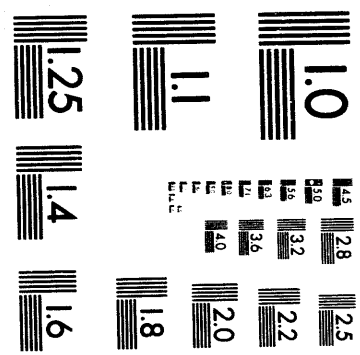
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UC-350

Fort Stewart Integrated Resource Assessment

Volume 1: Executive Summary

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Abstract

Some of the most difficult problems that a federal site has in reducing its energy consumption in a cost-effective manner revolve around understanding where the energy is being used, and what technologies could be employed to decrease the energy use. Many large federal sites have one or two meters to track electric energy use for several thousand buildings and numerous industrial processes. Even where meters are available on individual buildings or family housing units, the meters are not consistently read. When the federal energy manager has been able to identify high energy users, he or she may not have the background, training, or resources to determine the most cost-effective options for reducing this energy use. This can lead to selection of suboptimal projects that prevent the site from achieving the full life-cycle cost savings.

The U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP), supported by the Pacific Northwest Laboratory (PNL),[a] has developed a model program that provides a systematic approach to evaluating energy opportunities that 1) identifies the building groups and end uses that use the most energy (not just have the greatest energy-use intensity), and 2) evaluates the numerous options for retrofit or installation of new technology that will result in the selection of the most cost-effective technologies. In essence, this model program provides the federal energy manager with a roadmap to significantly reduce energy use in a planned, rational, cost-effective fashion that is not biased by the constraints of the typical funding sources available to federal sites. The results from this assessment process can easily be turned into a five- to ten-year energy management plan that identifies where to start and how to proceed in order to reach the mandated energy consumption targets.

This report provides the results of the fossil fuel and electric energy resource opportunity (ERO) assessments performed by PNL at the U.S. Army U.S Forces Command (FORSCOM) Fort Stewart facility located approximately 25 miles southwest of Savannah, Georgia. It is a companion report to Volume 2, *Baseline Detail*, and Volume 3, *Resource Assessment*.

(a) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-AC06-76RLO 1830.

Summary

The federal government is the single largest energy consumer in the United States with an annual consumption of 1.46 quads of energy during fiscal year (FY) 1991. Evidence suggests that there is enormous energy and dollar savings potential within the federal sector. With the implementation of the most life-cycle cost-effective technologies, between 25 and 40% of the annual energy bill for buildings and facilities (about 30% of the total federal energy consumption) could be saved. On October 24, 1992, the Energy Policy Act of 1992 (EPAct 1992) was issued. It directs federal agencies to reduce energy consumption by 20% from 1985 levels by the year 2000. In an effort to assist federal agencies in meeting this Act, the U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP), supported by the Pacific Northwest Laboratory (PNL), has been tasked by the U.S. Army Forces Command (FORSCOM) to identify, evaluate, and acquire all cost-effective energy projects at selected federal facilities.

Fort Stewart is a 279,270-acre U.S. Army FORSCOM facility supporting the training mission of the 24th Infantry Division (mechanized) near Savannah, Georgia. In FY 1991, 26,775 active military personnel were assigned to the Fort, and Reserve and National Guard training involved 41,600 personnel. To determine an energy consumption baseline the Fort was divided into the following four major areas: commercial, National Guard, family housing, and utility. Three of these areas had structures totaling 2,274 buildings and a total area of 10,896,819 ft^2. On-post utilities include the following: electricity, high temperature hot water (HTHW) system, chilled water system, water, fire protection, sewage, and outdoor lighting.

Total energy consumption at Fort Stewart in FY 1990 was 1,421,900 MBtu, at a cost of $9,045,000. Characteristic energy types included: electricity, natural gas, #2 fuel oil, #5 fuel oil, propane, and wood chips. While electricity, natural gas and wood chips made up approximately 90% of the total energy consumption, electricity was nearly 80% of the total energy cost. End uses for electricity included: heating, fans/pumps, lighting, cooling, cooking, refrigeration, domestic hot water, and other. Lighting made up over 20% of the electric energy consumption. Fossil fuel end uses included: space heating, hot water, cooking, and other. Space heating made up over one-half of total energy consumption. Wood chips were used exclusively at the central energy plant to produce HTHW.

The Fort Stewart analysis made use of the newly developed Facility Energy Decision Screening (FEDS) software. The FEDS software is designed to identify, characterize, and assess individual energy projects. At this point in the software development, the FEDS software analyzes most major building end uses (heating, cooling, lighting, envelope insulation, and service hot water), including their interactive effects (e.g., the effect a lighting technology has on heating and cooling loads), and provides specific cost, energy (and demand) charges, and life-cycle cost information, by cost-effective technology. The remaining energy resource opportunities (EROs) (motors, transmission & distribution, vehicles, etc.) are analyzed using manual calculation methods.

Following life-cycle cost (LCC) guidelines required for all federal energy decisions (10 CFR 436 1990), PNL prioritized the various energy resource opportunities (EROs) by 11 end-use categories (e.g., lighting, hot water, heating, etc.). The present value of the installed cost of all cost-effective EROs at Fort Stewart is approximately $14.2 million (1993$). The present value of the savings associated with this investment is approximately $47.7 million (1993$), for an overall net present value (NPV) of $33.4 million.

Both fossil fuel and electric EROs were reviewed and categorized for implementation based on a selection criteria methodology determined at an implementation planning workshops held in June and July 1993 with staff from Fort Stewart, the U.S. Army Corps of Engineers (COE) in Huntsville, Alabama, FORSCOM, and PNL. These meetings culminated with the development of a five-year plan to implement the cost-effective EROs found in Volume 3, *Resource Assessment* (Sullivan et al. 1993).

Acknowledgments

The authors gratefully acknowledge the assistance of numerous Fort Stewart and FORSCOM personnel associated with the development of this Integrated Resource Assessment. The people who worked with Pacific Northwest Laboratory (PNL) staff during site visits as well as over the phone and through the mail were both helpful in delivering us detailed information that increased the value and usefulness of our analysis, and enjoyable to work with.

While it is not possible to identify all by name who provided assistance, we would like to thank the following dedicated individuals, Nathaniel "Country" Adams, Chet Schratzmeier, George Walters and Randy Parks of the Central Energy Plant, and Walter Zechman of the National Guard Training Center. The endorsement of this project by the Fort Stewart Directorate of Engineering (DEH), Lieutenant Colonel David Fagan, is also appreciated.

Of invaluable importance to the completion of this study was the significant and conscientious assistance provided by Andy Bhan, Randy Jones, and Denise Kelley, all of Fort Stewart.

We wish to recognize our sponsor, Mr. Adrian Gillespie of the U.S. Army Forces Command, for his progressive attitude towards energy issues and his endorsement of energy efficiency at Fort Stewart.

In addition, the authors thank Marlene M. Hale, David R. Payson, Donna J. Stucky, Greg P. Sullivan, and Randy R. Wahlstrom, all of the Pacific Northwest Laboratory (Richland, Washington), for the conscientious, team-oriented, and high-quality assistance they brought to the Fort Stewart assessment.

L. L. (Chip) Larson
John M. Keller

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Abbreviations and Acronyms

AGL	Atlanta Gas Light Company
CFR	Code of Federal Regulations
CNG	compressed natural gas
COE	United States Army Corps of Engineers
DoD	United States Department of Defense
DOE	United States Department of Energy
DSM	demand-side management
ECIP	Energy Conservation Investment Program
EMCS	energy management and control system
E.O.	Executive Order
EPAct	Energy Policy Act of 1992
ERO	energy resource opportunity
ESCO	energy service company
EUI	energy-use intensity
FEDS	Facility Energy Decision Screening
FEEF	Federal Energy Efficiency Fund
FEMP	Federal Energy Management Program
FORSCOM	United States Army Forces Command
FY	fiscal year
Georgia Power	Georgia Power Company
GPC	Georgia Power Company
GPSC	Georgia Public Services Commission
HTHW	high temperature hot water
HVAC	heating, ventilation and air conditioning
IRP	Integrated Resource Plan
kW	kilowatt
kWh	kilowatt-hour
kW-mo	kilowatt-month
LCC	life-cycle cost
NIST	National Institute of Standards and Technology
NPV	net present value
MBtu	million British thermal units
MWh	megawatt-hour
O&M	operations and maintenance
PNL	Pacific Northwest Laboratory
PX	post exchange
SEPCO	Savannah Electric Power Company
SES	shared energy savings
SIR	savings to investment ratio
yr	year

1.0 Introduction

Nearly 2.4% of all energy used in the United States is consumed by the federal government in buildings, facilities, and operations, making it the single largest energy consumer in the country. In fiscal year (FY) 1991, the federal government consumed nearly 1.46 quads[a] of energy annually, at a cost of $11.26 billion. Of this, buildings and facilities consumed 0.41 quads at a cost of $3.75 billion (DOE 1992). Evaluations (completed and ongoing) by Pacific Northwest Laboratory at over 50 federal installations indicate that there is an enormous energy and dollar savings potential within the federal sector. Evidence suggests that there is a potential to save 25 to 40% of the annual energy bill by implementing the most life-cycle cost-effective technologies (Currie 1992). Furthermore, a level of investment of $5 billion to $10 billion between now and the year 2000 has the potential of saving $2 billion annually in the federal sector (Currie 1992). This investment would be applied towards the retrofit and replacement of current lighting, motor, transformer, water heating, space cooling, space heating, process, and vehicle equipment with new and more efficient technologies.

In line with the Energy Policy Act of 1992 (EPAct 1992), federal agencies have set a goal of 20% reduction in federal facility energy use and industrial process efficiency improvement by the year 2000 (from 1985 levels). This Act requires the purchase of energy-consuming goods or products that are the most life-cycle cost-effective. Other legislation affecting energy conservation goals in the federal sector include the life-cycle cost (LCC) method and procedures of 10 FR 436.

The 10 CFR 436 legislation mandates the use of LCC methods and procedures by all federal agencies for the design of new federal buildings and the application of energy conservation measures to existing buildings. EPAct addresses energy, environmental, and economic issues in a coordinated and comprehensive manner. It encourages investment in conservation and energy efficiency by gas and electric utilities by allowing utilities to recover the cost of demand-side management (DSM) incentives through rate recovery. It authorizes and encourages federal agencies to participate in utility incentive programs to increase energy efficiency and conserve water. It also establishes a Federal Energy Efficiency Fund to provide grants to agencies to assist them in meeting the energy reduction mandates with $10 million available in FY 1994 and $50 million available in FY 1995.

