FINAL SUBMISSION

EXECUTIVE SUMMARY

ENERGY SURVEY OF DINING FACILITIES
FORT KNOX, KENTUCKY

Prepared For:
DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT, CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

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DEPARTMENT OF THE ARMY
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INTRODUCTION

1. AUTHORIZATION. Performance of this energy survey of dining facilities at Fort Knox, Kentucky was authorized under Contract No. DACA27-85-C-0195 between the U.S. Army Engineer District, Louisville and Biagi, Chance, Cummins, London, Titzer, Inc., Consulting Engineers.

2. SCOPE. This energy survey consisted of performing an energy audit and analysis of the dining facilities identified in the following groups:

Group	BLDG NO.	TYPE/REASON
1.	1109C	P621-1120 FY 86
	1307C	P621-1120 Mod Project
2.	297	P64 w/ceiling fans
	1486	P64 w/ceiling fans
3.	1485	P64 Kitchen used only
4.	1475	P64 modernized
	1480	P64 modernized
	1482	P64 modernized
	2373	P64 modernized
	2375	P64 modernized
5.	2377	P64 small dining area
6.	2380	P64 air conditioned
	6544	P64 air conditioned
	6554	P64 air conditioned
7.	6578	P64A air conditioned
8.	6580	w/walk-in refrigerator
9.	2442	P Non Standard
10.	6012	P106 layout differs from others
	6018	P106 layout differs from others
11.	5915	P106
	5917	P106
	5940	P106
12.	6542	P64 School Units
	6543	P64 School Units
	6546	P64 School Units
13.	6548	P64 BCT Units minimum equipped
	6550	P64 BCT Units minimum equipped
	6551	P64 BCT Units minimum equipped

	6552	P64 BCT Units minimum equipped
	6555	P64 BCT Units minimum equipped
	6556	P64 BCT Units minimum equipped
	6557	P64 BCT Units minimum equipped
	6558	P64 BCT Units minimum equipped
14.	7741	P Non Std Stockade
15.	6669	T WW2 BCT Units
	6674	T WW2 BCT Units
	6719	T WW2 BCT Units
	6723	T WW2 BCT Units
	6818	T WW2 BCT Units
	6824	T WW2 BCT Units
	6828	T WW2 BCT Units
	6869	T WW2 BCT Units
	6872	T WW2 BCT Units
	6878	T WW2 BCT Units
	6887	T WW2 BCT Units
	6889	T WW2 BCT Units
16.	7053	T WW2 Rec Station
	7089	T WW2 Rec Station
17.	7394	T WW2 Pers Contr Fac

P64 Types also referred to as Hammerheads.
P106 Types also referred to as Disney Types.

The number of meals served is based upon the data obtained from the detailed survey of each building type. This was then multiplied by the number of buildings of each group.

Following is statistical data for each building type.

GROUP #	INDIVIDUAL SF	TOTAL SF	INDIVIDUAL CF	TOTAL CF	PER BLDG. INDIVIDUAL MEALS/DAY	PER GROUP TOTAL MEALS/DAY
*1	(2) 3,625	7,250	36,820	73,640	225	450
2	(2) 5,099	10,198	53,540	107,080	375	750
3	1,990	1,990	25,870	25,870	600	600
4	(5) 5,099	25,495	53,540	267,700	450	2,250
5	4,632	4,632	49,424	49,424	575	575
6	(3) 5,099	15,297	53,540	160,620	675	2,025
7	5,099	5,099	61,188	61,188	600	600
8	6,754	6,754	68,611	68,611	360	360
9	10,977	10,977	99,566	99,566	725	725
10	(2) 10,868	21,736	113,639	227,278	2,250	4,500
11	(3) 10,868	32,604	113,639	340,917	2,250	6,750
12	(3) 5,099	15,297	63,738	191,114	825	2,475
13	(8) 5,099	40,792	67,562	540,496	510	4,080
14	6,015	6,015	67,156	67,156	75	75
15	(12) 2,966	35,592	28,121	337,452	600	7,200
16	(2) 2,966	5,932	28,121	56,242	900	1,800
17	2,966	2,966	28,121	28,121	150	150
TOTAL		248,626 SF		2,782,475 C.F.		35,365 MEALS PER DAY OR APPROXI-MATELY 12,900,000 MEALS PER YEAR

( ) NUMBER IN PARA. INDICATES QUANTITY OF BUILDINGS INCLUDED IN GROUP.

*DELETED FROM PROJECT AT INTERIM SUBMITTAL DUE TO EXISTING ENERGY UP-GRADE OF BUILDINGS ALREADY IN PROGRESS.

Identification of energy conservation opportunities (ECOs) and documentation of anticipated energy savings were performed. Also, applicable project development brochures, 1391 forms and 5108-R forms were completed and are included with this submittal under separate cover.

3. PURPOSE. This study identified and analyzed energy conservation opportunities (ECOs) to determine if they were technically and economically feasible. A plan for implementation of these ECOs was developed. Identification of ECOs to be included in programming documents was accomplished through the Interim Submission review process.

4. CONTENT. This submission contains implementation programming documentation for all justifiable ECOs. These programming documents wee developed from the Interim Submission that listed all energy conservation opportunities identified during the field survey of dining facilities.

Also, included in this submission are charts, graphs and back-up material for energy conservation opportunities and how they were grouped into projects.

SUMMARY

The potential exists to save approximately 52.4% of the present energy being utilized annually by the Kitchen/Dining facilities included within this study.

From the initial field survey phase of the study through the energy calculations phase, the intent of the final outcome of this study was to develop suggestions and ideas into viable energy saving projects. Basically, as a result of performing the required energy calculations, there were ten projects developed for consideration (one project was deleted at Prefinal Review meeting).

Since there are varying programs available to fund the projects it became necessary to consider all economically feasible ECOs in regard to meeting the specific funding criteria. The four funding programs available for these projects are: Energy Conservation Investment Program (ECIP); Quick Return on Investment Program (QRIP); OSD Productivity Investment Funding (OSD PIF); and Productivity Enhancing Capitol Investment Programming (PECIP). Each of the funding programs have specific guideline requirements.

In several cases, one energy conservation opportunity could not stand alone as a project, but instead it had to be combined with others. This was due to construction cost limits and other program requirements.

A baseline of total energy usage at each dining facility type was estimated since no metering devices exists. This estimate was subdivided into the following energy using systems: heating; cooling; lighting; domestic hot water; kitchen cooking and equipment and energy transmission losses. Estimates for the HVAC and lighting systems energy use were established through use of computer simulation. Information obtained from American Society of Plumbing Engineers Design Manual, American Society of Heating, Refrigeration and Air Conditioning Engineers Design Manuals and manufacturer's published literature was used to estimate the energy consumption of the domestic hot water system and piping transmission losses.

Implementing the projects developed from this study will result in savings in the five energy using systems approximately as follows:

Heating:	72.3%
Cooling:	54.6%
Lighting:	14.1%
Domestic Hot Water:	48.4%
Energy Transmission Loss:	93.8%

The overall estimate of energy savings, when all five categories are combined, is approximately 52.4%.

Following is a project summary schedule:

PROJECT	FUNDING PROGRAM	PROJECT TITLE	CWE ($)	DESIGN 6% ($)	SIOH 6% ($)	PROJECT TOTAL COST ($)	ESTIMATED MILLIONS BTU SAVED ANNUALLY	FUEL TYPE SAVED		ESTIMATED FUEL COST ANNUAL SAVINGS ($)	ESTIMATED FUEL COST DISCOUNTED SAVINGS ($)	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK (YEARS)	FY89 PROJECT TOTAL COST ($)	
								NAT. GAS	ELEC.						
1	ECIP	VARIOUS PROJECTS	271,000	16,260	16,260	*273,168	6,298	✓	✓	28,589	641,352	2.35	9.48	296,027	
2	ECIP	INSULATE BUILDING	216,000	12,960	12,960	*217,728	2,550	✓		11,424	258,868	1.19	18.90	235,948	
3	QRIP	INSULATE PIPING SYSTEMS	83,950	5,037	5,037	94,024	14,880	✓		66,663	1,510,584	16.07	1.26	101,892	
4	PECIP	REDUCE LIGHTING ENERGY	16,325	979	979	18,283	496		✓	6,562	74,610	4.08	2.49	19,813	
5	ECIP	KITCHEN HOOD HEAT RECOVERY	1,702,000	102,120	102,120	*1,715,616	21,649	✓		96,988	2,197,748	1.28	17.54	1,859,179	
6	OSD PIF	INSULATE PIPING SYSTEMS	608,000	36,480	36,480	680,960	91,861	✓		411,537	9,325,428	13.69	1.47	737,943	
7	ECIP	PROGRAM EQUIPMENT OPERATION	273,000	16,380	16,380	*275,184	4,135	✓		25,172	570,398	2.07	10.84	298,211	
8	OSD PIF	REVISE D.H.W. SYSTEMS	256,000	15,360	15,360	286,720	14,662	✓		65,685	1,488,445	5.19	3.89	310,713	
9	PROJECT DELETED														
10	ECIP	MISC. GEN. CONSTR. PROJECTS	670,640	40,238	40,238	*676,004	8,421	✓	✓	47,616	1,025,855	1.52	14.08	732,572	

FY89 PROJECT TOTAL COST DERIVED FROM EIR BULLETIN 85-02 PROJECTED ESCALATION RATES FOR FY87 (4.2%) AND FY88 (4.0%).
PROJECTS LISTED IN RANDOM ORDER, NOT BY RECOMMENDED PRIORITY.
*90% ENERGY CREDIT APPLIED TO TOTAL COST FOR ECIP PROJECTS.

PROJECT SUMMARY SCHEDULE

Recommendations and Conclusions

It is recommended that all projects developed from this study be implemented. These projects have been derived from the Energy Conservation Opportunities identified during the field survey. They were selected specifically for their attractiveness in regard to quick return on investment and/or potential for major energy savings. These projects will effectively reduce the present energy consumption for the five energy subsystems considered as follows:

Heating: Approximately 72.3% savings in energy at $153,000
Cooling: Approximately 54.6% savings in energy at $4,700
Lighting: Approximately 14.1% savings in energy at $7,100
Domestic Hot Water: Approximately 48.4% savings in energy at $701,000
Energy Trans. Losses: Approximately 93.8% savings in energy at $1,000,000.

