Augsburg Military Base, it is hard not to notice the presence of an energy awareness program. Billboards and posters are displayed throughout the community to remind occupants of the benefits of saving energy. Moreover, incentive programs have been effectively created and utilized, for example, the renovations to the post office were paid for from the cost savings generated by the energy conservation efforts on base. Notably, the conservation efforts are clearly directed at the residents of the Augsburg community.

Energy conservation opportunities undertaken since 1975 include the following:

- installing outside air temperature reset controls;
- installing thermostatic control valves;
- reducing space temperatures through new controls and thermostat calibration;
- installing night setback controls;
- reducing domestic hot water temperature;
- insulating attics, roofs, and walls;

- installing thermopane windows and insulating doors;
- maintaining boilers;
- replacing steam heating systems with more efficient hydronic systems;
- repairing and installing new pipe insulation;
- consolidating boiler plants;
- installing timers for exhaust fans and lights;
- reducing lighting levels in corridors;
- installing photocells on security lighting;
- utilizing energy-efficient lamps.

E. Analysis of Energy Conservation Opportunities

A great many Energy Conservation Opportunities (ECOs) were investigated during the field survey for possible application in the buildings studied by EEI (See Table IV on page 24). A majority of the ECOs: were previously implemented, were not applicable to the building equipment or structure or were not economically justifiable (SIR <1) -- see Table V on page 25.

Thirteen (13) ECOs have been identified and recommended for implementation in buildings 62, 63, and 106. These ECOs have been packaged in two projects. Table I summarizes the recommended projects, SIR, simple payback period, implementation costs, annual cost savings, and annual energy savings for each project.

Project one, Facility Modifications, incorporates four ECOs; 1) reduce domestic hot water (DHW) temperature, 2) cycle anti-sweat heaters, 3) increase refrigeration temperatures, and 4) install timeclock for DHW heater. At annual cost savings of $334 and implementation costs totaling $549, this project is recommended for OMA funding.

Annual cost savings of $102,894 are expected from project 2, HVAC, lighting and weatherization modifications. Project 2 possesses an SIR of 4.40 and will cost $284,122 to implement. This project is an OSD - PIF funding candidate.

This project will reduce lighting expenditures by delamping overlit areas, turning off unnecessary lighting, converting interior and exterior lights to more efficient lighting types and modifying the fluorescent display fixtures.

Clearly the largest portion of savings from project 2 and the single most important item in this report involves the installation of Single Building Controllers (SBCs). The recommended system should be capable of being connected to a base-wide central energy management control system. This system will prove invaluable in assuring the optimal and ongoing scheduling of energy consuming equipment. First year cost savings of $74,824 are anticipated. Estimated implementation costs will total $150,967.

Building Weatherization, involves weatherstripping windows and doors, insulating pipes and valves, and insulating structural building components. Thermal energy costs are expected to be reduced by $6,715 per year at a total project cost of $83,670.

TABLE IV

ENERGY CONSERVATION OPPORTUNITIES INVESTIGATED

1. Insulate walls, ceiling and floors
2. Insulate pipes and valves
3. Install double glazing on windows
4. Install vestibules
5. Install loading dock seals
6. Install air barrier strips
7. Weatherstrip and caulk doors/windows
8. Add solar films to glass area
9. Reduce lighting levels (delamp)
10. Reduce unnecessary lighting
11. Interior lighting conversions
12. Exterior lighting modifications
    a. exterior lighting conversions
    b. install photocells
13. Utilize energy-efficient lamps
14. Utilize energy-efficient ballasts at burnout
15. Modify display lighting
16. Utilize reflectors for fluorescent lighting
17. Install energy-efficient motors
18. Variable speed drives for motors
19. Reduce anti-condensate heater operation
20. Return condensate
21. Infrared heaters
22. Prevent air stratification
23. Lower domestic hot water temperature
24. Shutdown water heaters during unoccupied periods
25. Waste heat recovery
26. Install night covers
27. Install air barrier strips for refrigeration fixtures
28. Cycle anti-sweat heaters
29. Scheduling of refrigeration equipment
30. Change refrigeration equipment to match smaller load
31. Improve refrigeration maintenance
32. Reduce refrigeration temperatures
33. Replace absorption chillers
34. Variable speed chiller compressor drives
35. Solar applications
36. Timers for bathroom exhaust fans
37. Connect air curtain to entrance doors
38. Single Building Controller (the following subheadings are all incorporated in the Single Building Controller evaluation)
    a. install timeclocks
    b. install night setback thermostats
    c. reduce/increase space temperatures during winter/summer operation
    d. reduce hours of operation
    e. reduce outside air ventilation rates
    f. dry bulb economizer cycles
    g. revise/repair HVAC controls
    h. demand limiting