The U.S. Department of Defense (DoD), with hundreds of installations worldwide, massive aviation fuel needs, and approximately 335,000 buildings, is the largest energy consumer within the federal government consuming approximately 87.1% of the total. It controls 1.94 billion square feet of federal buildings (69.0% of the total federal real property) with a total real property cost of $79.9 billion (48.6% of the total real property cost) (GSA 1989). Model programs being developed by PNL for DSM at DoD installations can set the standard for energy efficiency for all DoD and federal installations. These DSM programs are being deployed at several DoD installations.

Some of the most difficult questions that a federal site has to address in reducing its energy consumption in a cost-effective manner include where the energy is being used and what technologies could be employed to decrease the energy use. Many large federal sites have one or two meters to track electric energy use for several thousand buildings and numerous industrial processes. Even where meters are available on individual buildings or family housing units, the meters are not consistently read. When the federal energy manager has been able to identify high energy users, he or she may not have the background, training, or resources to determine

(a) One quad is equivalent to 1 quadrillion (10^{15}) Btu of energy.

the most cost-effective options for reducing this energy use. This can lead to selection of suboptimal projects that prevent the site from achieving the full life-cycle cost savings.

The model program the Federal Energy Management Program (FEMP) has developed constitutes a systematic approach to evaluating energy opportunities which 1) identifies the building groups and end uses that use the most energy (not just have the greatest energy-use intensity), and 2) evaluates the numerous options for retrofit or installation of new technology that will result in the selection of the most cost-effective technologies. In essence, this model program provides the federal energy manager with a roadmap to significantly reduce energy use in a planned, rational, cost-effective fashion that is not biased by the constraints of the typical funding sources available to federal sites. The results from this assessment process can easily be turned into a five- to ten-year energy management plan that identifies where to start and how to proceed in order to reach the mandated energy consumption targets.

In an effort to assist federal agencies in meeting the conditions of EPAct, DOE-FEMP (supported by PNL) has been tasked by the U.S. Army Forces Command (FORSCOM) to identify, evaluate, and acquire all cost-effective energy projects at selected federal facilities. FEMP's mission is to improve the efficiency and fuel flexibility of energy use in federal buildings, transportation, and operations, and to facilitate the transfer of energy management experience among federal agencies. At Fort Stewart, FEMP is designing a model program for federal customers served by the Georgia Power Company (GPC). This program will 1) identify and evaluate all electric and fossil fuel cost-effective energy projects; 2) develop a schedule for project acquisition considering project type, size, timing, and capital requirements, as well as energy and dollar savings; and 3) secure 100% of the financing required to implement electric energy efficiency projects from GPC and have GPC procure the necessary contractors to perform detailed audits and install the technologies.

This report provides a summary of the baseline of energy use information found in Volume 2, *Baseline Detail* (Keller et al. 1993), and of the assessment of energy resource opportunities found in Volume 3, *Resource Assessment* (Sullivan et al. 1993). In addition, it summarizes a strategy for implementation of this conservation and fuel-switching potential.

The Fort Stewart installation is characterized in Section 2. A baseline of energy use is found in Section 3. The analytical approach for determining energy resource opportunities (EROs) is described in Section 4, with a summary of resource assessment results in Section 4.1. Section 5 describes a strategy for implementation of EROs, and the conclusions and recommendations are found in Section 6. References are listed in Section 7, and the life-cycle cost methodology is provided in Appendix A. The Fort Stewart Extended Energy Project Implementation Plan is provided in Appendix B.

2.0 Site Characterization

Fort Stewart is a 279,270-acre U.S. Army Forces Command (FORSCOM) facility situated just north of Hinesville, Georgia. The Fort's mission is to provide training and support for the 24th Infantry Division (Mechanized) of the U.S. Army.

Active military personnel assigned to the Fort numbered 26,775 in FY 1991. 8,570 military personnel and dependents live at the Fort, with the remainder living in nine nearby off-post towns. Annual Reserve and National Guard training involved an estimated 41,600 military personnel in FY 1991. Civilians employed at the Fort numbered 3,093 in FY 1991; these personnel do not live in military housing. Military personnel and retirees (and their dependents) not assigned to the Fort affect energy consumption to some extent by their use of site facilities such as the post exchange (PX) and recreation centers. There are about 24,800 people within a 50-mile radius who are entitled to use these facilities, but the extent of this use has not been determined.

The Fort is divided into four major areas (for energy consumption and billing purposes), including commercial, National Guard, family housing, and utility (including exterior lighting, pumping, and transmission and distribution losses). Table 2.1 gives the number of buildings and total square feet for each of the areas.

There are 21 on-post family housing areas, containing 2,440 family housing units in 671 buildings. Buildings range from single-family to eight-unit rowhouse/townhouse structures. There is also variety in the unit floor plans of the housing stock, with the number of bedrooms ranging from two to four, and the floor area ranging from 750 to 3,714 ft^2. Almost all of the family housing built before 1978 have natural gas heat and hot water. After 1978, the housing is almost completely all-electric.

Table 2.1. Fort Stewart Building Characterization

Fort Area	Number of Buildings	Total Floorspace (ft^2)	Percent of Total Floorspace
Commercial	1,009	6,301,662	57.8
National Guard	594	1,271,539	11.7
Family Housing	671	3,323,618	30.5
Total	2,274	10,896,819	100.0

3.0 Energy Use Baseline

This section documents baseline energy use at Fort Stewart. This analysis examines the characteristics of electric, natural gas, #2 fuel oil, propane, and wood chip use for FY 1991. It also breaks down building energy consumption by fuel type, energy end use, and building type. A complete energy consumption reconciliation is presented that accounts for the distribution of energy use among buildings, utilities, central systems, and distribution losses. Table 3.1 shows a summation of the typical yearly energy consumption and cost for all facilities at Fort Stewart. For each energy type, the yearly total is shown in units appropriate to the energy type and in a common unit as a basis for comparison. Number 5 fuel oil is no longer used at Fort Stewart, but a equal amount (MBtu content) of wood chips and/or #2 fuel oil is assumed to be consumed instead. The total consumption values represent typical current yearly usage, from the best available data during 1990 and 1991. The yearly energy consumption was 1,421,900 MBtu, at a cost of $9,045,000.

Table 3.2 breaks down the energy consumption by fuel type and end use for the Fort's three major areas. The National Guard area is not included as a line item on this table because it was not included in the majority of the analysis. Utility readings, fuel delivery records and various building meters were used to determine the total energy consumption by building type within each area. These data, along with estimates of energy-use intensities (EUIs), were used to reconcile the energy consumption by building type and end-use category (lighting, heating, cooling, etc.).

Energy consumption is described with the following five figures: Figure 3.1 describes the energy use by fuel type, Figure 3.2 describes the energy use by facility sector, Figure 3.3 describes the energy use by end use for all fuels, Figure 3.4 describes the energy use by end use for electricity only, and Figure 3.5 describes the energy use by the combined fossil fuels.

Table 3.1. Typical Yearly Energy Consumption and Energy Cost at Fort Stewart

Energy Type	Yearly Total in Purchase Units	Yearly Total (MBtu[a])	Percent of Total Energy Consumption	Energy Cost (1990$ x 10^3)	Percent of Total Cost
Electricity	151,600 MWh	517,400[b]	36.4	7,040	77.8
Natural Gas	1,439 k-therm	143,900[c]	10.1	779	8.6
#2 Fuel Oil	486 k-gallon	67,510[d]	4.7	272	3.0
#5 Fuel Oil	546 k-gallon	80,020[d]	5.6	297	3.3
Propane	174 k-gallon	15,842[e]	1.1	77	0.9
Wood Chips	66,700 tons	600,300[f]	42.2	580	6.4
Totals:		1,421,900	100.0	9,045	100.0

(a) 1 MBtu = 1,000,000 Btu.
(b) 3,413 Btu/kWh.
(c) 100,000 Btu/therm; 1,050 Btu/ft^3 of natural gas.
(d) 0.1388 MBtu/gal of #2 fuel oil, 0.1466 MBtu/gal of #5 fuel oil.
(e) 0.0913 MBtu/gal of propane.
(f) 9 MBtu/ton.

Table 3.2. Energy Consumption by End Use (MBtu/yr)

	Fort Area			
Fuel Type/End Use	Commercial	Family Housing	Utility	Total
Electric:				
Heating	0	4,385	0	4,385
Cooling	35,790	45,538	0	81,328
Vent./Fans	37,400	8,029	0	45,429
DHW	0	2,477	0	2,477
Cooking	9,728	621	0	10,349
Refrigeration	18,224	15,604	0	33,828
Interior Ltg.	77,766	32,972	0	110,738
Exterior Ltg.	3,518	3,518	0	7,036
Other Bldg. End Use	55,556	9,441	0	64,998
Nat. Guard	16,153	0	0	16,153
Central Plant[(a)]	0	0	105,776	105,776
Street Ltg.	0	0	25,516	25,516
Trans. & Dist. Loss	0	0	9,353	9,353
Total	254,136	122,585	140,645	517,366
Percent of Total	49.1%	23.7%	27.2%	100.0%
Natural Gas:				
Heating	32,098	42,746	0	74,844
DHW	16,025	26,880	0	42,905
Cooking	14,233	10,951	0	25,184
Other	964	0	0	964
Total	63,320	80,577	0	143,897
Percent of Total	44.0%	56.0%	0.0%	100.0%
Fuel Oil #2:				
Heating	20,501	0	0	20,501
DHW	12,662	0	0	12,662
Central Plant[(a)]	0	0	34,336	34,336
Total	33,163	0	34,336	67,499
Percent of Total	49.1%	0.0%	50.9%	100.0%
Fuel Oil #5:				
Central Plant[(a)]	0	0	80,020	80,020
Propane:				
Heating	8,815	32	0	8,847
DHW	3,963	19	0	3,982
Cooking	1,889	8	0	1,897
Other	520	0	0	520
DEH (Trailer Park)	0	595	0	595
Total	15,187	654	0	15,841
Percent of Total	95.9%	4.1%	0.0%	100.0%
Wood Chips:				
Central Plant[(a)]	0	0	600,300	600,300
Total:	365,806	203,816	855,301	1,424,923
Percent of Total:	25.7%	14.3%	60.0%	100.0%

(a) Energy used at Central Plant to provide hot water and chilled water for buildings on the central distribution system.