The arrangement of the projects developed from this study can be based on many variables to establish a priority of consideration. Following are two such priority listings, the first is based on best payback potential and the second is based on best savings to investment ratio potential.

Project Priority: Best Payback Potential

1.	Project 3	Insulate Piping Systems
2.	Project 6	Insulate Piping Systems
3.	Project 4	Reduce Lighting Energy
4.	Project 8	Revise Domestic Hot Water System
5.	Project 1	Various Projects
6.	Project 7	Program Equipment Operation
7.	Project 10	Misc. General Construction Projects
8.	Project 5	Install Heat Recovery
9.	Project 2	Install Building Insulation
10.	Project 9	(Project Deleted)

Project Priority: Best Savings to Investment Ratio Potential

1.	Project 3	Insulate Piping Systems
2.	Project 6	Insulate Piping Systems
3.	Project 8	Revise Domestic Hot Water System
4.	Project 4	Reduce Lighting Energy
5.	Project 1	Various Projects
6.	Project 7	Program Equipment Operation
7.	Project 10	Misc. General Construction Projects
8.	Project 5	Install Heat Recovery
9.	Project 2	Install Building Insulation
10.	Project 9	(Project Deleted)

Implementing any or all of the projects will result in energy savings for the Kitchen/Dining facilities included in this study. Failure to implement these projects will continue the use of energy inefficient systems.

FIELD SURVEY SUMMARY

1. GENERAL. The initial phase of this study consisted of performing a field survey to determine the existing conditions at 49 Enlisted Mens Kitchen/Dining facilities at Fort Knox.

Distribution of the field survey forms were made at the interim submittal to those parties, as directed in the Contract Appendix A.

The field survey form was developed to insure obtaining comprehensive data. The form was based upon and included all data recommended by Corps of Engineers guidelines.

The data contained in the field survey form was the direct result of the information obtained during the on-site visits conducted in October, November, and December of 1985 and January 1986. The forty-nine dining facilities included in this project are divided into 17 groups based upon similiarities of construction, equipment, and use. It was observed during the field investigation and subsequent conversations with the Using Agency that there were already energy conservation projects planned for group 1 (Bldg. 1307C & 1109C0. This was discussed during the interim review meeting and it was decided that this group should not be included within this study.

In each group a selection of one dining facility was made for performing a detailed survey requiring approximately one day to complete. A walk-thru of the other dining facilities within a group was conducted to note any significant variations from the detailed survey facility.

The detailed survey consisted of an interview with the dining facility manager, followed by a facility survey to: compare the construction with Record Drawings; note significant items; record mechanical/electrical data (air flows, temperatures, motor amperages, lighting levels); photograph the facility for later in-office use; and complete a checklist of potential Energy Conservation Opportunities (ECOs).

Following are the General Construction, Mechanical, and Electrical ECO checklist items that were used for each group of buildings included in this study:

GENERAL CONSTRUCTION

Interior screening of windows during summer; Use of south facing glass in winter for passive solar; Windows broken; Windows poorly fitted allowing infiltration; Doors poorly fitted allowing infiltration; Doors slow acting allowing infiltration; Automatic door closers; Doors left open; Windows left open; Seal exterior wall openings; Gasket cooler/freezer doors; Clean walls; Clean windows; Paint walls and ceiling light colors; Post operating instructions; Preheat only equipment to be used; Publish energy conservation newsletter; Landscaping; Direct portable fans so that

they do not cool cooking equipment; Install foil between radiator/heater and uninsulated walls; Install storm windows in existing window opening; Replace window/reduce window area; Install storm doors in existing openings; Replace doors and/or add new doors; Create airlocks/vestibules (Interior or Exterior); Enclose loading dock; Insulation; Separate unheated or minimally heated spaces; Install insulating devices; Install shading or solar screen devices; Install air infiltration/vapor barrier; Lower ceiling heights; Install exterior insulating system; Install a trombe wall; Install new door closers.

MECHANICAL

Belt tension and alignment; Damper operation; Water treatment; Clean heat transfer surfaces; Lubricate equipment; Repair piping leaks; Repair ductwork leaks; Repair piping insulation; Repair ductwork insulation; Repair equipment insulation; Replace air filters; Replace pump seals; Reset heating hot water setpoint; Reset chilled water setpoint; Reset thermostats; Turn off equipment in unoccupied areas; Reset dampers; Perform regular maintenance of controls and equipment; Post operating instructions; Balance air systems; Provide wind breaks at outside air louvers; Avoid simultaneous heating and cooling systems operation; Check refrigerant charge on a regular basis; Repair/Replace Steam Traps; Turn off equipment during unoccupied periods; Defrost freezers; Install locking covers on thermostats; Repair plumbing fixture leaks; Reset domestic hot water heater setpoint; Flow restrictors on hot water faucets; Turn off domestic hot water recirculating pump; Try operating with one domestic water heater off; Insulate piping systems3ms; Insulate heating equipment; Program equipment operation; Install ceiling fans; Install attic ventilation; Install air curtains; Insulate ductwork; Interlock Heating/Cooling operation; Install automatic outside air dampers; Install heat recovery on exhaust air systems; Install temperature reset controls; Replace steam systems with hot water; Update temperature controls; Replace Low EER refrigeration equipment with high EER refrigeration equipment; Replace steam and condensate piping; Connect/expand base EMCS; Replace air cooled condenser with cooling tower; Install gas/steam/condensate meters; Preheat domestic hot water with waste heat; Solar domestic hot water heating; Revise domestic hot water heating system; Replace low efficiency HVAC equipment with high efficiency HVAC equipment.

ELECTRICAL

Reduce lighting energy; Clean lamps & fixtures; Utilize more efficiency lamps; Utility daylighting; Provide task lighting; Lower height of lighting fixture; Replace lamps with higher efficiency lamps; Lower lighting levels; Replace frosted incandescent bulbs with clear bulbs; Correct motor voltage; Lubricate motors; Clean motors; Turn off equipment not in use; Post operating instructions; Replace lighting fixtures; Program lighting systems operation; Revise lighting switching to permit turning off unused fixtures; Photo-cells for turning off fixtures when daylighting is available; Load shedding system; Power factor correction; Install electric meters.

Not all items included in these lists apply to each group of buildings. Many of the items could be included on a regularly scheduled preventative maintenance program. Some items do require considerable investment to implement and these items were analyzed to determine the feasibility of developing Energy Conservation projects.

The construction of each building was documented as to the type of construction, insulation, windows, doors, roof construction, ceiling heights, floor coverings, blinds, curtains, and other data that could be useful in performing an energy survey.

The dining facility manager was given the opportunity to discuss systems operation and effectiveness, specific problem areas, and to offer suggestions for improvement.

Typically, Low Cost/No Cost ECO Items are those that should be accomplished by the maintenance or operations staffs at either no or very little investment cost. Since the cost for implementing those items is little or none, a very quick payback is expected.

All other ECOs differ in that a substantial investment cost is anticipated for these items, typically requiring either expertise or manpower beyond that available through maintenance and operations staff. While the cost is higher, the energy savings potential is typically greater than for Low Cost/No Cost ECO Items.

The field survey forms were the basis for assumptions made in arriving at energy conservation results. Data obtained for this purpose includes items such as equipment operation schedules, occupancy patterns, and meals served. However, a significant added use of the field survey form can be made by the Using Agency. Equipment items noted as not operational should be repaired. Air flow readings that are significantly out of line with design requirements should be adjusted. The Low Cost/No Cost ECO Items are measures that can be pursued immediately thru Maintenance and Operations. Some items have no cost and require only an operations procedure to implement. Others have very little cost and can be implemented with the assistance of Maintenance staff.

2. General Construction Observations

The buildings that house the dining facilities range from approximately 20 to 40-year-old structures. These buildings, as in all older buildings, are in need of maintenance and repair. At the time these buildings were constructed, a different set of standards was followed in terms of insulation, window treatment, etc. Therefore the buildings do not meet the more stringent energy standards of today.

Over the years, the Corps and the Army have instituted certain policies to save energy and should be complimented for their efforts. The policies include the entrance of five soldiers at a

time to the dining facilities, thus insuring the closing of entrance doors during inclement weather. The installation of double insulating glass, insulation, solar film and shading devices and landscaping have also helped to save energy. These policies of usage and modernization were observed during the field survey.

Observations of the Maintenance and operation nature made during the field survey include broken windows needing replacement, hardware on doors and windows requiring adjustment to close properly, and openings in exterior walls at pipe penetrations that could easily be sealed. The performance of these items through the utilization of base maintenance personnel will save energy. The maintenance of all these structures with energy savings in mind is recommended as part of this study.

ECO CALCULATIONS SUMMARY

1. GENERAL. Items identified as potential Energy Conservation Opportunities (ECOs) from the field survey checklists were analyzed in the Interim Submission to determine their feasibility. The calculations revealed the extent of expected energy savings, the simple payback ratios and savings to investment ratio. In addition, for each applicable ECO, a preliminary estimate of construction cost was made. Refer to the following summary tables of applicable ECOs for each of the groups of Buildings included in this study. The ECO's are arranged by savings to investment ratio priority.