TABLE V

ECO'S REJECTED

The following is a summary of ECOs that are not recommended because they fail to meet funding requirements as provided in DAEN-ZCF-U, "Energy Conservation Investment Program (ECIP) Guidance" (i.e., the projects posses an SIR <1).

Title	SIR
Building 62 - Modify display lighting	0.81
Building 62 - Install electronic ballast upon present ballast failure	0.42
Building 63 - Install vestibules	0.09
Building 63 - Install electronic ballast upon present ballast failure	0.41
Building 106 - Install vestibules	0.18
Building 106 - Install electronic ballast upon present ballast failure	0.40
Building 106 - Install air barrier strips	0.62
Building 106 - Modify display lighting	0.99
Parking Lot - Exterior lighting conversion	0.48

F. Energy and Cost Savings

A 51% reduction in total energy costs amounting to $103,315 per year can be realized in buildings 62, 63 and 106 following the implementation of all the recommended energy conservation projects. The resultant reduction in total energy consumption amounts to 8,358 MBtu or a 59% reduction in consumption. Table VI (on page 28) summarizes initial consumption, ECOs recommended and final consumption for the three (3) post exchange buildings studied in this report. Table VI is graphically represented in Figures 4 and 5 (on page 29) which portray electrical and thermal energy consumption before and after the implementation of the recommended projects and in Figures 6 and 7 (on page 30) which depict the energy costs before and after project implementation.

The present electric energy cost for these three (3) buildings amounts to $114,582. After the implementation of all the recommended ECOs, a 34% reduction is anticipated, saving $39,052 per year.

Regarding thermal consumption, a 73% decrease in costs is expected. Cost savings of $64,263 per year are anticipated.

Individual building consumption and savings are provided in Tables VII through IX (on pages 31 to 33).

Building 62

Total energy costs in building 62 can be reduced by 76% by implementing the recommended projects. Annual cost savings amounting to $20,918 are anticipated.

Annual electric costs will be reduced by 32% amounting to $2,428. Likewise energy consumption will be reduced by 100 MBtu per year.

Regarding thermal consumption, a 93% decrease in consumption can be realized. The potential savings are remarkably high because presently all of the floor space is heated while only 17% is utilized by occupants. Thus the elimination of heating the unoccupied spaces throughout the heating season validates the potential thermal savings. Analysis of the energy use index indicates a final building use of 2,375 Btu/SF. Adjusting this number to account for only occupied spaces reveals a more typical energy use index.

Building 63

It is expected that $67,033 per year or 53% of the total energy costs can be saved in building 63. Energy consumption annually will be reduced by 5,181 MBtu.

Electrical cost savings exceed energy savings because of the non-energy savings associated by limiting the peak electrical demand. A 40% reduction in costs and a 35% reduction in energy can be achieved.

Thermal costs and consumption will be reduced by 71%. The greatest thermal savings will result from the implementation of an SBC. The SBC will provide 91% of the total thermal savings.

Building 106

Finally, the total costs in building 106 are expected to decrease by 32% for a total savings of $15,366 per year. Total energy consumption will be reduced by 1,100 MBtu per year.

Electrical cost savings will be reduced by $8,276 per year. Analysis of the electrical energy use index indicates a typical consumption rate for a facility which utilizes all electric kitchen equipment.

Thermal costs and consumption will be reduced by 60%. Annual cost savings of $7,090 are anticipated.