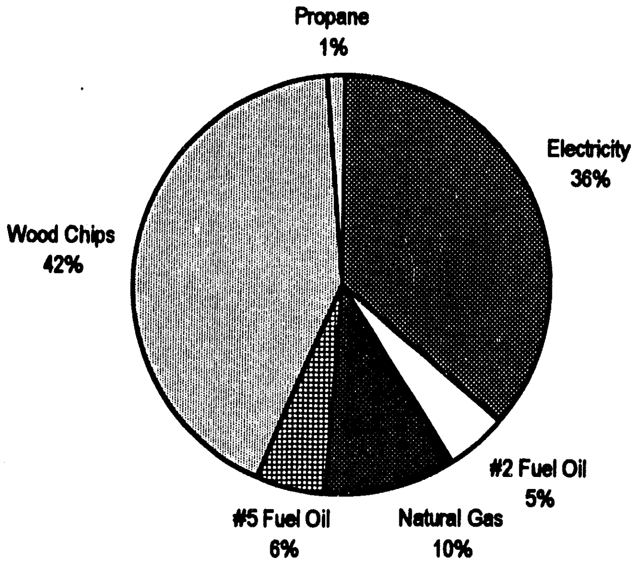

Figure 3.1. Energy Use by Fuel Type (MBtu)

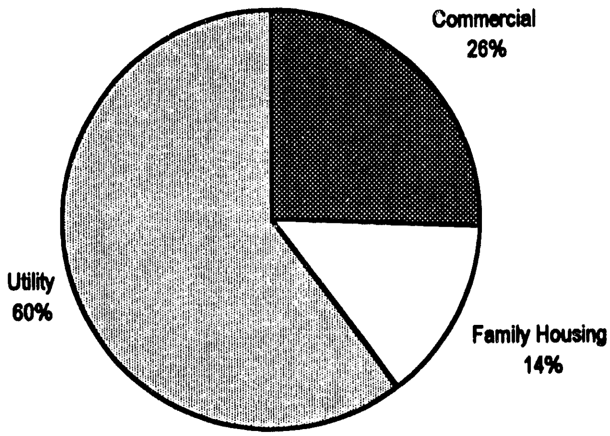

Figure 3.2. Energy Use by Facility Sector (MBtu)

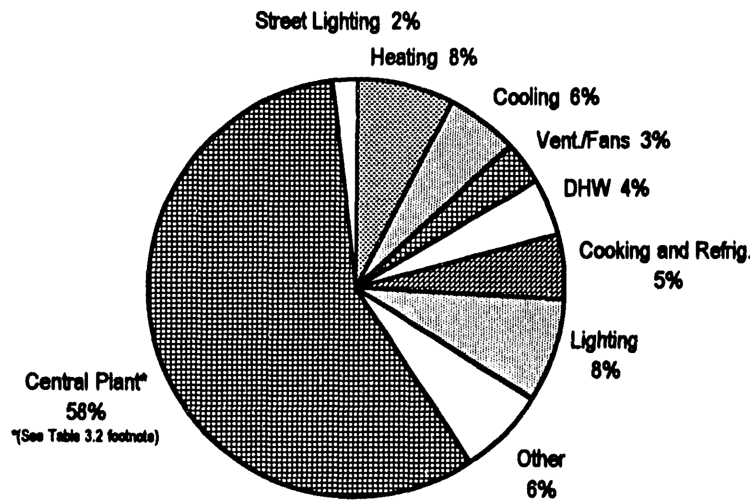

Figure 3.3. Energy Use by End Use for All Fuels (MBtu)

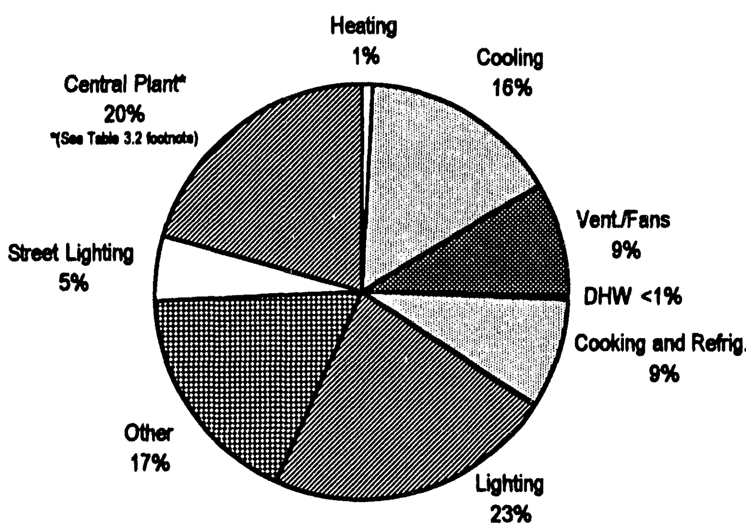

Figure 3.4. Energy Use by End Use for Electricity (MBtu)

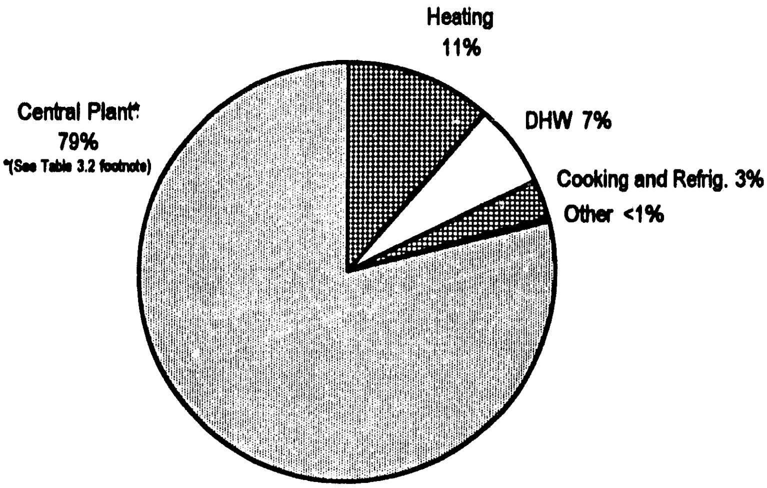

Figure 3.5. Energy Use by End Use for Fossil Fuels (MBtu)

4.0 Energy Resource Opportunities

The number of conceivable energy conservation measures, fuel-switching opportunities, and renewable energy projects at a federal site is very large. PNL uses two methods to select, evaluate, and prioritize these energy resource opportunities (EROs). The first method PNL uses is the Facility Energy Decision Screening (FEDS) Model. FEDS is a multi-level software tool designed to provide a comprehensive approach to fuel-neutral, technology-independent integrated (energy) resource planning and acquisition.

There are currently two levels of FEDS: FEDS Level-1 and FEDS Level-2. Level-1 is designed for installation energy managers as a screening tool. Level-2 can also be used by installation energy managers to identify, characterize, and assess individual energy projects. However, Level-2 goes to the next level of detail, providing detailed information on energy and cost savings, as well as the estimated investment requirement for specific technology retrofits.

At this point in the software development, Levels 1 and 2 analyze most major building end uses (heating, cooling, lighting, insulation, and service hot water), including their interactive effects (e.g., the effect a lighting technology has on heating and cooling loads), providing specific cost, energy (and demand), and life-cycle cost information, by cost-effective technology.

The second method PNL addresses are those EROs not analyzed by the FEDS software. This analytical approach is a three-step, manual-calculation (hereafter referred to as "manual") process that has been developed by PNL to make ERO selection, evaluation, and prioritization manageable. The steps are the following:

- *Preliminary Screening*. Select promising EROs from a master list (see Table 1.1 in Volume 3, *Resource Assessment*), considering the site's mission, building stock, end-use equipment characteristics, utility characteristics, climate,energy costs, other local conditions that affect ERO viability, and recommendations from site staff.
- *Cost and Performance Analysis*. Establish, with a reasonable degree of accuracy, the technical and economic feasibility of each ERO that passed the preliminary screening. An analysis is performed comparing the operating and economic performance of the existing equipment and the ERO. Where applicable, impacts on energy security and the environment are included in the analysis.
- *Life-Cycle Cost Analysis and Prioritization*. Perform a life-cycle cost (LCC) analysis and rank EROs by net present value (NPV), so that a package with the optimal return on investment can be defined. If any utility cost-sharing or rebate programs exist, they can be included within this evaluation step.

The third step, LCC analysis and prioritization of EROs, is required by federal law (10 CFR 436). All federal agencies are required to evaluate the LCC of potential energy investments. An LCC evaluation computes the total long-run costs of a number of potential actions, and selects the action that minimizes the long-run costs and maximizes the NPV of the energy investment. These requirements are discussed in more detail in Appendix A.

4.1 Resource Assessment

This section summarizes the results of the ERO analysis, and aggregates the savings potential into major end-use categories. The specific EROs are described in detail in Volume 3, *Resource Assessment*. Analysis results are presented in 11 common energy end-use categories (e.g., boilers and furnaces, service hot water, and building lighting).

The use of two analysis methods complicates reporting of summary results. The FEDS software calculates its own baseline energy consumption based on 30-year average weather data, while the manual calculations use information developed in Volume 2, *Baseline Detail*. This makes it possible to only summarize the results as "FEDS" and "Manual," and no single grand total for energy or cost savings is available. Further details on the FEDS software and the summary results are provided in Sections 1 and 3 of Volume 3.

As illustrated in Table 4.1, the present value (PV) of the installed cost of all EROs constituting the minimum LCC efficiency resource (i.e., cost-effective) at Fort Stewart is approximately $14.2 million in 1993 dollars (1993$). The PV of the savings associated with this investment is approximately $47.7 million, for an overall NPV of $33.4 million.

Table 4.2 provides a breakdown and summary of the cost-effective energy resource at Fort Stewart. Cost-sharing and rebate incentives from the utility would normally be factored into the analysis. Because the applicability of potential demand-side management (DSM) programs from the electric utility, Georgia Power Company (GPC), is uncertain, Fort Stewart project managers decided that this document would present an economic analysis from the government-funding-only perspective. That way, if no cost-sharing with the utility could be arranged, the document would present a conservative estimate of potential savings to Fort Stewart and FORSCOM in their planning for implementation of various EROs. Once details of a cost-sharing agreement with the utility have been reached, the economic analysis can be redone at any time.

The operations and maintenance (O&M) savings are a reflection of the incremental cost difference between the cost of maintaining the existing equipment and that of maintaining new or retrofitted equipment. Because maintenance costs of new or retrofitted equipment are often the same as the costs to maintain the existing equipment, this incremental maintenance cost is often zero.

To accompany Table 4.2 is Table 4.3, which presents a breakdown and summary of both the energy and demand savings for the first year and full implementation of the cost-effective energy resource at Fort Stewart. The "NAs" in the table reflect the restriction that the current version of the Level-2 software does not report demand savings separately, and that there are no demand charges for fossil fuels.