GROUP 2

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	60.4	0.37	$ 5,376
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	3.9	5.84	5,040
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	3.38	6.7	3,920
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	3.38	6.4	1,765
E/ECO-7	INSTALL ELECTRIC METERS	3.17	3.59	487
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.76	7.46	604
GC/ECO-7	INSULATION	1.82	12.5	13,500
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFIEIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.65	3.63	121
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.3	17.4	51,968
M/ECO-18	INSTALL GAS/STEAM/CONDENSATE METERS	1.19	19.1	6,272
M/ECO-3	PROGRAM EQPT. OPERATION, INSTALL & UPDATE TEMP CONTROLS, CONNECT TO EMCO	1.18	12.3	8,848
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
M/ECO-22	REPLACE LOW EFF. HVAC EQPT. WITH HIGH EFF. HVAC EQPT.	0.46	25.	50,400
M/ECO-20	SOLAR DOMESTIC HOT WATER HEATING	0.24	60.8	105,112
GC/ECO-9	INSTALL INSULATING DEVICES	0.20	114.	7,280
M/ECO-17	REPLACE AIR COOLED CONDENSER W/COOLING TOWER	0.14	82.	66,800
M/ECO-14	REPLACE LOW EER REFRIG.EQPT. WITH HIGH EER REFRIG. EQPT.	0.13	86.3	952
M/ECO-6	INSTALL AIR CURTAINS	0.06	35.4	2,688

GROUP 3

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	35.9	0.63	$ 14,896
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	5.52	4.1	5,040
M/ECO-19	PREHEAT DOMESTIC HOT WATER	4.7	4.85	3,920
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	1.85	12.2	1,735
GC/ECO-7	INSULATION	1.82	12.5	7,730
E/ECO-7	INSTALL ELECTRIC METERS	1.61	7.08	478.20
M/ECO-6	INSTALL AIR CURTAINS	1.6	14.	1,344
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUSE AIR SYSTEMS	1.52	14.9	38,080
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.15	19.8	5,936
M/ECO-3	PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS	1.05	13.9	4,816
M/ECO-15	REPLACE STEAM AND CONDENSATE PIPING	0.34	66.5	29,904
M/ECO-20	SOLAR DOMESTIC HOT WATER HEATING	0.23	64.5	178,107

GROUP 4

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	60.4	0.37	$ 5,376
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	3.9	5.85	3,920
E/ECO-7	INSTALL ELECTRIC METERS	3.72	3.06	487.20
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	3.22	6.8	1,850
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	3.15	7.2	5,040
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.76	7.47	3,024
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.85	2.59	903.84
GC/ECO-7	INSULATION	1.82	12.5	13,500
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.3	17.4	51,968
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
M/ECO-3	PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS CONNECT/EXPAND BASE EMCS	1.18	12.3	8,848
M/ECO-20	SOLAR DOMESTIC HOT WATER HEATING	0.22	64.9	134,344

GROUP 5

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	60.4	0.37	$ 5,376
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	3.9	5.85	3,920
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	3.15	7.2	5,040
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.77	7.4	3,012
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	1.93	11.3	3,087
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.8	3.01	723.08
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.3	17.4	51,968
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
M/ECO-3	CONNECT/EXPAND BASE EMCS INSTALL TEMPERATURE RESET CONTROLS PROGRAM EQUIPMENT OPERATION UPDATE TEMPERATURE CONTROLS	1.18	12.3	8,848
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
GC/ECO-7	INSULATION	1.06	21.5	16,800

GROUP 6

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	35.9	0.63	$ 14,896
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	6.3	3.6	3,920
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	3.38	6.4	1,765
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	3.22	7.	2,410
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	2.97	7.6	5,040
E/ECO-7	INSTALL ELECTRIC METERS	2.77	4.11	487.20
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.85	2.59	1,446.14
GC/ECO-7	INSULATION	1.42	15.9	16,020
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.3	17.3	51,968
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
M/ECO-3	INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS CONNECT/EXPAND BASE EMCS PROGRAM EQUIPMENT OPERATION	1.18	12.3	8,848
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
GC/ECO-14	INSTALL A TROMBE WALL	.36	63.	24,248

GROUP 7

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-10	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	4.7	4.8	$ 3,920
M/ECO-1	INSULATE PIPING SYSTEMS	4.03	5.62	9,520
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	3.83	5.9	5,040
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	3.38	6.4	1,765
E/ECO-7	INSTALL ELECTIRC METERS	2.45	4.63	487.20
E/ECO-1	REPLACE LIGHTING FIXTURES REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.56	7.3	2,822.40
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.42	15.9	56,448
GC/ECO-7	INSULATION	1.34	16.9	16,937
M/ECO-3	PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS CONNECT/EXPAND BASE EMCS	1.23	11.8	8,960
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570

GROUP 8

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	25.1	0.9	$ 6,608
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	3.5	6.4	3,920
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	3.38	6.4	1,765
GC/ECO-7	INSULATION	2.69	8.4	2,520
E/ECO-7	INSTALL ELECTRIC METERS	2.28	4.99	487.20
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEM	1.43	15.8	56,448
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
M/ECO-3	PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS CONNECT/EXPAND BASE EMCS	1.1	13.3	6,720
E/ECO-1	REPLACE LIGHTING FIXTURES REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS	0.68	16.6	2,352
GC/ECO-2	REPLACE WINDOW: REDUCE WINDOW AREA	0.66	24.6	17,125

GROUP 9

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATE TOTAL INVESTMENT
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.76	7.45	$ 4,825
E/ECO-7	INSTALL ELECTRIC METERS	2.64	4.3	487.20
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	1.87	11.7	1,065
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.7	13.4	56,448
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	1.4	15.9	5,040
GC/ECO-7	INSULATION	1.35	16.	25,420
M/ECO-3	PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS	1.27	11.5	6,720
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.17	8.67	2,214.41
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
GC/ECO-10	INSTALL SHADING OR SOLAR SCREEN DEVICES	1.11	10.25	2,900
GC/ECO-2	REPLACE WINDOW: REDUCE WINDOW AREA	0.41	41.5	31,020

GROUP 10

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	20.7	1.1	$ 5,040
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	5.6	3.9	1,065
E/ECO-7	INSTALL ELECTRIC METERS	3.96	2.87	487.20
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.76	7.45	4,825
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	2.3	9.9	7,056
M/ECO-3	UPDATE TEMPERATURE CONTROLS PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS	2.1	7.1	8,960
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.65	2.51	205.64
GC/ECO-7	INSULATION	1.40	14.4	26,700
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.4	15.8	56,448
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
GC/ECO-2	REPLACE WINDOW: REDUCE WINDOW AREA	0.74	27.1	26,015

GROUP 11

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATE TOTAL INVESTMENT
GC/ECO-11	INSTALL AIR INFILTRATION/ VAPOR BARRIER	24.2	NA	$ 1,015
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	8.27	2.7	5,040
E/ECO-7	INSTALL ELECTRIC METERS	3.77	3.02	487.20
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.76	7.45	4,825
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	2.3	9.9	7,056
M/ECO-3	PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE CONTROLS INSTALL TEMPERATURE RESET CONTROLS	2.1	7.1	8,960
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.8	12.7	56,448
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.72	2.8	205.64
GC/ECO-7	INSULATION	1.40	14.4	26,700
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
GC/ECO-2	REPLACE WINDOW: REDUCE WINDOW AREA	0.74	27.1	26,015

GROUP 12

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	35.9	0.63	$ 14,896
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	7.26	3.1	3,920
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	6.07	3.73	5,040
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	3.10	7.2	3,762
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.78	7.4	2,401
E/ECO-7	INSTALL ELECTRIC METERS	1.97	5.77	487.20
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.6	13.9	56,448
GC/ECO-7	INSULATION	1.31	17.18	17,256
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6.272
M/ECO-3	CONNECT/EXPAND BASE EMCS PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS	1.18	12.3	8,848
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
E/ECO-1	REPLACE LIGHTING FIXTURES UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS	0.33	34.56	2,352
M/ECO-12	REPLACE STEAM SYSTEMS WITH HOT WATER	0.27	82.5	35,728

GROUP 13

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-1	INSULATE PIPING SYSTEMS	35.9	.63	$ 14,896
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	6.07	3.73	5,040
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	5.17	4.38	3,920
GC/ECO-11	INSTALL AIR INFILTRATION/ VAPOR BARRIER	3.53	NA	2,951
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	3.04	7.5	3,762
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	2.06	11.0	2,410
E/ECO-7	INSTALL ELECTRIC METERS	2.01	5.66	487.20
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.6	13.9	56,448
GC/ECO-7	INSULATION	1.25	18.	18,072
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
M/ECO-3	PROGRAM EQUIPMENT OPERATION INSTALL TEMPERATURE RESET CONTROLS UPDATE TEMPERATURE CONTROLS CONNECT/EXPAND BASE EMCS	1.18	12.3	8,848
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
E/ECO-1	REPLACE LIGHTING FIXTURES UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS	0.29	34.5	2,352
M/ECO-12	REPLACE STEAM SYSTEMS WITH HOT WATER	0.27	82.5	35,728

GROUP 14

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	3.9	5.84	$ 5,040
E/ECO-7	INSTALL ELECTRIC METERS	3.57	3.18	487.20
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	2.76	7.9	2,160
M/ECO-19	PREHEAT DOMESTIC HOT WATER WITH WASTE HEAT	2.3	9.9	3,920
E/ECO-1	REPLACE LIGHTING FIXTURES REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS	1.89	6.01	3,057.60
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	1.52	14.9	38,080
GC/ECO-7	INSULATION	1.47	15.4	7,500
M/ECO-3	PROGRAM EQUIPMENT OPERATION UPDATE TEMPERATURE CONTROLS	1.25	11.7	8,960
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.19	19.1	6,272
GC/ECO-6	ENCLOSE LOADING DOCK	1.11	20.	1,570
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	0.42	49.	7,995
GC/ECO-2	REPLACE WINDOW: REDUCE WINDOW AREA	0.25	91.	12,910

GROUP 15

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-21	REVISE DOMESTIC HOT WATER	3.75	6.04	$ 5,040
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	2.44	8.9	1,220
M/ECO-22	REPLACE HOW EFFICIENCY HVAC EQUIPMENT WITH HIGH EFFICIENCY HVAC EQUIPMENT	2.42	9.4	2,352
GC/ECO-7	INSULATION	2.35	9.7	14,560
M/ECO-3	PROGRAM EQUIPMENT OPERATION UPDATE TEMPERATURE CONTROLS	2.35	6.2	935
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	1.97	10.4	5,070
M/ECO-9	INSTALL AUTOMATIC OUTSIDE AIR DAMPERS	1.9	12.2	1,400
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.81	12.5	1,680
E/ECO-7	INSTALL ELECTRIC METERS	1.77	6.42	487.20
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.72	3.15	84.32
GC/ECO-6	ENCLOSE LOADING DOCK	0.7	29.	2,269
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	0.58	38.8	29,904
M/ECO-6	INSTALL AIR CURTAINS	0.52	43.4	2,688
M/ECO-20	SOLAR DOMESTIC HOT WATER HEATING	0.18	80.6	178,109