Table VI: Project Summary: AAFES Post Exchange Facilities - Buildings 62, 63 & 106

			Annual Electricity			Annual Thermal			Annual Total Energy		
			$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Initial Building Energy Cost & Consumption :			114582	4741	26202	87454	9343	51634	202036	14085	77836

Project	SIR	Impl. Cost	Annual Electric Svgs $	Annual Electric Svgs MBtu	Annual Electric Svgs Btu/SF	Annual Thermal Svgs $	Annual Thermal Svgs MBtu	Annual Thermal Svgs Btu/SF	Annual Total Svgs $	Annual Total Svgs MBtu	Annual Total Svgs Btu/SF
1. Facility modifications	10.96	549	334	14	77	86	9	51	420	23	128
2. HVAC, Lighting & Weatherization modifications	4.40		(components listed below)								
- Lighting modifications		49485	21358	884	4883				21358	884	4883
- Single Building Controller (SBC)		150967	17360	594	3283	57462	6140	33931	74822	6734	37214
- Building weatherization		83670				6715	717	3869	6715	717	3869
TOTALS :		284671	39052	1492	8243	64263	6866	37851	103315	8358	46094

	Annual Electricity $	Annual Electricity MBtu	Annual Electricity Btu/SF	Annual Thermal $	Annual Thermal MBtu	Annual Thermal Btu/SF	Annual Total Energy $	Annual Total Energy MBtu	Annual Total Energy Btu/SF
Final Building Energy Cost & Consumption :	75530	3249	17959	23191	2477	13783	98721	5727	31742
Percent (%) Reduction :	34%	31%	31%	73%	73%	73%	51%	59%	59%

Figure 4: Present Energy Consumption (MBtu)

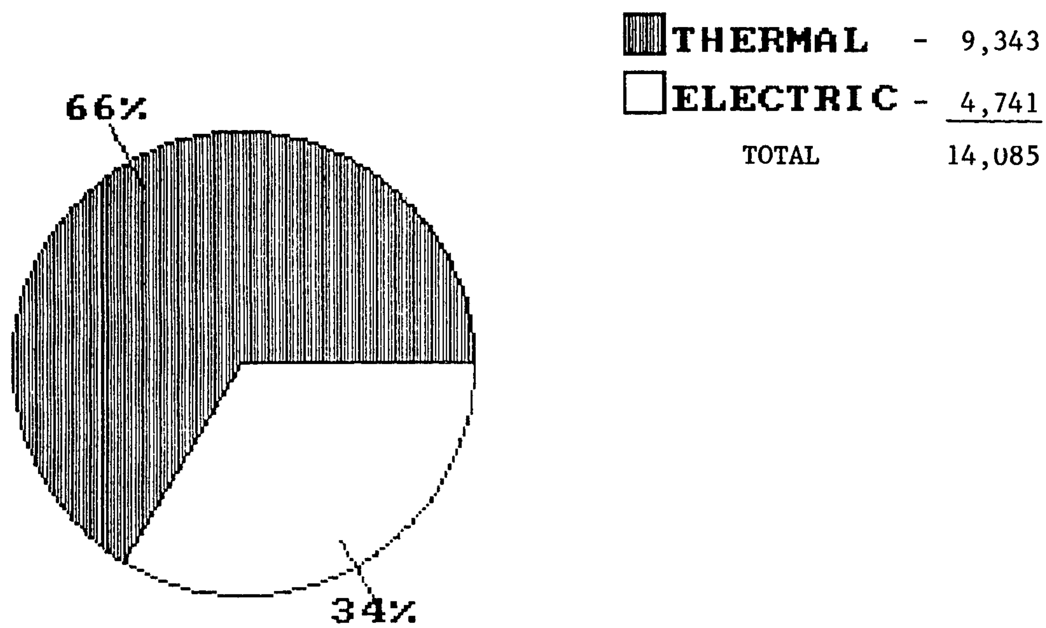


Figure 5: Energy Consumption After Implementation of Projects (MBtu)