The cost-effective ERO results have been aggregated by ERO category. Hot water EROs represent the greatest efficiency resource, accounting for 25.5% of the total energy savings. Lighting and heating also represent significant savings; each are approximately 20% of the total 245,244 MBtu savings available. Cost information, broken out by ERO category, is not available at this time.

Tables 4.4 and 4.5 present the breakdown and summary of the total fuel balance at Fort Stewart. Table 4.4 shows the energy consumption and savings predicted by the Level-2 software, for those

Table 4.1. Total Savings, Cost, and NPV (1993$)

Total Present Value of Installed Cost	Total Present Value of All Savings	Total Net Present Value
14,236,298	47,679,260	33,442,962

Table 4.2. Summary of the Cost-Effective Energy Resource at Fort Stewart (1993$)

ERO Category	Present Value of Installed Cost	Present Value of Energy and Demand Savings	Present Value of O&M Savings	Present Value of Replacement Savings	Present Value of Total Savings	Total Net Present Value
Cooling	15,071	111,175	0	(13,957)	97,218	82,147
Ext. Lighting	40,000	933,740	0	(16,203)	917,537	877,537
FEDS Level-2	10,716,690	NA	NA	NA	35,653,362	24,936,672
Motors	2,759,046	7,096,458	(8,811)	1,175,938	8,263,585	5,504,539
Trans. & Dist.	14,440	937,801	(44)	0	937,757	923,317
Transportation	691,051	1,279,193	1,142,653	(612,045)	1,809,801	1,118,750
Totals	14,716,690	NA	NA	NA	47,679,260	33,442,962

Table 4.3. Summary of the Energy and Demand Savings at Fort Stewart

ERO Category	First Year Energy Savings (MBtu)	First Year Demand Savings (kW-mo)	Full Implement Energy Savings (MBtu)	Full Implement Demand Savings (kW-mo)	Annualized Energy and Demand Savings (1993 $)
Cooling (Level-2)	30,953	NA	30,953	NA	NA
Cooling	323	277	323	277	7,117
Heating (Level-2)	51,429	NA	51,429	NA	NA
Hot Water (Level-2)	62,579	NA	62,579	NA	NA
Lights (Level-2)	50,335	NA	50,335	NA	NA
Ext. Lighting	7,953	52	7,953	52	59,771
Motors	32,174	15,329	34,234	17,837	454,258
Trans. & Dist.	4,284	2,457	4,284	2,457	60,030
Transportation	0	0	3,603	0	81,884
Vent (Level-2)	5,215	NA	5,215	NA	NA
Totals	245,244	NA	250,907	NA	NA

Table 4.4. Fuel Balance at Fort Stewart: Level-2 EROs

	Existing		Resulting		Net Conservation	
Fuel Type	Energy Use (MBtu)	Demand (kW-mo)	Energy Use (MBtu)	Demand (kW-mo)	Energy Use (MBtu)	Demand (kW-mo)
Chilled Water	112,127	NA	92,204	NA	19,921	NA
District Hot Water	115,595	NA	77,899	NA	37,696	NA
Electricity	471,611	NA	386,663	NA	84,948	NA
Fuel Oil #2	53,377	NA	38,475	NA	14,901	NA
Natural Gas	159,333	NA	138,811	NA	20,523	NA
Propane	36,655	NA	14,133	NA	22,522	NA
Totals	948,698	NA	748,185	NA	200,511	NA

Table 4.5. Fuel Balance at Fort Stewart: Manual EROs

	Existing		Conservation		New Load		Resulting		Net Conservation	
Fuel Type	Energy Use (MBtu)	Demand (kW-mo)	Energy Use Reduction (MBtu)	Demand Reduction (kW-mo)	Increased Energy Use (MBtu)	Increased Demand (kW-mo)	Energy Use (MBtu)	Demand (kW-mo)	Energy Use Reduction (MBtu)	Demand Reduction (kW-mo)
Diesel	11,848	NA	6,733	NA	0	NA	5,116	NA	6,733	NA
Electricity	510,244	278,810	46,794	20,622	0	0	463,450	258,188	46,794	20,622
Fuel Oil #2	67,510	NA	0	NA	0	NA	67,510	NA	0	NA
Fuel Oil #5	80,020	NA	0	NA	0	NA	80,020	NA	0	NA
Gasoline	16,774	NA	14,882	NA	0	NA	1,893	NA	14,882	NA
Natural Gas	143,900	NA	0	NA	18,012	NA	161,912	NA	(18,012)	NA
Propane	15,842	NA	0	NA	0	0	15,842	NA	0	NA
Wood Chips	600,300	NA	0	NA	0	0	600,300	NA	0	NA
Totals	1,446,439	278,810	68,408	20,622	18,012	0	1,396,042	258,188	50,396	20,622

EROs currently analyzed by Level-2. Table 4.5 shows the energy consumption and savings predicted for the EROs not covered by Level-2. The existing energy consumption in Table 4.4 is calculated by Level-2 based on a 30-year-average weather file, while the energy data in Table 4.5 is for FY90, as reported in the Volume 2 companion report to this document (Keller et al. 1993). Total fuel use after ERO implementation was determined, where possible, by subtracting the total fuel savings from the total existing fuel use. The "NAs" in the table reflect the restriction that the current version of the Level-2 software does not report demand savings separately, and that there are no demand charges for fossil fuels.

For building EROs (analyzed by Level-2), the estimated annual electricity consumption at Fort Stewart is 138,181 MWh. Full implementation of all electric EROs results in a reduction of 24,889 MWh. This represents a reduction of approximately 18.0% over total electricity consumption. The estimated annual fossil fuel consumption (natural gas, #2 fuel oil, and propane) at Fort Stewart is 249,365 MBtu. Full implementation of all fossil fuel EROs results in net conservation of 57,946 MBtu. This represents net conservation of 23.2% of total consumption.

The end uses of chilled water and district hot water were not broken out by fuel. The estimated annual chilled water use is 9,271,891 ton-hours. Full implementation of all chilled water EROs results in a reduction of 1,640,154 ton-hours, or 18% of total consumption. The estimated annual district hot water use is 115,595 MBtu. Full implementation of all district hot water EROs results in a reduction of 37,696 MBtu, or 33% of total consumption.

For non-building EROs, the estimated annual electricity consumption at Fort Stewart is 149,500 MWh. Full implementation of all electric EROs results in a reduction of 13,700 MWh. This represents a reduction of approximately 9.2% over total electricity consumption. The estimated annual fossil fuel consumption (natural gas, #2 fuel oil, propane, gasoline, and diesel) at Fort Stewart is 255,875 MBtu. This total excludes wood chip and #5 fuel oil use, as well as any diesel and gasoline used for vehicles not addressed through EROs. Full implementation of all fossil fuel EROs results in conservation of 21,614 MBtu and a new load of 18,012 MBtu, for a net reduction of 3,602 MBtu. This represents conservation of 8.4% of total consumption, new load of 7.0%, and an overall decrease of 1.4%.

Energy resource potential is described with the following four figures: Figure 4.1 describes the net present value, Figure 4.2 describes the energy savings for all EROs, Figure 4.3 describes the energy resource potential in MBtu's by fuel type for building (Level-2) EROs, and Figure 4.4 describes the energy resource potential in MBtu's by fuel type for non-building EROs.