GROUP 16

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-21	REVISE DOMESTIC HOT WATER	4.14	5.48	$ 5,040
GC/ECO-5	CREATE AIRLOCKS/VESTIBULES (INTERIOR OR EXTERIOR)	2.44	8.9	1,220
GC/ECO-7	INSULATION	2.35	9.7	14,560
M/ECO-3	PROGRAM EQUIPMENT OPERATION UPDATE TEMPERATURE CONTROLS	2.35	6.2	935
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	1.97	10.4	5,070
M/ECO-9	INSTALL AUTOMATIC OUTSIDE AIR DAMPERS	1.9	12.2	1,400
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.81	12.5	1,680
E/ECO-7	INSTALL ELECTRIC METERS	1.77	6.42	487.20
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.71	3.18	84.68
GC/ECO-6	ENCLOSE LOADING DOCK	0.8	29.	2,269
M/ECO-6	INSTALL AIR CURTAINS	0.6	35.4	2,688
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	0.58	38.8	29,904
M/ECO-20	SOLAR DOMESTIC HOT WATER HEATING	0.18	80.2	265,805

GROUP 17

ITEM NUMBER	DESCRIPTION	SAVINGS TO INVESTMENT RATIO	SIMPLE PAYBACK RATIO	ESTIMATED TOTAL INVESTMENT
M/ECO-3	PROGRAM EQUIPMENT OPERATION UPDATE TEMPERATURE CONTROLS	2.5	5.82	$ 896
GC/ECO-5	CREATE AIRLOCK/VESTIBULES (INTERIOR OR EXTERIOR)	2.44	8.9	1,220
M/ECO-22	REPLACE LOW EFFICIENCY HVAC EQUIPMENT WITH HIGH EFFICIENCY HVAC EQUIPMENT	2.42	9.4	2,352
GC/ECO-7	INSULATION	2.35	9.7	14,560
GC/ECO-4	REPLACE DOORS AND/OR ADD NEW DOORS	1.97	10.4	5,070
M/ECO-9	INSTALL AUTOMATIC OUTSIDE AIR DAMPERS	1.9	12.2	1,400
E/ECO-7	INSTALL ELECTRIC METERS	1.85	6.14	487.20
M/ECO-18	INSTALL GAS/STEAM/ CONDENSATE METERS	1.81	12.5	1,680
E/MO-1	REDUCE LIGHTING ENERGY UTILIZE MORE EFFICIENT LAMPS REPLACE LAMPS WITH HIGHER EFFICIENCY LAMPS LOWER LIGHTING LEVELS	1.78	3.37	542.30
M/ECO-21	REVISE DOMESTIC HOT WATER HEATING SYSTEM	0.83	27.4	5,040
GC/ECO-6	ENCLOSE LOADING DOCK	0.8	29.	2,269
M/ECO-6	INSTALL AIR CURTAINS	0.6	35.4	2,688
M/ECO-10	INSTALL HEAT RECOVERY ON EXHAUST AIR SYSTEMS	0.58	38.8	29,904
M/ECO-20	SOLAR DOMESTIC HOT WATER HEATING	0.17	84.4	46,565

The calculations that were performed utilized information obtained from TRACE computer runs for the different groups. These computer runs provided an estimation of building energy usage for heating and cooling (where applicable). Also, the effect that adding building insulation and kitchen hood heat recovery had on the heating and cooling energy consumption was analyzed by the TRACE computer runs. Lighting energy usage calculations involved using the Lumen Dollars Investment program.

2. GENERAL CONSTRUCTION ECOS. Calculations for the general construction ECOs included such items as: replacing doors; creating airlocks/vestibules; enclosing loading docks; and installing building insulation. From the field checklists, only the specific items applicable to each group was analyzed. These calculations generally involved reducing the existing air infiltration into the buildings and the loss of heating and cooling from the buildings. Several of the items had very good energy savings potential.

3. MECHANICAL ECOs. Calculations for the mechanical ECOs included such items as: replacing pipe insulation; revising domestic hot water systems; programming equipment operation; etc. Many of the mechanical ECO's had good potential for energy savings and also had savings to investment ratios greater than one. The implementation of the mechanical ECOs will provide an energy savings, in heating and air conditioning, domestic hot water and pipe transmission losses.

4. ELECTRICAL ECOs. Calculations for the electrical ECOs included such items as replacing inefficient lights and/or light fixtures. The calculations indicated that there is potential energy savings involved with light replacement.

5. ECO FUNDING PROGRAM. From the ECO calculations performed, it was possible to group the ECOs into several projects. Grouping the ECOs together to form projects required analyzing their construction cost versus their payback. There were four funding programs available to provide the economic backing of the projects. Each of the programs have different criteria for construction cost and payback potential. The programs are:

1. Energy Conservation Investment Program (ECIP)
To qualify for ECIP project, the construction cost shall be greater than $200,000 with a Savings to Investment Ratio greater than one (1.0).

2. Quick Return on Investment Program (QRIP).
To qualify for QRIP funding, the construction cost shall not exceed $100,000 with a 2 year or less payback potential.

3. OSD Productivity Investment Funding (OSD PIF).
To qualify for OSD PIF funding, the construction cost shall exceed $100,000 with a payback of 4 years or less.

4. Productivity Enhancing Capital Investment Programming (PECIP).

To qualify for PECIP funding, the construction cost shall exceed $3000 with a payback of 4 years or less.

6. COMBINING ECOS INTO PROJECTS

From meetings and discussions with the Louisville District Corps of Engineers and input from the installation, a grouping or combining of ECOs into projects was determined. Basically, ten projects were developed. (Project No. 9 was deleted at Prefinal review meeting). These projects are:

Project 1. ECIP Funded: Various projects, including creating airlocks/vestibules; replacing doors; enclosing loading docks; programming equipment operation; installing automatic outside air dampers; revising domestic hot water system; replacing low efficiency HVAC equipment; and reducing lighting energy.

BUILDINGS INCLUDED IN PROJECT: 6669, 6674, 6719, 6723, 6818, 6824, 6828, 6869, 6872, 6878, 6887, 6889, 7053, 7089, 7394

ESTIMATED ANNUAL ENERGY SAVED: 6298 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $28,600

Project 2. ECIP FUNDED: Install Building Insulation

BUILDINGS INCLUDED IN PROJECT: 6669, 6674, 6719, 6723, 6818, 6824, 6828, 6869, 6872, 6878, 6887, 6889, 7053, 7089, 7394

ESTIMATED ANNUAL ENERGY SAVED: 2550 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $11,400

Project 3. QRIP FUNDED: Insulated Piping Systems

BUILDINGS INCLUDED IN PROJECT: 297, 1486, 1485, 2377

ESTIMATED ANNUAL ENERGY SAVED: 14,880 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $66,600

Project 4. PECIP FUNDED: Reduce Lighting Energy

BUILDINGS INCLUDED IN PROJECT: 297, 1486, 1475, 1480, 1482, 2373, 2375, 2377, 2380, 6544, 6554, 2442, 6012, 6018, 5915, 5917, 5940, 6578, 7741

ESTIMATED ANNUAL ENERGY SAVED: 496 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $6500

Project 5. ECIP FUNDED: Install Heat Recovery on Kitchen Exhaust Hood

BUILDINGS INCLUDED IN PROJECT: 297, 1486, 1485, 1475, 1480, 1482, 2373, 2375, 2377, 2380, 6544, 6554, 6578, 6580, 2442, 6012, 6018, 5915, 5917, 5940, 6542, 6543, 6546, 6548, 6550, 6551, 6552, 6555, 6556, 6557, 6558, 7741

ESTIMATED ANNUAL ENERGY SAVED: 21,649 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $96,900

Project 6. OSD PIF FUNDED: Insulate Piping Systems

BUILDINGS INCLUDED IN PROJECT: 1475, 1480, 1482, 2373, 2375, 2380, 6544, 6554, 6578, 6580, 6542, 6543, 6546, 6548, 6550, 6551, 6552, 6555, 6556, 6557, 6558

ESTIMATED ANNUAL ENERGY SAVED: 91,861 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $411,000

Project 7. ECIP FUNDED: Program Equipment Operation

BUILDINGS INCLUDED IN PROJECT: 297, 1486, 1485, 1475, 1480, 1482, 2373, 2375, 2377, 2380, 6544, 6554, 6578, 6580, 2442, 6012, 6018, 5915, 5917, 5940, 6542, 6543, 6546, 6548, 6550, 6551, 6552, 6555, 6556, 6557, 6558, 7741

ESTIMATED ANNUAL ENERGY SAVED: 4135 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $25,000

Project 8. OSD PIF FUNDED: Revise Domestic Hot Water Systems

BUILDINGS INCLUDED IN PROJECT: 297, 1486, 1485, 1475, 1480, 1482, 2373, 2375, 2377, 2380, 6544, 6554, 6578, 6580, 2442, 6012, 6018, 5915, 5917, 5940, 6542, 6543, 6546, 6548, 6550, 6551, 6552, 6555, 6556, 6557, 6558, 7741

ESTIMATED ANNUAL ENERGY SAVED: 14,662 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $65,600

Project 9. PROJECT DELETED

Project 10. ECIP FUNDED: Misc. General Construction Projects including: replacing doors, enclosing loading docks; installing building insulation; installing shading or solar screens; and creating airlocks/vestibules.

BUILDINGS INCLUDED IN PROJECT: 297, 1486, 1485, 1475, 1480, 1482, 2373, 2375, 2377, 2380, 6544, 6554, 6578, 6580, 2442, 6012, 6018, 5915, 5940, 6542, 6543, 6546, 6548, 6550, 6551, 6552, 6555, 6556, 6557, 6558, 7741

ESTIMATED ANNUAL ENERGY SAVED: 8421 Million BTU

ESTIMATED ANNUAL DOLLARS SAVED: $47,600

Project development brochures were developed for each of the ten projects. Also, 1391 forms were completed for the ECIP projects and OSD PIF projects. In addition, 5108-R forms were filled out for the OSD PIF project, the QRIP, and PECIP projects.

ENERGY SUMMARY ANALYSIS

GENERAL. The Kitchen/Dining facilities included within this project are: 297, 1486, 1485, 1475, 1480, 1482, 2373, 2375, 2377, 2380, 6544, 6554, 6578, 6580, 2442, 6012, 6018, 5915, 5917, 5940, 6542, 6543, 6546, 6548, 6550, 6551, 6552, 6555, 6556, 6557, 6558, 7741, 6669, 6674, 6719, 6723, 6818, 6824, 6828, 6869, 6872, 6878, 6887, 6889, 7053, 7089, 7394

EXISTING ENERGY USAGE. There are five basic types of energy utilized by the Kitchen/Dining facilities that are analyzed in this study. They are: heating; cooling; lighting; domestic hot water; and energy transmission. Cooking related energy and kitchen equipment operation are included only to establish the baseline energy usage for the Kitchen/Dining facilities.