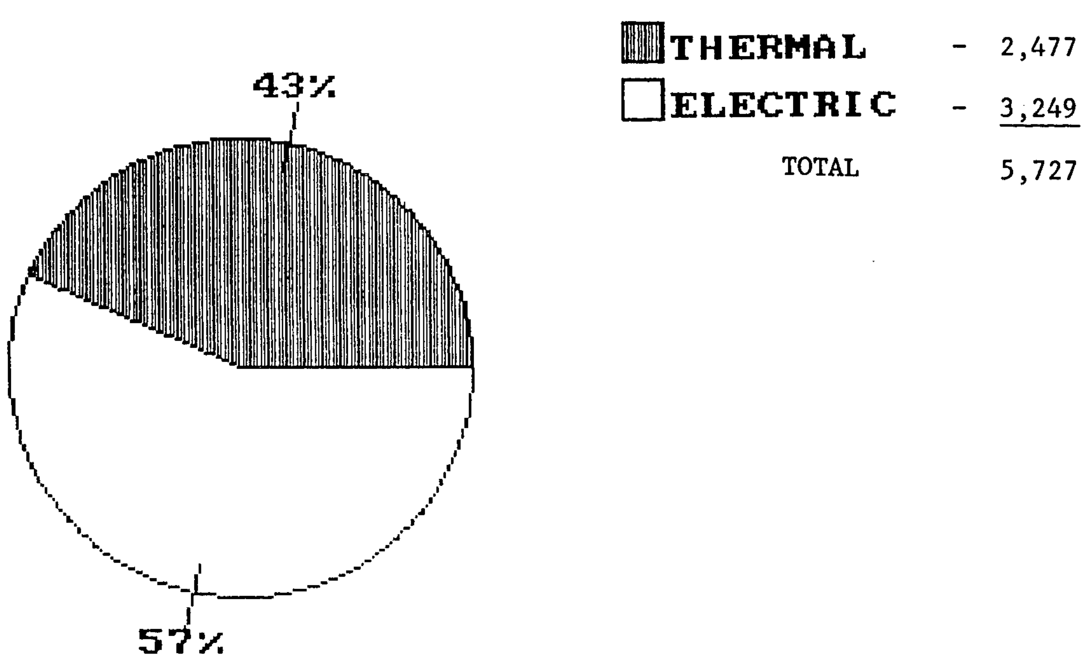


Figure 6: Present Energy Costs

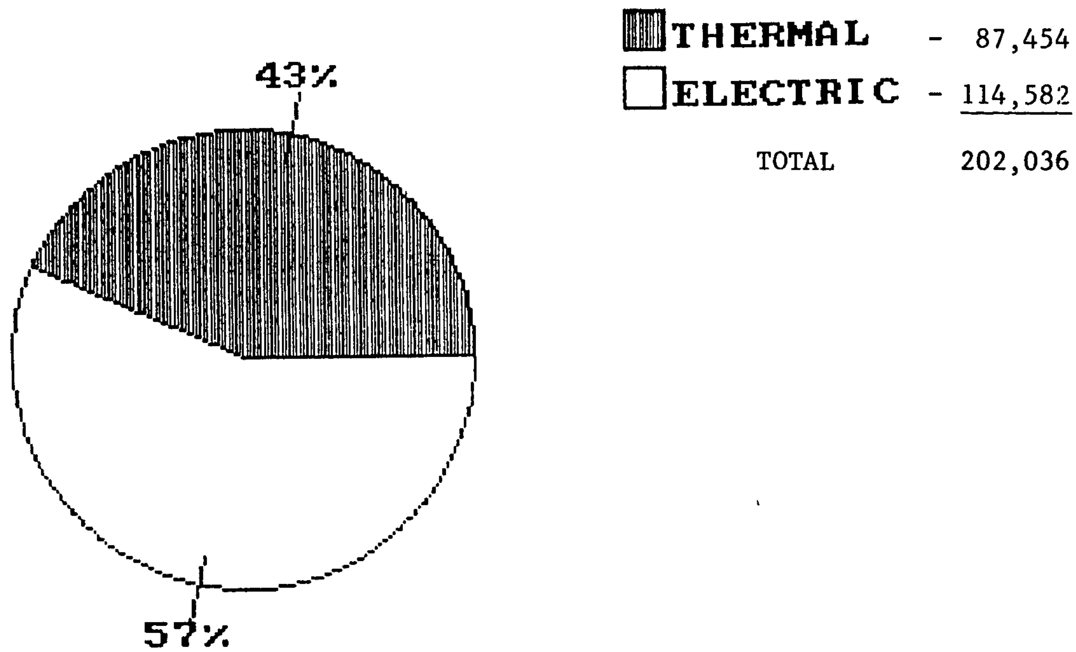


Figure 7: Energy Costs After Implementation of Projects

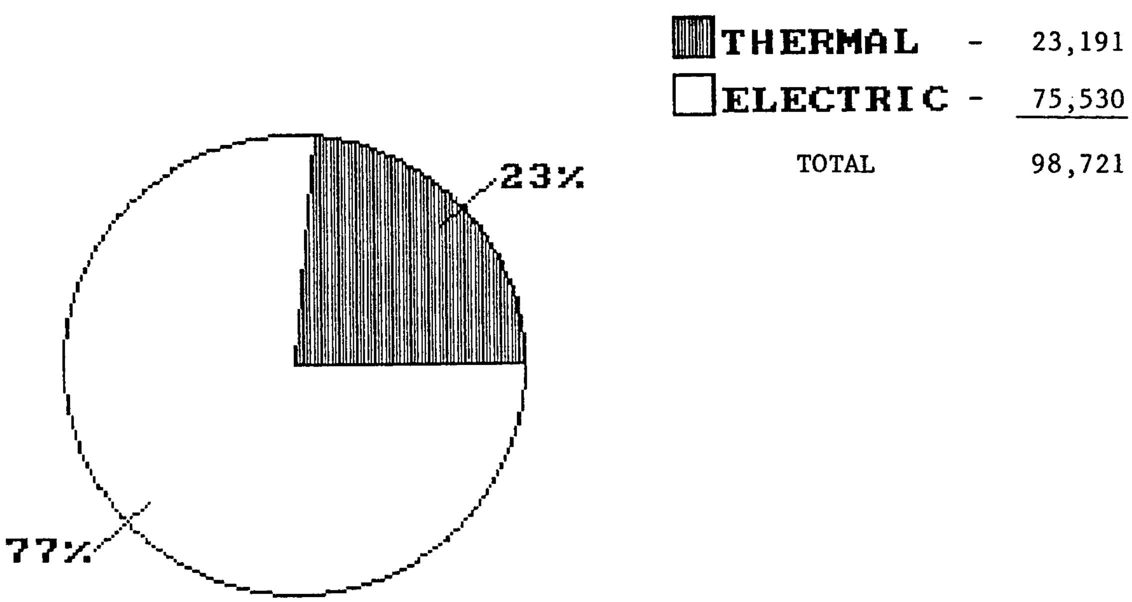


Table VII: Project Summary: Building 62-Quarter Master Kaserne

	Electricity			Thermal			Total Energy		
	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Initial Building Energy Cost & Consumption :	7617	315	5113	19860	2122	34419	27477	2437	39532

			Electric Svgs			Thermal Svgs			Total Svgs		
ECO title	SIR	Cost	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Delamp excessively lit areas	15.63	1514	1629	67	1094				1629	67	1094
Install timeclock for DHW heater	6.35	142	68	3	46				68	3	46
Discontinue unnecessary lighting	5.15	706	109	5	73				109	5	73
Single Building Controller (SBC)	5.31	40655	171	7	115	16825	1798	29160	16996	1805	29275
Interior lighting conversions	5.12	1413	382	16	256				382	16	256
Exterior lighting modifications	1.75	468	70	3	47				70	3	47
Weatherstrip windows and doors	1.45	2307				180	19	313	180	19	313
Insulate drop ceiling 1st floor	1.09	25400				1484	159	2571	1484	159	2571
TOTALS		72605	2428	100	1630	18489	1975	32044	20918	2076	33674