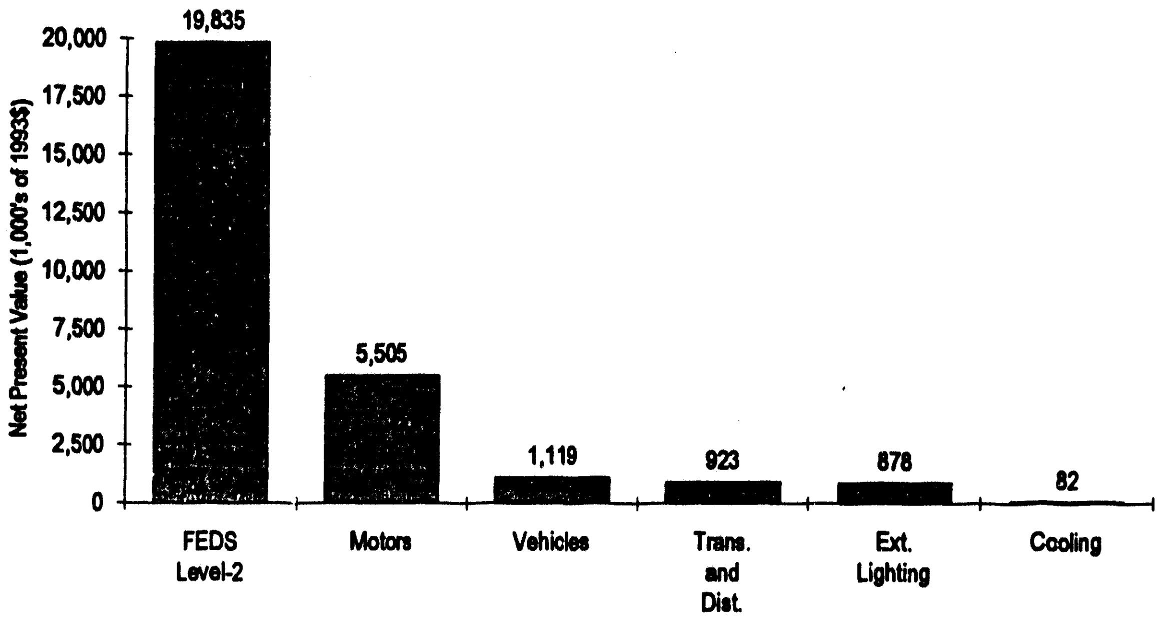

Figure 4.1. Net Present Value

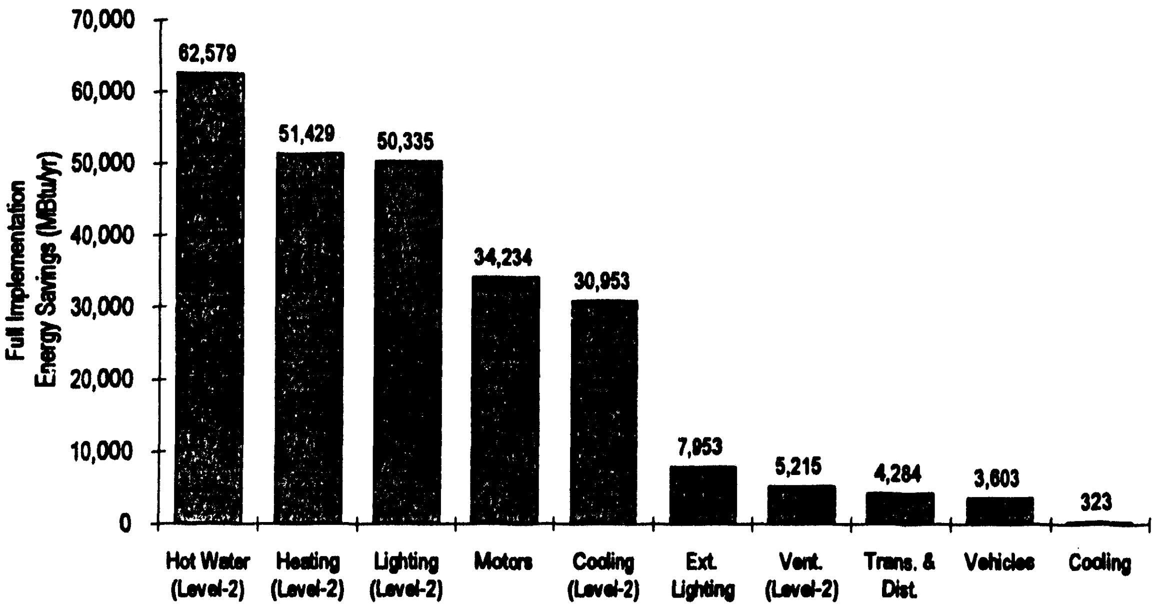

Figure 4.2. Full Implementation Annual Energy Savings for All EROs

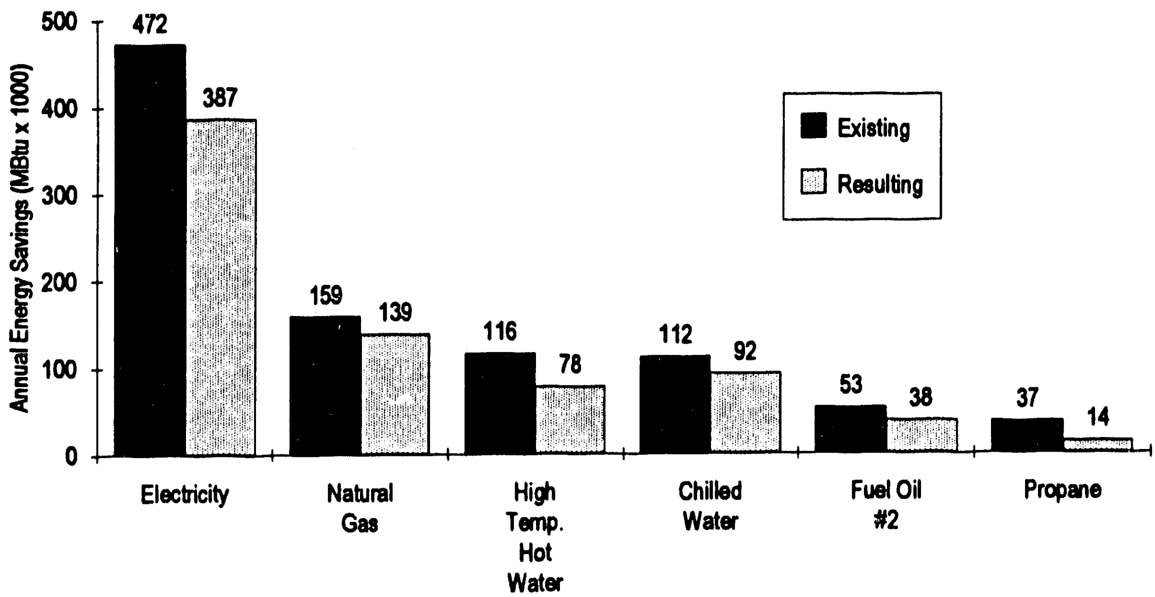

Figure 4.3. Energy Resource Potential (MBtu) for Building EROs

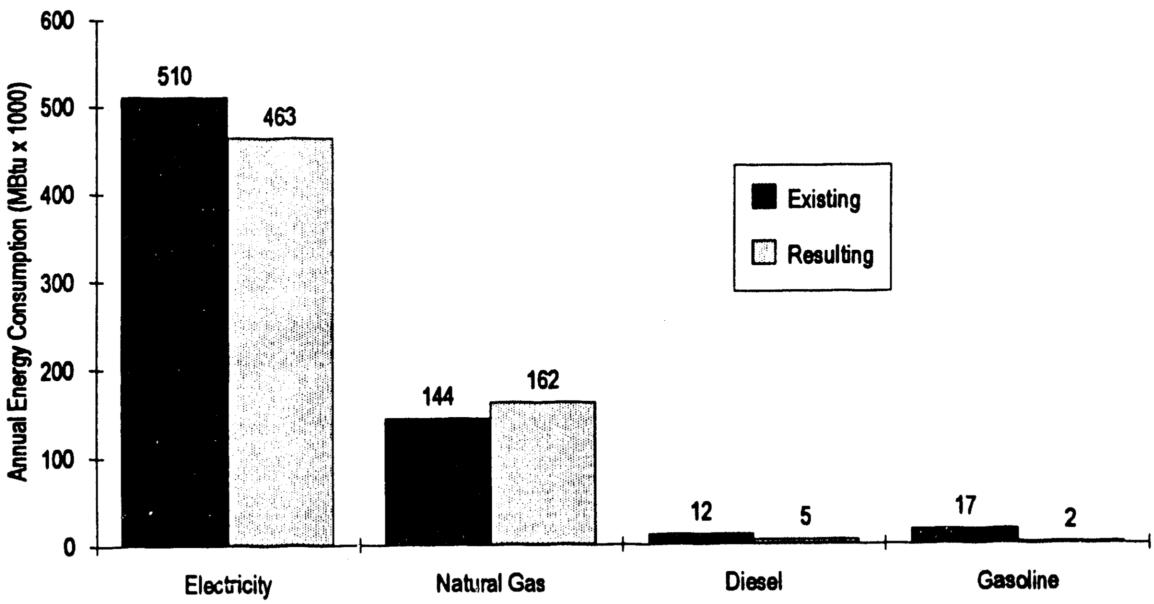

Figure 4.4. Energy Resource Potential (MBtu) for Non-Building EROs

5.0 Implementation Strategy

The purpose of the integrated resource planning (IRP) process is to develop an analytical and rational approach to reducing the energy consumption (and energy cost) at Fort Stewart. The implementation step of this process reviews energy resource opportunities (EROs) identified in the integrated resource assessment and develops a framework for a five-year energy management plan. When fully developed, this plan will discuss the types of projects, timing, sources of funding, and other considerations for Fort Stewart. In addition, a strategy for negotiating with the electric utility (Georgia Power Company) and the gas utility (Atlanta Gas Light Company) needs to be part of this plan to fully take advantage of the utility incentives offered through promotional and demand-side management (DSM) programs.

In 1993, two implementation planning workshops were held in Huntsville, Alabama—the first in June and the second in July. Present at both workshops were staff from Fort Stewart, U.S. Army Forces Command FORSCOM), Huntsville U.S. Army Corps of Engineers (COE), and Pacific Northwest Laboratory (PNL).

The objective of the first workshop was three fold: identify major project groups, time-phase the projects, and integrate the projects into the *Fort Stewart Vision 2004* program.

At the second workshop, PNL provided background on the Facility Energy Decision Screening Level 2 (Level-2) analysis, and the criteria for project selection were established. The major selection criteria included:

- financial/cost effectiveness
- technology selection (risk, order of implementation)
- mission considerations
- savings verification requirements
- operations and maintenance (O&M) considerations
- environmental impacts.

The EROs for electric and fossil fuels were reviewed and categorized based on the selection criteria and Fort Stewart priorities. EROs with relatively small investment cost and significant savings were singled out for prompt implementation. EROs with significant Energy Conservation Investment Projects (ECIP) potential were identified for documenting and submission in accordance with ECIP program requirements.

Additional projects, which are not part of the PNL assessment, were suggested by the workshop participants. Some suggested projects take advantage of on-going energy activities at Fort Stewart, some involve special technologies, and others encourage regular reviews of institutional programs. With the exception of institutional programs, to determine the cost-effectiveness of these additional projects, and to be consistent with the PNL assessment, special technologies and projects need to be evaluated using the federally mandated LCC methodology.

At the workshops, nearly 1900 EROs were divided into 45 projects to be implemented over the next five years. These EROs are the "winners," that is, they possess the largest net present value compared to similar technologies using the same and alternate fuels. Examples of major projects to be initiated immediately at Fort Stewart include:

- A building envelope energy efficiency improvement project, including both residential and non-residential buildings, that upgrades or installs insulation, weatherization, and window technologies. Included in the project is to acquire all DSM incentives available through the GPC integrated resource plans approved in 1993.

- Replacing standard efficiency motors with high efficiency or variable speed drive motors will result in significant energy reduction. The project includes analyzing and determining if the motor is oversized for its application, which will result in additional energy savings.

- Immediate transmission and distribution energy efficiency opportunities exist in two areas, power factor correction and conservation voltage reduction. Both of these opportunities are particularly attractive because of their low investment cost and immediate energy savings.

Other projects to be subsequently implemented include:

- water conservation measurers with particular emphasis on programs contained in the Energy Policy Act of 1992,

- residential and non-residential domestic hot water system replacements, and

- adding timers, photo-sensors, and similar controls to outdoor recreational and physical training lighting systems.

Figure 5.1 presents a proposed implementation schedule of projects developed from the Integrated Resource Assessment and the workshops. The project descriptions, located in Appendix B of this document, were taken from the draft Fort Stewart *Extended Energy Project Implementation Plan* currently being developed by the U.S. Army Corps of Engineers, Huntsville. The reference numbers in the left column of Figure 5.1 correspond (by fiscal year) to the numbered projects in Appendix B. Some project durations are shown on the schedule, but most of these projects will require several years to design, procure, and fully implement, and although not shown, may go beyond the end of the fiscal year. Verification of the energy savings will continue for the life of the equipment.

5.1 Utility Partnership Status

The passage of Georgia House Bill 280 required that Georgia Power Company (GPC) file an integrated resource Plan (IRP) that establishes supply-side and demand-side management resources. The utility will require significant load (kW) in the near future to meet the system needs. GPC filed an IRP on January 10, 1992, in which new demand-side management (DSM) programs were introduced for approval by the Georgia Public Service Commission (GPSC). The estimated avoided cost for baseload in the IRP is 2 cents/kWh and $350/kW. Therefore, DSM program incentives were designed based on the avoided cost of capacity.

The GPSC ruled on the GPC and the Savannah Electric and Power Company (SEPCO) IRPs on July 8, 1992. PNL, with co-funding from the Army, FEMP and the Air Force, analyzed both the IRP filing by GPC and the GPSC ruling on the adequacy of the IRP filing.[a] PNL provided this review to the Air Force, FEMP and the Army for comment. The GPSC found significant shortcomings in the IRPs, particularly with the number and level of incentives offered for DSM programs. Based on the GPSC ruling, GPC and SEPCO filed additional and more aggressive DSM programs.