There are no meters presently installed at these facilities to determine the baseline energy consumed annually. Therefore, it was necessary to estimate the energy consumption through the use of computer simulations and various ASHRAE and other publications literature.

The estimated annual energy consumption for the Kitchen/Dining facilities are summarized for each group in the table A through Table F.

GROUP NUMBER	ESTIMATED ANNUAL HEATING ENERGY PER BLDG. INTHERMS	STEAM $0.5768 PER THERM	HEATING WATER $0.6408 PER THERM	FUEL OIL $0.739 PER THERM	GAS $0.4614 PER THERM	NUMBER BLDGS. PER GROUP	TOTAL ANNUAL HEATING THERMS PER GROUP	TOTAL ANNUAL HEATING ENERGY COST	
1	---	---	---	---	---		---	---	
2	5003 2980	$2886 ---	--- $1910	---	---	2	15,966	$ 9,592	
3	4998	$2883	---	---	---	1	4,998	$ 2,883	
4	5003 2980	$2886 ---	--- $1910	---	---	5	39,915	$23,980	
5	4994 2212	$2881 ---	--- $1417	---	---	1	7,206	$ 4,298	
6	4998 3422	$2883 ---	--- $2193	---	---	3	25,260	$15,228	
7	4998 3422	$2883 ---	--- $2193	---	---	1	8,420	$ 5,076	
8	4263 1410	$2459 ---	--- $ 904	---	---	1	5,673	$ 3,363	
9	6769	$3904	---	---	---	1	6,769	$ 3,904	
10	13,209	---	$8,464	---	---	2	26,418	$16,928	
11	13,209	---	$8,464	---	---	3	39,627	$25,392	
12	4998 3422	$2883 ---	--- $2,193	---	---	3	25,260	$15,228	
13	4998 3422	$2883 ---	--- $2,193	---	---	8	67,360	$40,608	
14	8859	$5110	---	---	---	1	8,859	$ 5,110	
15	4291	---	---	---	$2683	12	51,492	$32,196	
16	4291	---	---	---	$2683	2	8,582	$ 5,360	
17	4427	---	---	---	$2746	1	4,427	$ 2,746	
TOTAL							342,232 THERMS	$211,892 DOLLARS	

NOTES: 1. FOR GROUPS 2 THRU 14, ADD 4542 MILLION BTU FOR DOORS, AIRLOCK, AND AIR INFILTRATION ESTIMATED LOAD
2. REFER TO ATTACHED SHEETS FOR ADDITIONAL INFORMATION.

M=1,000,000 TABLE A

HEATING ENERGY

342,232 therms x 100,000 $\frac{BTU}{THERM}$ =34,223 MBTU

GROUP NUMBER	ESTIMATED ANNUAL COOLING ENERGY PER BUILDING KWH	$0.045/KWH	NUMBER BLDGS PER GROUP	TOTAL ANNUAL COOLING KWH PER GROUP	TOTAL ANNUAL COOLING ENERGY COST PER GROUP	
1	---	---	---	---	---	
2	11,669	$525	2	23,338	$1050	
3	---	---	---	---	---	
4	11,669	$525	5	58,345	$2625	
5	10,717	$482	1	10,717	$ 482	
6	3,070	$138	3	9,210	$ 414	
7	3,070	$138	1	3,070	$ 138	
8	6,451	$290	1	6,451	$ 290	
9	18,059	$813	1	18,059	$ 813	
10	12,467	$561	2	24,934	$1122	
11	12,467	$561	3	37,401	$1683	
12	---	---	---	---	---	
13	---	---	---	---	---	
14	---	---	---	---	---	
15	---	---	---	---	---	
16	---	---	---	---	---	
17	---	---	---	---	---	
TOTAL				KWH 191,525	$ DOLLARS $8617	

M= 1,000,000 TABLE B

COOLING ENERGY

$\frac{191,525 \times 3415}{100,000}$ = 6541 therms

191,525 KWH x 3.4 x 10^3 = 654 MBTU

GROUP NUMBER	ESTIMATED ANNUAL LIGHTING LOAD IN KWH PER GROUP	TOTAL PER BLDG. KWH	NUMBER BLDGS PER GROUP	TOTAL KWH LIGHTING PER GROUP	$0.045 / KWH TOTAL GROUP COST	
1	---	---	---	---	---	
2	37,274	60,279	2	74,548	$ 3,355	
3	7,571	30,576	1	7,571	$ 341	
4	47,757	70,762	5	238,785	$10,745	
5	39,060	58,968	1	39,060	$ 1,758	
6	29,702	52,707	3	89,106	$ 4,010	
7	23,733	46,738	1	23,733	$ 1,068	
8	20,384	43,389	1	20,384	$ 917	
9	30,888	50,336	1	30,888	$ 1,390	
10	48,121	75,348	2	96,242	$ 4,331	
11	44,554	71,781	3	133,662	$ 6,015	
12	14,560	37,565	3	43,680	$ 1,966	
13	15,288	38,293	8	122,304	$ 5,504	
14	40,768	67,995	1	40,768	$ 1,835	
15	10,702	33,707	12	128,424	$ 5,779	
16	10,702	33,707	2	21,404	$ 963	
17	12,267	35,272	1	12,267	$ 552	
TOTAL				1,122,826	$50,529	

TABLE C

M=1,000,000

ANNUAL LIGHTING USAGE

1,122,826 KWH x 3.4 x 10^3= 3818 MBTU

$$\frac{1,122,826 \times 3415}{100,000} = 38,345 \text{ therms}$$

GROUP NUMBER	ESTIMATED ANNUAL DOM. HOT WATER ENERGY IN THERMS PER GROUP	GAS $0.4614 / THERM	NUMBER BLDGS PER GROUP	TOTAL THERMS PER GROUP	TOTAL COST PER GROUP	
1	---	---	---	---	---	
2	4,623	2,133	2	9,246	4,266	
3	7,123		1	7,123	3,287	
4	4,069		5	20,345	9,387	
5	4,069		1	4,069	1,877	
6	6,502		3	19,506	9,000	
7	5,442		1	5,442	2,511	
8	---	---	1	---	---	
9	2,594		1	2,594	1,197	
10	28,767		2	57,534	26,546	
11	22,602		3	67,806	31,286	
12	9,192	4,241	3	27,576	12,724	
13	9,192	4,241	8	73,536	33,930	
14	4,623		1	4,623	1,995	
15	6,794	3,135	12	37,620	17,358	
16	9,452	4,361	2	18,904	8,722	
17	1,644	759	1	1,644	759	
TOTAL				357,568	$164,845	

TABLE D
M=1,000,000

DOMESTIC HOT WATER ENERGY

357,568 THERMS x 100,000 $\frac{\text{BTU}}{\text{THERM}}$
=35,757 MBTU

GROUP NUMBER	ESTIMATED ANNUAL TRANSMISSION LOSS IN THERMS PER GROUP	STEAM $0.5768 / THERM	NUMBER BLDGS. PER GROUP	TOTAL ANNUAL TRANSMISSION LOSS-$ PER GROUP	ESTIMATED ANNUAL THERMS PER GROUP	
1	---	---	---	---	---	
2	34,188	$19,720	2	39,440	68,376	
3	56,150	$32,387	1	32,287	56,150	
4	34,188	$19,720	5	98,600	170,940	
5	34,188	$19,720	1	19,720	34,188	
6	56,150	$32,387	3	97,161	168,450	
7	4,151	$ 2,394	1	2,394	4,151	
8	17,778	$10,254	1	10,254	17,778	
9	---	---	1	---	---	
10	---	---	2	---	---	
11	---	---	3	---	---	
12	56,150	$32,387	3	97,161	168,450	
13	56,150	$32,387	8	259,096	449,200	
14	---	---	1	---		
15	---	---	12			
16	---	---	2			
17	---	---	1			
TOTAL				$ 656,213	1,137,683	

TABLE E

M= 1,000,000

ENERGY

TRANSMISSION LOSSES

1,137,683 THERMS x 100,000 $\frac{\text{BTU}}{\text{THERM}}$

=113,768 MBTU

ESTIMATED KITCHEN EQPT. ENERGY CONSUMPTION

GROUP	GAS USAGE MBTU	GAS COST $	ELEC. USAGE KWH	ELEC. COST $	TOTALS
2	1,810	8,104	1,168	15,454	
3	1,800	8,062	90	1,183	
4	4,120	18,455	3,240	42,870	
5	1,508	3,825	611	8,082	
6	4,455	19,956	270	3,549	
7	1,331	5,962	90	1,183	
8	1,354	6,064	313	4,140	
9	1,449	6,491	620	8,203	
10	5,318	23,822	180	2,366	
11	37,593	168,402	270	3,549	
12	3,507	15,708	270	3,549	
13	9,024	40,424	560	9,464	
14	1,331	5,962	90	1,183	
15	10,560	47,304	1,788	23,652	
16	1,582	7,086	298	3,942	
17	701	3,140	238	3,154	
TOTAL MBTU	87,443 MBTU		10,096 MBTU		97,539 MBTU
TOTAL COST		$388,767		$135,523	$524,290

M=1,000,000

TABLE F

Utilizing the information provided in the preceeding tables, an estimate of the existing energy utilized by the Kitchen/Dining facilities included in this study can be calculated.

Heating	34,223 Million BTU	$211,892
Cooling	654 Million BTU	8,617
Electricity(Lighting)	3,818 Million BTU	50,529
Dom. Hot Water	35,757 Million BTU	164,845
Energy Trans. Loss	113,768 Million BTU	1,137,683
Kitchen Equipment	97,539 Million BTU	524,290
	285,759 Million BTU	$2,097,856

Based on the energy consumption types, the corresponding percentages of the total are:

	Million BTU
Heating	: 12.0%
Cooling	: 0.2%
Elec. (Light)	: 1.4%
Dom. Hot Water	: 12.5%
Energy Trans. Loss	: 39.8%
Kitchen Equipment	: 34.1%

Refer to Figure 1 for graphic representation of existing baseline energy usage for the Kitchen/Dining facilities included in this study.