	Electricity			Thermal			Total Energy		
	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Final Building Energy Cost & Consumption :	5189	215	3483	1371	146	2375	6559	361	5858
Percent (%) Reduction :	32%	32%	32%	93%	93%	93%	76%	85%	85%

Table VIII: Project Summary: Building 63-Quarter Master Kaserne

	Electricity			Thermal			Total Energy		
	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Initial Building Energy Cost & Consumption :	71724	2968	34151	54845	5859	67424	126569	8827	101575

			Electric Svgs			Thermal Svgs			Total Svgs		
ECO title	SIR	Cost	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Delamp excessively lit areas	13.32	5755	5436	225	2588				5436	225	2588
Discontinue unnecessary lighting	12.45	1954	1593	66	759				1593	66	759
Single Building Controller (SBC)	6.95	87665	15668	524	6025	35362	3778	43473	51030	4302	49497
Interior lighting conversions	5.93	13871	4301	178	2048				4301	178	2048
Exterior lighting modifications	3.95	701	127	5	60				127	5	60
Insulate pipes and valves	2.68	4128				595	64	732	595	64	732
Insulate walls	1.67	30360				2728	291	3354	2728	291	3354
Modify display lighting	1.07	15076	1223	51	582				1223	51	582
TOTALS		159510	28348	1048	12062	38685	4133	47558	67033	5181	59620

	Electricity			Thermal			Total Energy		
	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Final Building Energy Cost & Consumption :	43376	1920	22088	16160	1726	19866	59536	3646	41954
Percent (%) Reduction :	40%	35%	35%	71%	71%	71%	53%	59%	59%

Table IX: Project Summary: Building 106-Sheridan Kaserne

	Electricity			Thermal			Total Energy		
	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Initial Building Energy Cost & Consumption :	35241	1458	45005	12749	1362	42036	47990	2820	87041

			Electric Svgs			Thermal Svgs			Total Svgs		
ECO title	SIR	Cost	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Reduce DHW temperature	93.95	18				86	9	285	86	9	285
Delamp excessively lit areas	18.20	2479	3247	134	4147				3247	134	4147
Interior lighting conversions	12.98	3706	2794	116	3569				2794	116	3569
Cycle anti-sweat heaters	9.25	298	209	9	267				209	9	267
Increase refrigeration temperatures	8.22	92	58	2	73				58	2	73
Discontinue unnecessary lighting	4.59	721	226	9	288				226	9	288
Exterior lighting modifications	3.74	1120	221	9	282				221	9	282
Single Building Controller (SBC)	3.65	22647	1521	63	1943	5275	564	17394	6797	627	19337
Insulate pipes and valves	3.46	252				47	5	155	47	5	155
Insulate attic floor	1.47	21222				1681	180	5544	1681	180	5544
									0	0	0
TOTALS		52555	8276	342	10569	7090	757	23378	15366	1100	33947

	Electricity			Thermal			Total Energy		
	$	MBtu	Btu/SF	$	MBtu	Btu/SF	$	MBtu	Btu/SF
Final Building Energy Cost & Consumption :	26965	1116	34436	5659	605	18658	32624	1720	53094
Percent (%) Reduction :	23%	23%	23%	56%	56%	56%	32%	39%	39%

G. General Recommendations for Post Exchange Facilities

The purpose of this section is to identify general energy conservation opportunities (ECO's) for post exchange facilities as required by the Scope of Work. All of the recommendations which follow have been considered for implementation in buildings 62, 63, and 106. The relevant ECO's are summarized in Table VI through IX on the preceding pages.

There are an abundance of energy conservation opportunities which pertain to post exchange facilities. It is not possible to delineate all of these opportunities for general distribution in this report; however, several notable books on this subject include:

1) Reducing Energy Costs in Wholesale Distribution, National Association of Wholesale Distributors, 1979;

2) Energy Conservation in Existing Buildings, DOE/CS-0132, U. W. Department of Energy, 1980;

3) Saving Money with Energy Conservation, DOE/CS-0137 and COE/CS-0143, U. S. Department of Energy, 1980;

4) Manual of Energy Savings in Existing Buildings and Plants, Stephen L. Baron, P.E., 1978.