In late 1992, GPC withdrew and refiled its commercial/industrial and its custom DSM programs, subsequently refiling a modified commercial/industrial program only. The custom program, which is generally the most viable to large federal installations, was not refiled.

(a) Letter Report: Critical Review of Georgia Power Company Integrated Resource Plan and the Georgia Public Service Commission Ruling on Georgia Power Company and Savannah Electric and Power Company Integrated Resource Plans. Pacific Northwest Laboratory, Richland, Washington, August 1992.

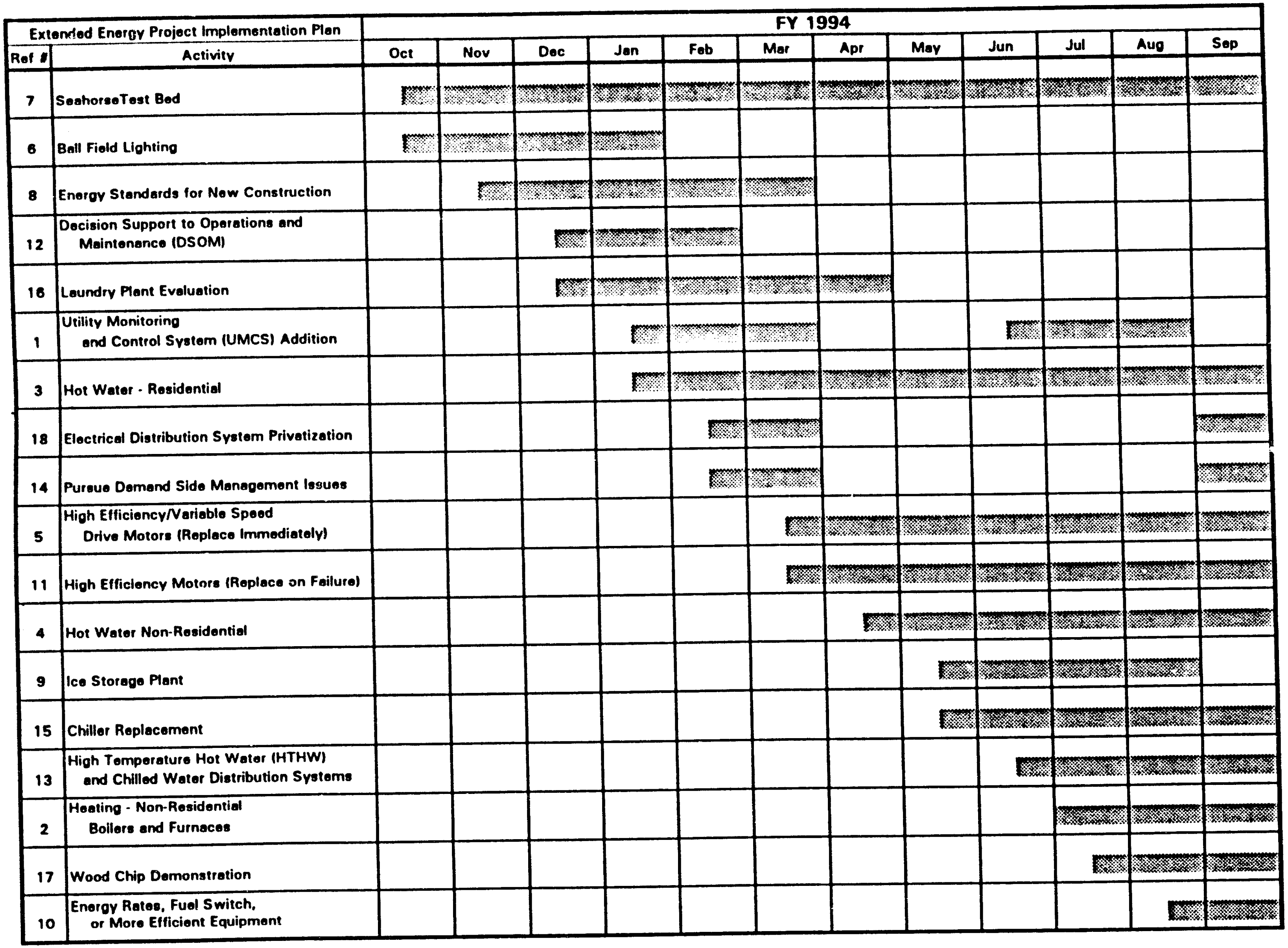

Figure 5.1. Fort Stewart Extended Energy Project Implementation Plan

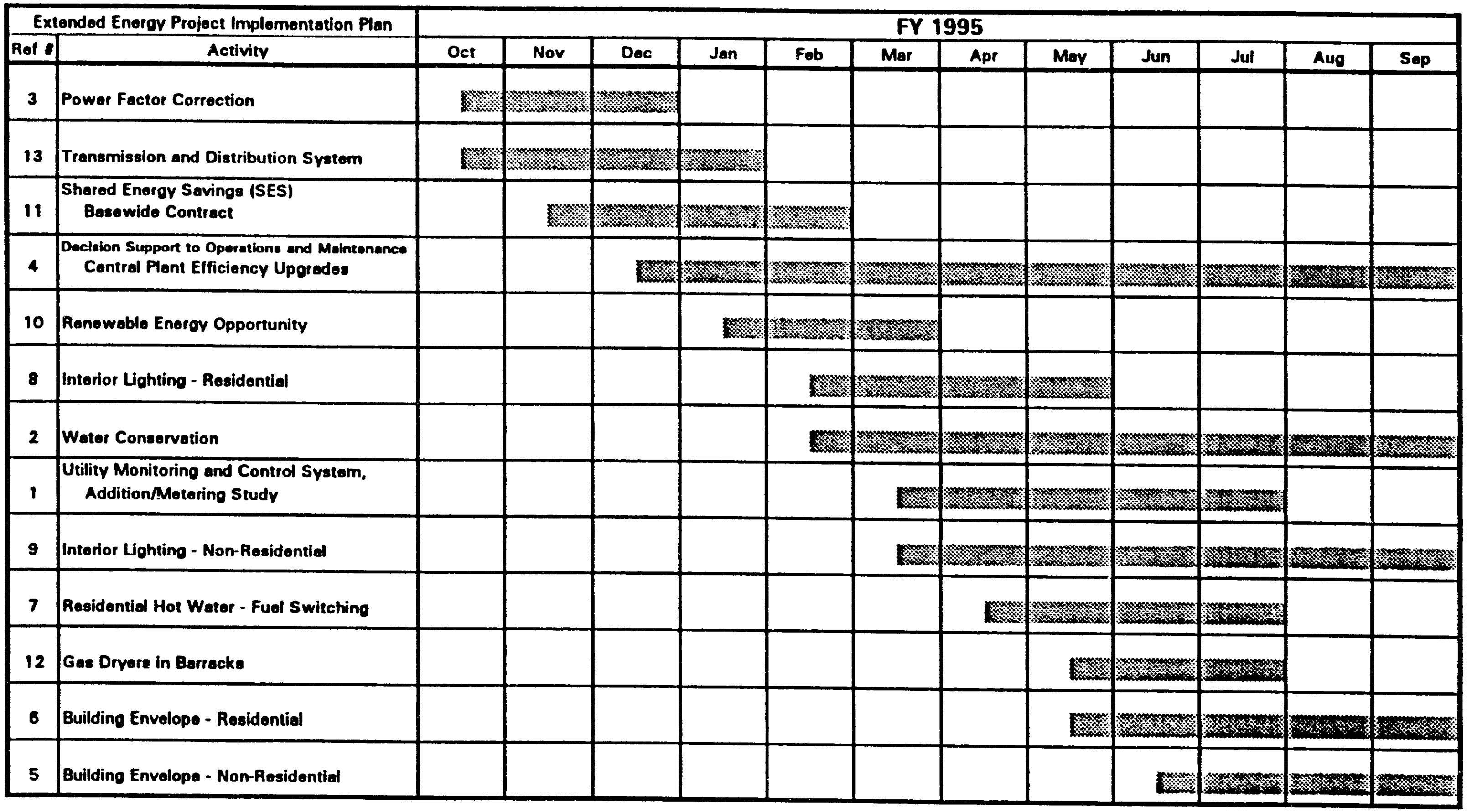

Figure 5.1. (contd)