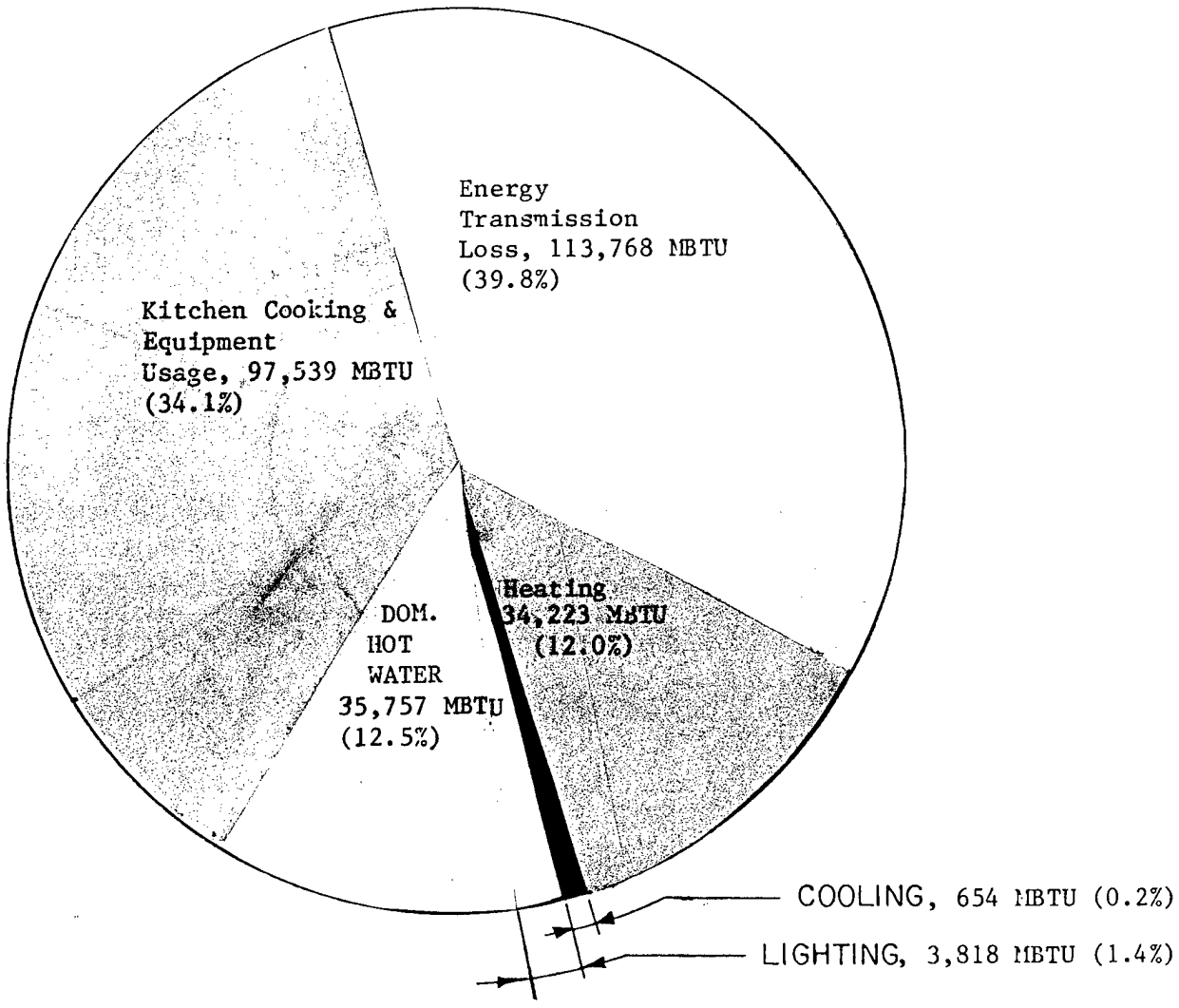


FIGURE 1

EXISTING ANNUAL BASELINE ENERGY CONSUMPTION

EXISTING FUEL COSTS AND CONSUMPTION. The installation provided the following information for this study.

FY85 FUEL CONSUMPTION

NATURAL GAS:	1,622,065	mcf @ $4.614/1000 CU.FT.
ELECTRICITY:	154,699,000	KWH @ $0.045/KWH
FUEL OIL :	1,743,080	GALS @ $1.03/GAL

From Table F and Table G, the existing Kitchen/Dining facilities energy consumption is:

NATURAL GAS CONSUMPTION

HEATING:	34,223 MBTU
DOM. HOT WATER:	35,757 MBTU
ENERGY TRANS. LOSS:	113,768 MBTU
KITCHEN COOKING & EQPT:	87,443 MBTU
	271,191 MBTU

For Natural Gas, 1 CU.Ft. produces 1030 BTU, then 26,329 mcf is consumed to produce the 271,191 MBTU. This represents only 1.6% of the natural gas consumed at the installation.

ELECTRICITY CONSUMPTION

Cooling:	654 MBTU
LIGHTS:	3,818 MBTU
KITCHEN EQPT:	10,096 MBTU
	14,568 MBTU

For Electricity, WATT x 3.4 = BTU.

$$14{,}568 \text{ MBTU} \times 3.4 \text{ W/BTU} = 4.95 \times 10^{10} \text{ W} = 4.95 \times 10^{7} \text{ KW}$$

CONVERTING BASE USAGE TO KW GIVES

$$154{,}699{,}000 \text{ KWH} \times 24 \text{ HR/DAY} \times 365 \text{ DAY} = 1.36 \times 10^{12} \text{ KW}$$

The electrical energy used by the Kitchen/Dining facilities represents only 0.003% of the electricity consumed at the installation.

There was no fuel oil consumed at the Kitchen/Dining facilities included in this study.

PROJECT NO.	PROJECT TYPE	ECO'S INCLUDED IN PROJECT	HEATING ENERGY SAVED MILLION BTU	HEATING $ SAVED	COOLING ENERGY SAVED MILLION BTU	COOLING $ SAVED	ELECTRICITY ENERGY SAVED MILLION BTU	ELECTRICITY $ SAVED	DOM. HOT WATER ENERGY SAVED MILLION BTU	DOM. HOT WATER $ SAVED	PIPE TRANS. LOSS ENERGY SAVED MILLION BTU	PIPE TRANS. LOSS $ SAVED	
1	ECIP	GC/ECO-5	405	1935									
		GC/ECO-4	1350	7290									
		GC/ECO-6	270	1080									
		M/ECO-3	496	2268									
		M/ECO-9	390	1725									
		M/ECO-21							2642	11860			
		M/ECO-22	702	3263									
		E/MO-1					43	597					
2	ECIP	GC/ECO-7	2550	11430									
3	QRIP	M/ECO-1									14880	66600	
4	PECIP	E/MO-1					428	5600					
		E/ECO-1					68	900					
5	ECIP	M/ECO-10	*15386	68662									
6	OSD PIF	M/ECO-1									91861	411500	
7	ECIP	M/ECO-3	4135	25100									
8	OSD PIF	M/ECO-19							5564	22800			
		M/ECO-21							9098	40700			
9	PROJECT DELETED												
10	ECIP	GC/ECO-5	2101	8583	33	463							
		GC/ECO-4	1898	9067	136	630							
		GC/ECO-6	390	1300									
		GC/ECO-7	3675	23,300	166	769							
		GC/ECO-10			22	290							

TOTAL SAVINGS FOR EACH COLUMN NOT ACCUMULATIVE.
* DOES NOT INCLUDE ENERGY AVAILABLE FROM COOKING.

TABLE G

PROJECTED ENERGY SAVINGS:

With the implementation of the projects developed in this study, there will be a substantial energy savings realized. The estimated breakdown of potential energy savings for each project is as follows in Table G.

The total heating energy savings, if all projects are implemented, is not an accumulative total of all the project. It is assumed that the heating energy savings from the implementation of building heat recovery systems and building insulation will introduce a de-evaluation factor for all other heating ECOs. The estimated heating energy savings is based on the following calculations:

FROM HEATING ENERGY SUMMARY TABLE A.....34,223 MBTU

PROJECTED MAJOR ECO SAVINGS

M/ECO-10 (HEAT RECOVERY): -15,386 MBTU
GC/ECO-7 (BLDG. INSULATION): -(2550 + 3675) MBTU

-21,611 MBTU -21,611 MBTU

12,612 MBTU

PROJECTED SAVINGS WITH ADDITIONAL IMPLEMENTATION OF REMAINING ECOs (DE-EVALUATION FACTORS). REFER TO TABLE G FOR PROJECTED ECO SAVINGS.

GC/ECO-5: $\frac{2506}{34,223}$ = -7.3%

GC/ECO-4: $\frac{3248}{34,223}$ = -9.5%

GC/ECO-6: $\frac{660}{34,223}$ = -1.9%

M/ECO-3: $\frac{496}{34,223}$ = -1.4%

M/ECO-9: $\frac{390}{34,223}$ = -1.1%

M/ECO-22: $\frac{702}{33,748}$ = -2.1%

-23.3% x 12,612 = -2939 MBTU

9673 MBTU

PRESENT HEATING ENERGY: 34,223 MBTU

PROJECTED HEATING ENERGY SAVINGS: 34,223 MBTU - 9673 MBTU = 24,550 MBTU

PERCENT SAVINGS: $\frac{24,550}{34,223}$ = 71.7% SAVINGS

FROM TABLE G AND THE PRECEEDING CALCULATIONS, THE ESTIMATED ENERGY SAVINGS ARE:

HEATING:	24,550 MILLION BTU	(16.5%)
COOLING:	357 MILLION BTU	(0.24%)
ELEC. (LIGHTING):	539 MILLION BTU	(0.36%)
DOM. HOT WATER:	17,304 MILLION BTU	(11.6%)
ENERGY TRANS. LOSS:	106,741 MILLION BTU	(71.3%)
	149,491 MILLION BTU	

The projected energy consumption savings are as follows:

HEATING: $\frac{24,550 \text{ MBTU}}{34,223 \text{ MBTU}} = 71.7\%$

COOLING: $\frac{357 \text{ MBTU}}{654 \text{ MBTU}} = 54.6\%$

ELEC (LIGHTING): $\frac{539 \text{ MBTU}}{3818 \text{ MBTU}} = 14.1\%$

DOM. HOT WATER: $\frac{17,304 \text{ MBTU}}{35,757 \text{ MBTU}} = 48.4\%$

ENERGY TRANS. LOSS: $\frac{106,741 \text{ MBTU}}{113,768 \text{ MBTU}} = 93.8\%$

Refer to figures 2 through 6 for graphic representation of existing energy cost and projected savings.