There are several obvious characteristics which many post exchanges have in common. The most notable is the extremely high operating costs of lighting systems. Contributors to the extensive lighting costs include unnecessarily long lighting hours of operation, and incandescent floodlighting of merchandise.

Another common characteristic is the excessive outside air ventilation rates which are present in ventilated buildings.

Reducing lighting energy is as easy as turning off the light switch. Unfortunately, most of the occupants leave lights on unnecessarily. The most notable areas include bathrooms, employee lounges, and storage areas. Automatic devices such as motion sensors and spring-wound timers will reduce lighting energy consumption. The use of incandescent flood lamps to highlight merchandise is a large consumer of lighting energy in post exchanges. Eliminating unnecessary display lighting and/or converting the necessary display lighting to fluorescent lamps which utilize a reflector base will substantially reduce energy costs. Another common waste of lighting energy occurs after the store is closed. In many facilities all the floor lights remain on until "closeout" procedures are finished and the manager(s) turn out the lights. Adopting a policy such as turning off all display lighting and utilizing task lighting for "closeout" procedures is a cost effective way to easily reduce energy consumption. Other methods in which lighting energy costs can be reduced include establishing incentive programs for reduced lighting consumption, delamping overlit areas, replacing incandescent lamps with fluorescent lamps, utilizing energy-efficient lamps and ballasts at burnout, replacing exterior fixtures with more efficient high intensity discharge fixtures, and installing photocells on exterior fixtures.

The three (3) largest heating, ventilating and air conditioning energy saving opportunities result from:

1) reducing occupied/unoccupied space temperatures during the heating season and increasing temperatures during the cooling season;
2) reducing occupied equipment hours of operation;
3) reducing ventilation rates.

There are various methods to accomplish a reduction in HVAC energy costs. They include adjusting and calibrating controls, modifying energy inefficient sequences of operations, installing timeclocks, installing night setback thermostats, and implementing a quality preventive maintenance program for system components. One of the most effective means available to control and monitor HVAC energy consumption is through a Single Building Controller (SBC). Generally, the annual cost savings provided by an effective SBC installation will offset the implementation costs in a period of two (2) to three (3) years.

Modifications to the building envelope may be warranted as well. However, these projects usually are the least cost effective way to reduce energy consumption. Modifications may include: insulating ceilings, walls, and floors; weatherstripping and caulking windows and doors; installing double pane windows; installing loading dock seals; and installing vestibules.

General Recommendations for Post Exchange Facilities

The operation and maintenance of building systems is vital to energy conservation efforts. Poor O&M practices will unnecessarily waste energy and money. The following lists provide common O&M practices to be followed.

Lighting

- Institute a group relamping program; relamp when light output decreases to 75% of initial output.
- Clean all fixtures and diffusers when relamping.
- Utilize energy-efficient lamps when relamping.
- Turn off lights when not in use; instruct employees of the importance and benefits of reducing unnecessary lighting; it may also be advantageous to place posters and individual stickers on bulletin boards and next to light switches reminding the staff to turn lights off.
- Implement policy changes to reduce lighting levels during store closeout; utilize task lighting over cash registers and other areas where employees are still working.
- Establish incentive programs for both managers and employees to reduce lighting costs.
- Clean ceilings, walls and floors frequently to improve reflective qualities.
- Clean windows in areas where natural lighting is utilized.
- When repainting, select a light color to increase illuminance.

HVAC

Inspect and clean all systems on a regular basis. Remove all obstructions from heating/cooling systems. Keep all air registers clean and unobstructed. Some of the items to check include:

- radiators,
- heating coils,
- HVAC controls,
- motors,
- dampers,
- air filters,
- fan belts,
- cooling coils,
- condensing coils,
- pipe insulation,
- timeclocks,
- thermostats.

Building Structure

- Inspect exterior walls for cracks.
- Inspect windows and doors for excessive infiltration.
- Inspect windows and doors for proper closing operation.
- Keep windows and doors closed when building is conditioned.