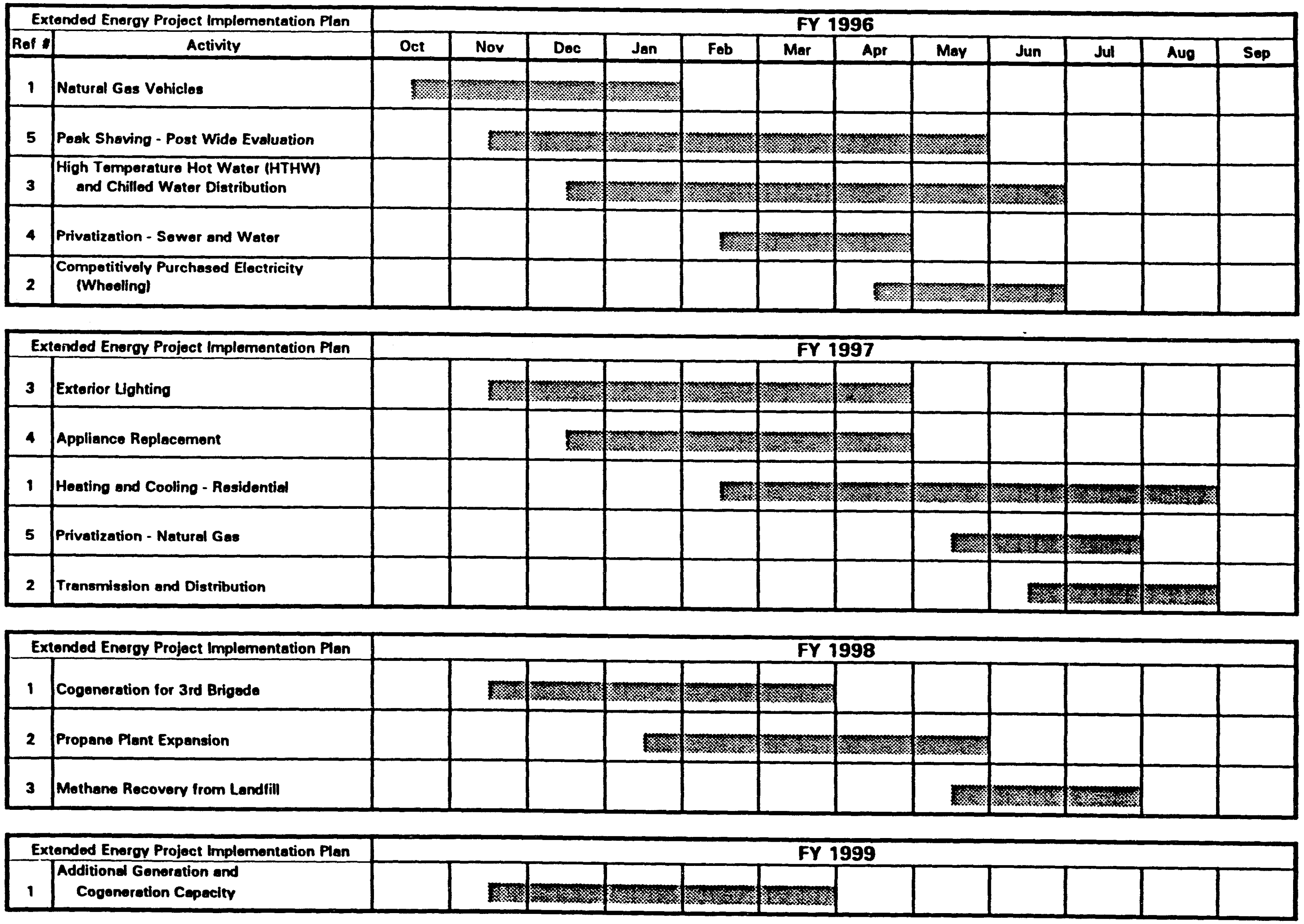

Figure 5.1. (contd)

On January 5, 1993, the GPSC ruled on the *Application of Georgia Power Company for Certification of Demand-Side Programs*. The ruling granted in part GPC's residential DSM programs. The applicability of the residential program to a federal installation such as Fort Stewart was subject to debate. GPC eventually wrote a letter[a] declaring as its position, " . . . the approved residential program is fully applicable to all military family housing units located at DoD installations serviced by Georgia Power throughout the State of Georgia." The letter was reviewed for opinion by staff of the Regulatory Law Office, Office of the Judge Advocate General, Department of the Army, the official federal intervener in the State of Georgia. The opinion expressed was that the letter justified considering the residential DSM programs offered by GPC.

The *Application of Georgia Power Company for Certification of Commercial and Industrial Demand-Side Programs* was ruled on by the GPSC on August 5, 1993. The GPSC's order grants with modifications GPC's commercial and industrial programs, which includes a Small Business Rebate Program, a Custom Financing Program for New Construction, a Custom Lighting Program, and an Energy Analysis Service.

Neither the residential nor the commercial/industrial DSM programs approved by the GPSC are particularly attractive to Fort Stewart, but they are not without merit either. The two programs lack attractiveness because they apply to only a few of the myriad of efficient technology opportunities available and the incentives are minimal. Nevertheless, some efficient technology's capital costs can be reduced by the GPC DSM program and where applicable and life-cycle-cost effective, Fort Stewart should take advantage of the savings.

Atlanta Gas Light (AGL) Company submitted its integrated resource plan to the GPSC in December 1992. Subsequently, the Commission rejected the IRP in its entirety for reasons outside of the scope of this discussion. Because of the rejection, AGL does not have an approved DSM program at this time.

Fort Stewart should acquire all possible efficient technologies in the most expedient manner available. During the next two years (and beyond), Fort Stewart can expect new and revised DSM programs from both GPC and AGL. Staying appraised of developing and evolving DSM programs will provide several benefits to the Fort. For instance, limited resources and time often force deferring implementing desirable efficient technology opportunities. Staying appraised of developing DSM programs will help in determining which technologies to defer, and for how long. Another benefit involves the on-going process of reviewing and revising the energy efficiency implementation plan. Staying appraised of developing DSM programs will ensure that revisions to the implementation plan take advantage of new DSM opportunities.

(a) Georgia Power Company letter, to Major General Paul E. Blackwell, Commanding General Fort Stewart, from W. Paul Bowers, Vice President, Retail Sales & Services, dated May 18, 1993.

6.0 Conclusions And Recommendations

The integrated resource assessment at Fort Stewart was the first opportunity to analyze a major site using the Facility Energy Decision Screening Level 2 (Level-2) software. The significant conclusions and lessons learned from this work include:

- This systematic approach to identifying energy opportunities provides a framework for long-range energy planning which includes a means to achieve the mandated energy reduction goals. The projects identified from this analysis can be implemented over a period of several years as funding is available.

- FEDS Level-2 software results are significantly more accurate, complete, and comprehensive than results which would have been produced using alternative methods. Results with comparable levels of detail and accuracy (i.e., interactive effects) would be impossible to obtain using manual methods, and far too costly to attempt to combine an array of existing software systems.

- Substantial energy reduction and cost savings are available at Fort Stewart even with the exceptionally low cost of energy for electricity, natural gas, and wood chips. Building EROs, analyzed using the Level-2 software, provide a savings of 21.1% of the annual energy consumption and 20.3% of the annual energy expenditures. Non-building EROs, analyzed by the FEDS process, provide a savings of 6.6% of the annual energy consumption and 7.6% of the annual energy expenditures.

- DSM funding through Georgia Power Company appears limited to the differential costs of a limited number of efficient technologies. DSM funding is not available from Atlanta Gas Light Company, but it and GPC can be expected to have new, more extensive programs in the future. Other funding sources should be explored for other electric, non-electric, and fuel-switching projects. Other funding sources include (but are not limited to) the Energy Conservation Investment Program (ECIP) and Shared Energy Savings (SES).

- The implementation process, although predominately directed toward acquiring energy efficient technology, also must consider and integrate other issues that have potential to affect energy consumption. Examples of other issues include regular reviews of utility rate schedules, energy standards for retrofit and new construction, and institutional procedures that ensure energy efficient technologies are installed when replace-on-failure occurs.

- The Energy Policy Act of 1992 provides Fort Stewart new and expanded opportunities in other energy-related technologies such as water, solar and other renewables. Further evaluation of these opportunities should occur following the same life-cycle cost methodology (10 CFR, Part 436) as all other EROs evaluated in this assessment.

The major recommendations of this assessment include:

- The Level-2 input file is a detailed record of all of the facilities on Fort Stewart. Maintain and improve the Level-2 input file as more detailed information becomes available and as the Fort changes with time, especially with the implementation of *Vision 2004*. Some of the changes that can affect the results include new construction, building demolition and decommissioning, utility rate changes, and ERO implementation. These items will affect the LCC effectiveness of the remaining EROs and may result in the addition of more EROs.

- Maintain functional FEDS Level-2 software at Fort Stewart. The Level-2 software is a tool that provides capabilities beyond analyzing the LCC effectiveness of EROs. The Level-2 software can be used to quickly and methodically examine many types of proposals (such as shared energy savings and alternative funding) and new energy savings suggestions ("what if" ideas.) Use of the Level-2 software provides consistency and auditable results in accordance with federal regulations.

7.0 References

10 CFR 436. 1990. U.S. Department of Energy. "Federal Energy Management and Planning Programs." (Revision as of January 1, 1990). *U.S. Code of Federal Regulations*.

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Appendix A

Life-Cycle Cost Methodology

Appendix A

Life-Cycle Cost Methodology

According to the provisions of 10 CFR Part 436,[1] federal agencies are required to analyze all potential energy investments using a life-cycle cost (LCC) methodology developed by the National Institute of Standards and Technology (NIST).[2] The NIST LCC methodology calculates all relevant costs of a project and discounts them to result in present dollars, and then subtracts that sum from a similarly constructed LCC of baseline, current conditions or technology. This difference is called the net present value (NPV) of the action being considered. Actions are cost-effective if the NPV is positive and greater than the NPV of alternative actions. Following this methodology results in minimizing the LCC of energy services at a site.

This economic analysis is central to the Federal Energy Management Program (FEMP) model approach for federal energy efficiency using the FEDS (Facility Energy Decision Screening) system to develop a fuel-neutral assessment of facilities to identify and quantify energy efficiency resources, supply alternatives, and fuel-switching opportunities.

All energy resource opportunities (EROs) identified by the FEDS assessment and described in the Volume 3 Resource Assessment report (Sullivan et al. 1993) are therefore subjected to the LCC economic analysis to determine their cost-effectiveness. The purpose of the FEDS assessment is to identify the facility energy efficiency resource alternatives available to decision makers; the economic analysis provides an estimate of the installed cost and energy savings of the cost-effective resource available at a facility using the most current and realistic assumptions possible. individual projects and actions considered for implementation should be examined and analyzed more thoroughly at a project level prior to design and implementation.

Under the NIST methodology, energy prices are escalated and costs and benefits are discounted using factors taken from the current edition of "Energy Prices and Discount Factors for Life-Cycle Cost Analysis."[3] Costs and benefits are analyzed over a 25-year period, reflecting the average expected remaining life of a typical building. Other key assumptions in the methodology are:

- Prices for all goods and services (e.g., installed cost of a technology) will vary at the same rate as the inflation rate; therefore the "real" rate of inflation is zero.

- Energy or fuel prices vary at a rate different than that of the inflation rate. NIST reports the value by which the energy prices vary from the real rate of inflation (the escalation rate).

- All costs and benefits are discounted using the current federal discount rate (4.0% real for CY 1993).

- All EROs are analyzed for a 25-year period. This does not mean that a 25-year life is assumed for all installed equipment: actual estimates of equipment life are used, and the costs of replacing worn out equipment over a 25-year period are incorporated. The 25-year analysis period also does not mean that all streams of savings from EROs are assumed to endure 25 years: many are assumed to disappear as the existing equipment is replaced with more efficient equipment as part of the baseline.

- The analysis assumes that upfront unconstrained federal financing (at the federal discount rate) is available for all potential energy efficiency improvements and actions.

The last assumption, unconstrained (unlimited) federal financing, is incorporated into the LCC analysis to determine the total cost-effective energy efficiency resource at a site. Therefore, the analysis (under the unconstrained funding assumption) results in a menu of all identified energy project opportunities whose benefits exceed their costs.

In the presence of constraints on the funding available to implement these projects, some method of prioritizing the projects is needed. It is for this reason that a savings to investment ratio (SIR) is calculated to rank order projects starting with the project with the highest SIR. This ranking allows available capital to be allocated to those cost-effective projects in an order that results in the greatest savings per dollar of investment.