From previous pages, the baseline energy usage for the Kitchen/Dining areas was calculated to be 285,759 Million BTU.

Implementation of all the projects developed from this study will result in the following savings:

$$\frac{149,491 \text{ Million BTU}}{285,759 \text{ Million BTU}} = 52.4\%$$

HEATING ENERGY. Heating energy reduction will result with the implementation of projects number 1, 2, 5, 7, and 10. The over-all heating savings is anticipated to be 24,550 million BTU, or 71.2% of the existing annual heating energy. This large reduction is anticipated because of implementating several major items for the facilities. These include utilizing kitchen hood exhaust heat to preheat make-up air to the buildings. Also, installing building insulation and airlocks/vestibules will reduce heating energy usage substantially.

Refer to Annual Heating Energy Comparison Graph, Figure 3.

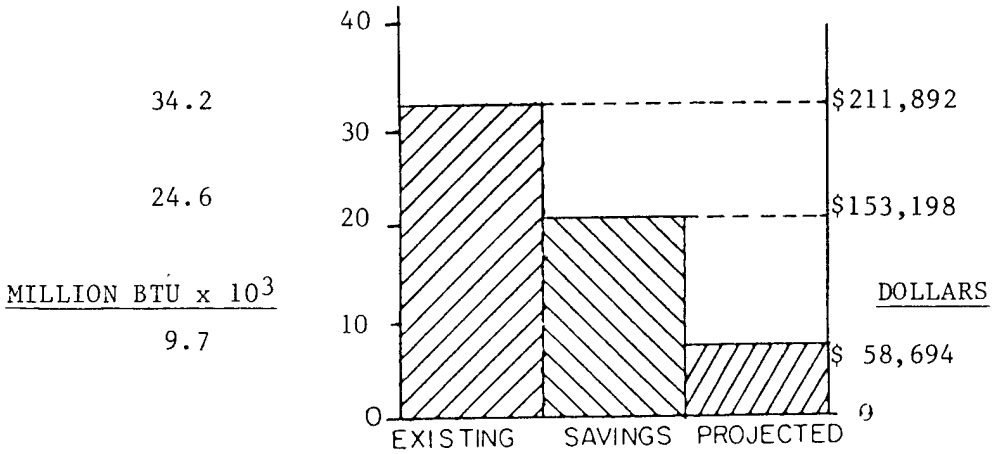
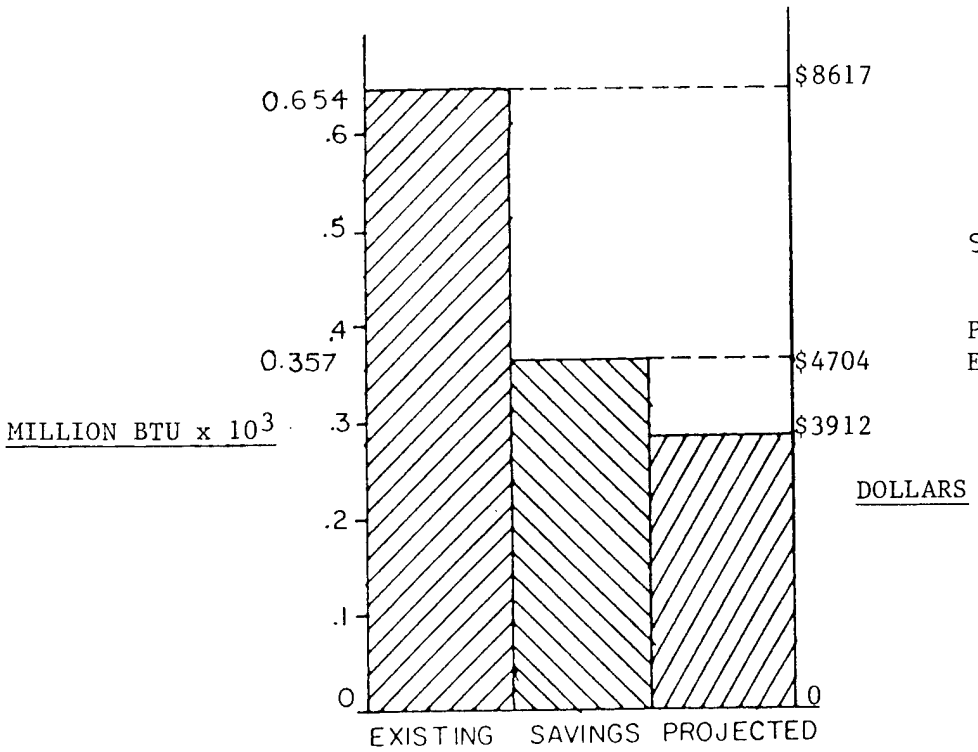


FIGURE 2

ANNUAL HEATING ENERGY COMPARISON

COOLING ENERGY. Cooling energy reduction will result with the implementation of project number 10. Since most of the existing Kitchen/Dining facilities have no air conditioning or only minimal air conditioning, there is less potential for savings in this energy type. However, as previously mentioned, some cooling energy can be saved with the implementation of project 10. An estimation of 357 million BTU's can be saved annually, or 54.6 of the existing cooling energy.

Refer to Annual Cooling Energy Comparison Graph, Figure 4.



SAVINGS: $\frac{0.357}{0.654} = 54.6\%$

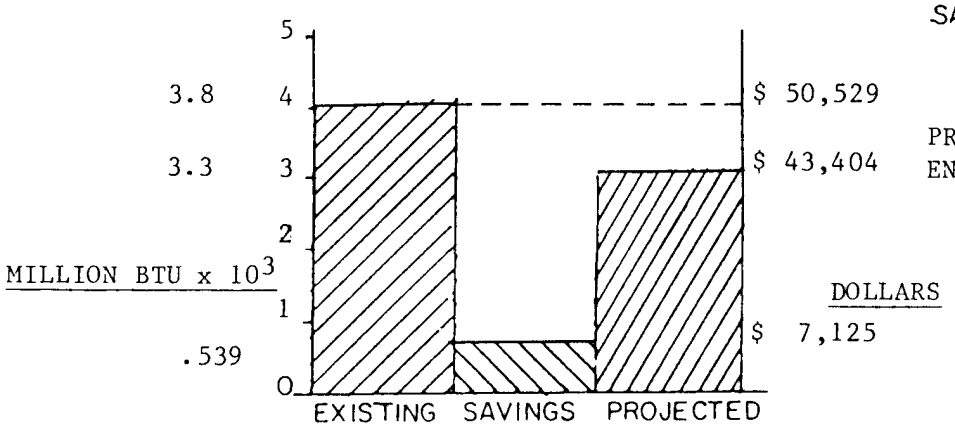
PROJECTED COOLING ENERGY CONSUMPTION:
297 MILLION BTU
@ $4704

FIGURE 3

ANNUAL COOLING ENERGY COMPARISON

LIGHTING. Lighting energy reduction will result with the implementation of project 1 and 4. Basically, these projects require utilizing more efficient lights and light fixtures. Estimation of annual energy savings is 539 million BTUs, or 14.1% of the existing lighting energy.

Refer to Annual Lighting Energy Comparison Graph, Figure 5.



SAVINGS = $\frac{.539}{3.818}$ = 14.1%

PROJECTED LIGHTING
ENERGY CONSUMPTION: 3279 MILLIONBTU
@ $ 43,404

FIGURE 4

ANNUAL LIGHTING ENERGY COMPARISON

DOMESTIC HOT WATER. Domestic hot water energy reduction will result with the implementation of project 1 and 8. These projects lower water storage tank temperatures and utilize waste heat from high temperature steam condensate to preheat incoming water. Estimation of annual energy savings is 17,304 million BTU's, or 48.4% of the existing domestic hot water energy.

Refer to Annual Domestic Hot Water Comparison Graph, Figure 6.

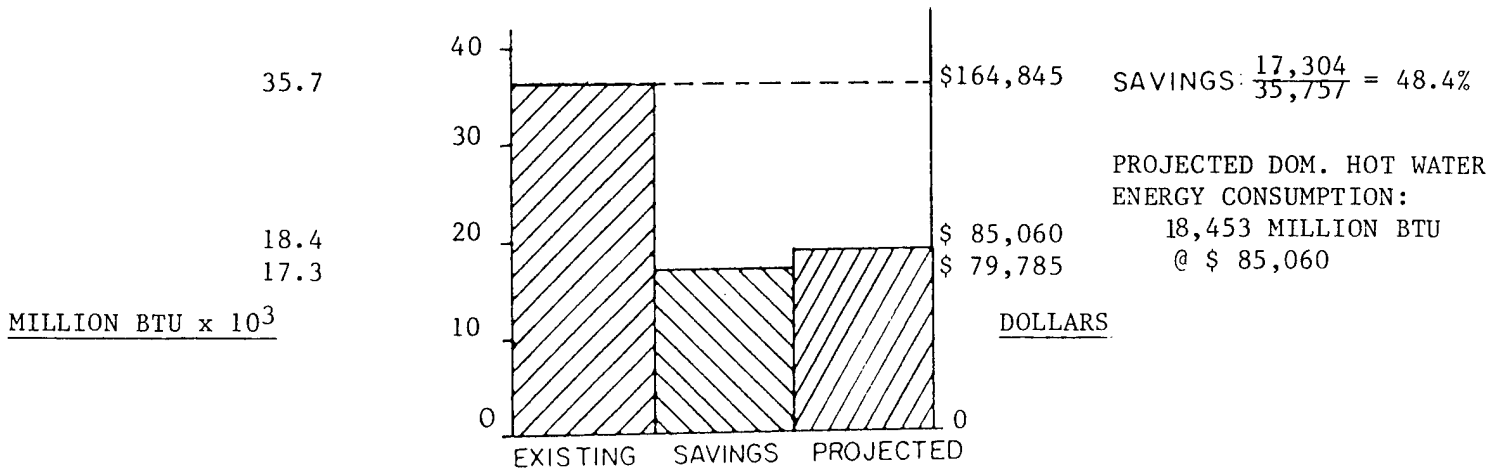


FIGURE 5

ANNUAL DOMESTIC HOT WATER COMPARISON

ENERGY TRANSMISSION LOSSES. Transmission loss energy reduction will result with the implementation of project 3 and 6. These projects will replace missing or damaged insulation on piping systems serving the Kitchen/Dining facilities. The existing piping insulation may contain asbestos and should be analyzed. If asbestos is present, then removal, handling and disposition of insulation containing asbestos must comply with Local, State and Federal regulations. Implementation of these projects will save approximately 106,741 million BTU's, or 93.8% of the pipe transmission losses. While the energy transmission loss may seem excessive for the Kitchen/Dining areas, it can be explained. The calculated loss for this ECO was developed with all the steam and condensate piping serving the Kitchen/Dining facility (with damaged or deteriorated insulation) plus the steam and condensate systems headers and mains within the Boiler and Mechanical rooms. The headers and mains also serve the remaining larger portion of the Barracks Buildings. Because of this, the actual savings from insulating pipes in the Boiler and Mechanical Room is for the entire building, including the Kitchen/Dining facility and the Barracks.

Refer to Annual Energy Transmission Loss Graph, Figure 6.

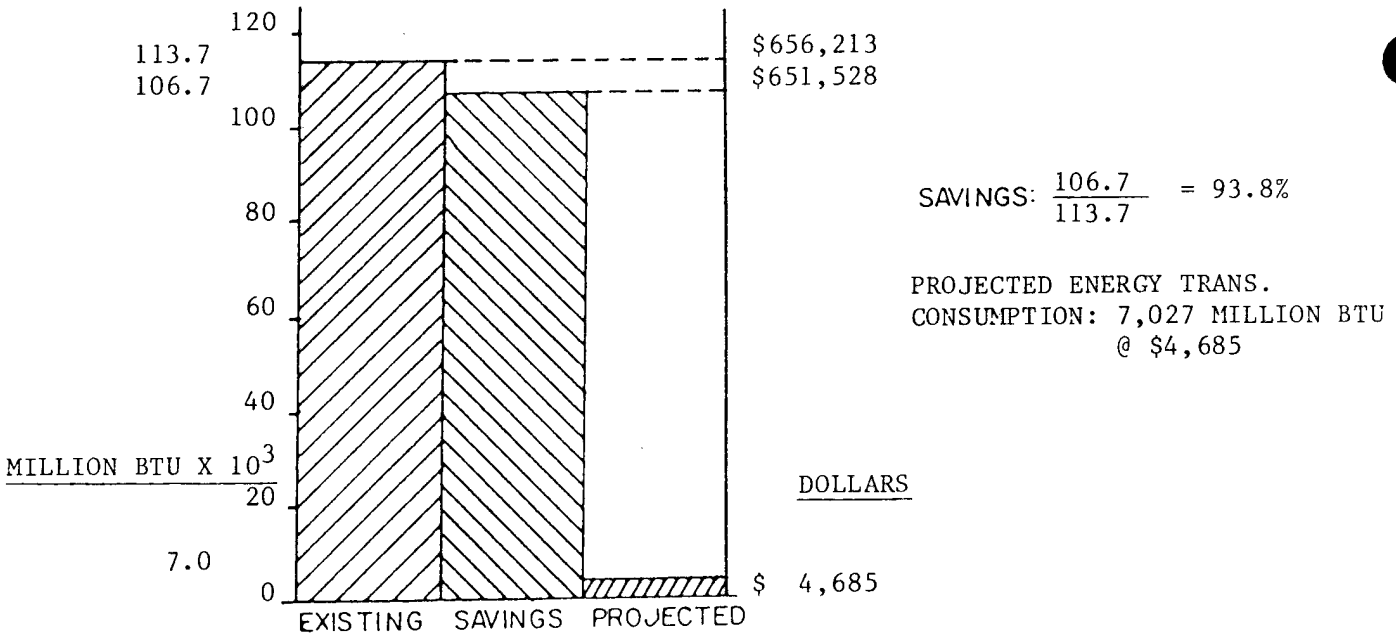


FIGURE 6

ANNUAL ENERGY TRANSMISSION LOSS COMPARISON

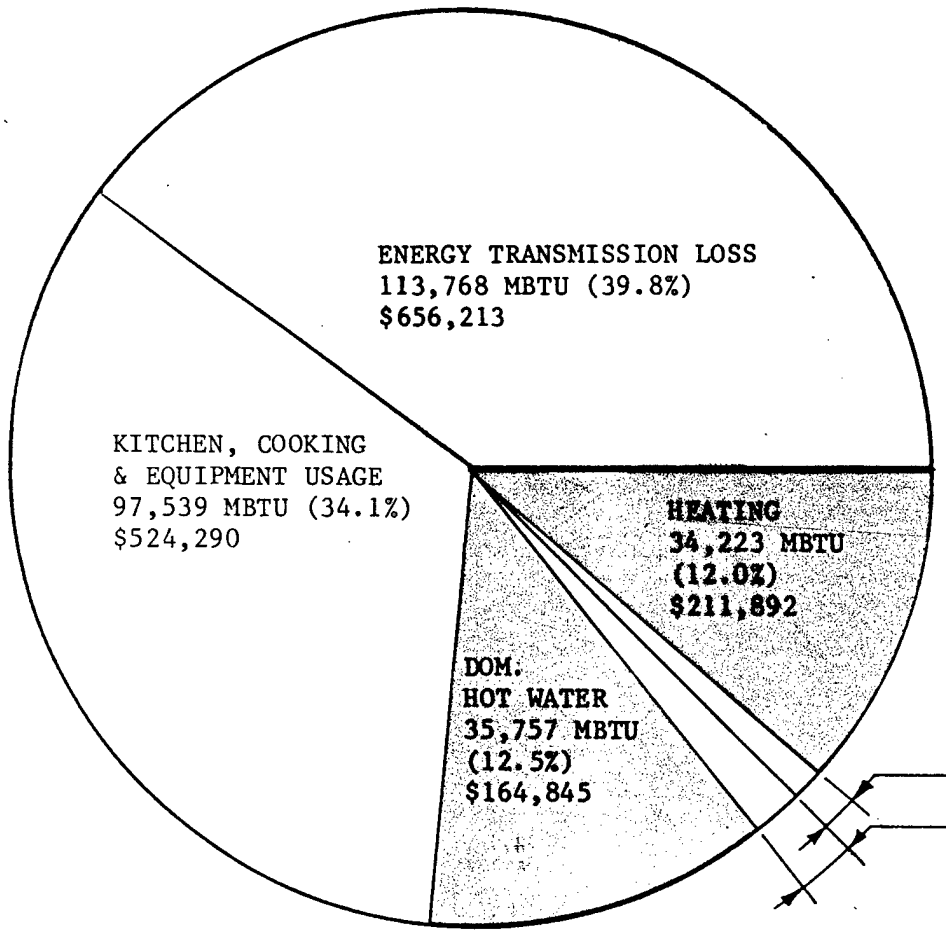
SUMMARY. With the implementation of all 10 projects, it is anticipated that a total, over-all energy reduction for the Kitchen/Dining facilities will be approximately 80%.

ENERGY COMPARISON - EXISTING VS. PROJECTED:

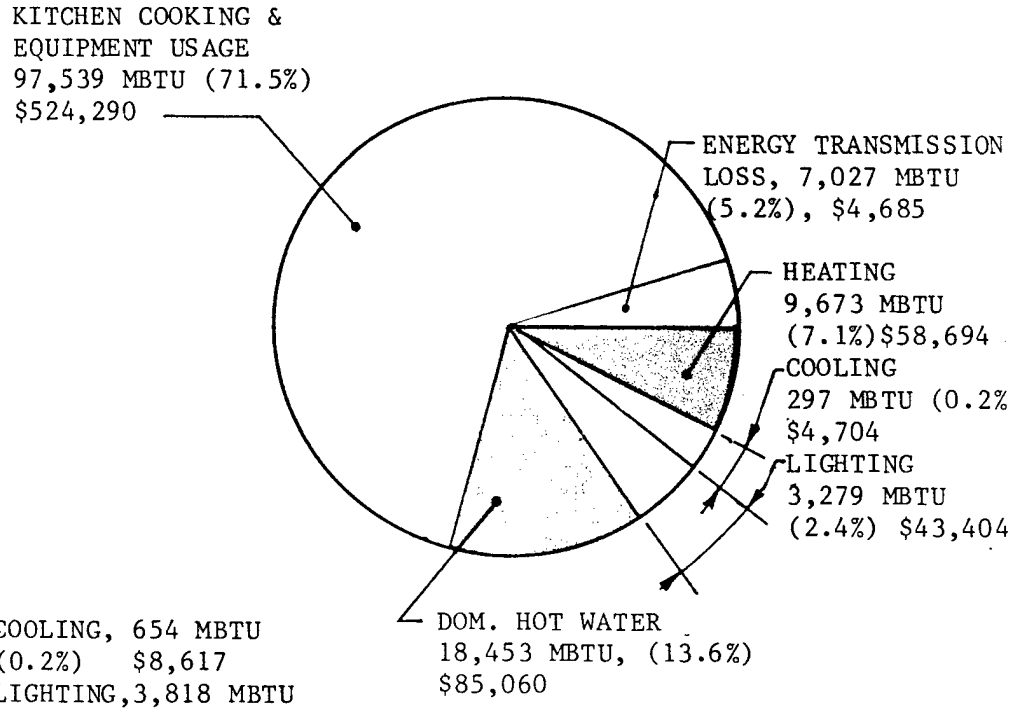
Figure 7 graphically indicates how the projects developed from this study will save energy for the Kitchen/Dining facilities. The size of the pie-graphs offers a visual representation of existing energy consumption versus a projected 52.4% reduction in the energy consumption after implementation of the projects developed from this study.

Projected energy consumption

HEATING:	9,673 MILLION BTU	(7.1%)
COOLING:	297 MILLION BTU	(0.2%)
ELEC (LIGHTING):	3,279 MILLION BTU	(2.4%)
DOM. HOT WATER:	18,453 MILLION BTU	(13.6%)
ENERGY TRANS. LOSS:	7,027 MILLION BTU	(5.2%)
KITCHEN COOKING & EQPT.:	97,539 MILLION BTU	(71.5%)
	136,268 MILLION BTU	



EXISTING ANNUAL BASELINE ENERGY CONSUMPTION



NOTE: AREA OF THIS CIRCLE REFLECTS A 52.4% REDUCTION OF ENERGY USAGE THAN AREA OF EXISTING BASELINE ENERGY CONSUMPTION.

ESTIMATED ENERGY CONSUMPTION AFTER IMPLEMENTATION OF THE TEN PROJECTS

FIGURE 7