For most agencies or facilities, the entire list of cost-effective projects from the LCC analysis is significant and cannot be financed from a single source. Rather, all available funding sources need to be determined. Funding sources include federal funds (MILCON, ECIP, Federal Energy Efficiency Fund); utility financing including utility offered rebates or other financial assistance; and energy services industry-financed projects. Each of these funding sources has its own requirements and its own costs and therefore the cost-effectiveness of individual projects needs to be evaluated using the LCC analysis adjusted for each potential funding source's costs and constraints.

Many assumptions in addition to those listed above are required in the course of a FEDS assessment. In every case, the analysis team attempts to make the most realistic and defensible assumption. Where uncertainty exists, the team attempts to err on the side of conservatism. Therefore, the resulting estimate of the total cost-effective energy efficiency resource is a minimum estimate of the total potential resource, given the above assumptions. A more exact estimate and/or the development and design of projects may require a detailed facility audit which is beyond the scope of a FEDS assessment.

References

1. 10 CFR Part 436. 1990 U.S. Department of Energy. "Federal Energy Management and Planning Programs." (Revision as of January 1, 1990.) U.S. Code of Federal Regulations.

2. U.S. Department of Commerce, National Bureau of Standards (NBS). November 1987. *Life-Cycle Costing Manual for the Federal Energy Management Program*. NBS Handbook 135, Prepared for Federal Energy Management Program Staff Office, U.S. Department of Energy. U.S. Government Printing Office, Washington, D.C.

3. National Institute of Standards and Technology (NIST). 1992. *Energy Prices and Discount Factors for Life-Cycle Cost Analysis 1993*. NIST Handbook 135, National Technical Information Service, Springfield, Virginia.

Appendix B

Fort Stewart Extended Energy Project Implementation Plan

Appendix B

Fort Stewart Extended Energy Project Implementation Plan

FY 1994

1. Utility Monitoring and Control System (UMCS) Addition

This project consists of utilizing the UMCS five-year indefinite delivery order contract to add to the UMCS for items such as connecting existing emergency generators to the system to be utilized to reduce the peak electrical demand. Also, the system will be utilized to shed electrical loads during peak electrical demand hours, to activate/deactivate equipment on time schedules, and to perform other energy conservation functions. Design of the first delivery order has been completed. The basic contract was awarded 19 July 1993.

2. Heating - Non-Residential Boilers and Furnaces

Boiler and furnace replacement/upgrade to higher-efficiency models will be evaluated. This project also considers potential fuel switches to or from gas or oil in all non-residential buildings with these fuels available.

3. Hot Water - Residential

Replace existing gas and electrical water heaters with new efficient models in the family housing areas. This project also considers potential fuel switches to or from gas or electricity in all residential buildings with these fuels available.

4. Hot Water - Non-Residential

Replace existing gas and electric water heaters with new efficient models for non-residential buildings. This project also considers potential fuel switches to or from gas or electricity in all non-residential buildings.

5. High-Efficiency/Variable Speed Drive Motors (Replace Immediately)

Many motors, particularly for fan and pump applications, are either oversized or sized to meet the maximum load. Evaluate single speed and variable speed drive motors to determine if correct sizes are being used. Develop mechanisms to track motor replacements and associated savings. For existing single speed standard efficiency motors, replace with high-efficiency models. A variable speed drive adjusts motor speed to meet only the required load, greatly reducing unnecessary energy consumption. Variable speed Drives are not typically considered for motors below one horsepower.

6. Ballfield Lighting

This project consists of adding timer controls to existing ballfield/physical training lighting systems. The controls allow for a predetermined amount of time to elapse before turning off the lights. The controls do allow for a manual override as well as timed reset if necessary.

7. Seahorse Test Bed

This is a demonstration project. Gas-fired water heaters will be installed on the exterior wall of selected family housing units and metered. The life-cycle cost of the system will be evaluated. Equipment monitoring set to begin in January 1994 and run one year. Test results to be published late calendar year 1995.

8. Energy Standards for New Construction

The project will involve development of installation-wide standards to ensure that any new construction is as energy efficient as practical. The standards will utilize the latest guidelines/ standards from the Department of Energy (DOE), the Department of Defense (DOD), the Corps of Engineers (COE), and other sources.

9. Ice Storage Plant

Evaluate the effectiveness of the existing ice storage facility and provide recommendations regarding the application of the ice storage concept as a method for space cooling and electric peak shaving.

10. Energy Rates, Fuel Switch, or More Efficient Equipment

Every two years, evaluate the installation's utility rates and other options, to include gas and electricity, to determine if they are best suited to satisfy mission requirements. The electrical rates will include time of day kilowatt-hour (kWh) charges and peak load charges. Future evaluations should include the possibility of "wheeling" of energy. (Wheeling is the buying of energy from another utility and using the local utility's distribution system to transport the energy to the post.) Analyze Georgia Power's and Atlanta Gas Light's offering of services. Also, if there is a major change of facility configuration or as conditions warrant, evaluate the various sources of fuel being used to determine if better choices exist. Fuel switching as well as upgrading to more energy efficient equipment will be considered. This effort is consistent with growth associated with *Vision 2004*.

11. High-Efficiency Motors (Replace on Failure)

Investigate feasibility of replacing, on failure, existing single speed standard efficiency motors with high-efficiency motors. A standard operating procedure for replacement on failure is to be developed. Develop mechanism to track motor replacement and associated savings. These motors are typically used for fan and pump applications. High-efficiency motors are typically not considered for motors below one horsepower.

12. Decision Support to Operations and Maintenance (DSOM)

DSOM has the potential to save operations, maintenance, and fuel costs for the Central Energy Plant. In addition, DSOM can significantly enhance safety and provide the capability to meet existing and future environmental requirements. This project will evaluate the Central Energy Plant to determine the extent of the economic savings available in operations, maintenance, and fuel costs from DSOM.

13. High Temperature Hot Water (HTHW) and Chilled Water Distribution Systems

Perform Energy Engineering and Analysis Program study to determine if it is feasible to supply additional buildings from the base wide HTHW and chilled water distribution networks.

14. Pursue Demand-Side Management (DSM) Related Issues

Continue coordination with Atlanta Gas Light Company to stay abreast of existing and future incentives with regard to natural gas. This effort includes upgrading equipment to more efficient models, fuel switching, and extending distribution systems to new areas.

15. Chiller Replacement

Due to chlorofluorocarbon regulations, many existing chillers will have to be retrofitted to utilize alternate refrigerants. Life-cycle cost analyses will be performed to determine the most cost effective alternative system considering retrofit of the existing units, new standard refrigeration units of higher efficiency, new gas engine driven units, gas-fired absorption units, and ground coupled heat pumps.

16. Laundry Plant Evaluation

The laundry plant is a major energy user, primarily as steam. Energy losses occur at many points - some of these can be eliminated cost effectively. An evaluation of the existing laundry plant and steam distribution system should be completed. The plant has three natural gas-fired boilers which supply steam to hot water generators and a steam distribution system for use in the laundry facility. Evaluation should include boiler efficiency (tune-up), steam leak and steam trap evaluation. The U.S. Army Construction Engineer Research Laboratory (CERL) will be requested to conduct the evaluation.

17. Wood Chip Demonstration

The Environmental Protection Agency (EPA) will provide funding to install and conduct studies on small heating systems fueled with wood chips. This is a demonstration project. Fort Stewart, GA, and Camp Lejeune, NC, are the two Department of Defense installations under consideration for participation.

18. Electrical Distribution System Privatization

Privatization of the electrical distribution system has been proposed by Georgia Power Company. Preliminary discussions have taken place between Fort Stewart and Georgia Power. Georgia Power is to propose the level of service and cost of the proposed plan. An independent life-cycle cost analysis must be performed.

Fort Stewart Extended Energy Project Implementation Plan

FY 1995

1. Utility Monitoring and Control System (UMCS) Addition/Metering Study

Evaluate all available systems that achieve the same objectives. Even if Fort Stewart makes an initial commitment for one year to installation of Enerlink, continued use of this system should be examined closely in light of functions that can be transferred to utility control system functions such as cost allocation and recovery, bill estimation, and verification, "what if" analysis of different rates to the same consumption, etc. Initiate six months after installation of Enerlink and complete well before renewal date for lease of software. Evaluate the feasibility of including additional equipment and buildings on the existing UMCS to shed electrical loads during peak electrical demand hours, to activate/deactivate equipment on time schedules, and to perform other energy conservation functions. Examples of additional areas to evaluate for possible energy savings through UMCS include central plant boilers and sewage lift station equipment.

2. Water Conservation

Identify and evaluate water efficiency and conservation opportunities available to Fort Stewart, which are consistent with and support the Energy Policy Act of 1992. Potential funding sources for feasible projects are also to be identified.

3. Power Factor Correction

Power factor correction reduces losses in the distribution system and reduces or eliminates excess reactive load charges that the installation incurs each month. A poor power factor can be corrected by installing capacitors, typically at the site substation.

4. Decision Support to Operations and Maintenance - Central Plant Efficiency Upgrade

Coordinate with Fort Stewart plant operators and the Decision Support to Operations and Maintenance (DSOM) preliminary screening to determine areas within the plant that offer potential for improved efficiencies and energy conservation. DSOM has the potential to save operations, maintenance, and fuel costs for the central energy plant. In addition, DSOM can significantly enhance safety and provide the capability to meet existing and future environmental requirements. This project will evaluate the central energy plant to determine the extent of the economic savings available in operations, maintenance, and fuel costs from DSOM, and will provide an installation specific conceptual design.

5. Building Envelope (Non-Residential)

Evaluate building envelope energy efficiency improvement opportunities consistent with Atlanta Gas Light Company and Georgia Power Company approved demand-side management (DSM) programs. Applicable DSM provisions will be included in project development. Typical environmentally controlled non-residential building envelope considerations for energy use reduction include added insulation to wall and/or attic, infiltration reduction, weather stripping, attic ventilation (forced or natural), window replacement upgrade (higher efficiency), and exterior surface finish (roof and/or walls). Coordinate with Phase I Whole Neighborhood Revitalization Project included in *Vision 2004*.

6. Building Envelope (Residential)

Evaluate building envelope energy efficiency improvement opportunities consistent with Atlanta Gas Light Company and Georgia Power Company approved demand-side management (DSM) programs. Applicable DSM provisions will be included in project development. Typical environmentally controlled residential building envelope considerations for energy use reduction include added insulation to wall and/or attic, weather stripping, attic ventilation (forced or natural), window replacement upgrade (higher efficiency), and exterior surface finish (roof and/or walls). Coordinate with Phase I Whole Neighborhood Revitalization Project included in *Vision 2004*.

7. Residential Hot Water - Fuel Switching

Replaces existing gas and electrical water heaters with new efficient models in the family housing areas. This project also considers potential fuel switches to or from gas or electricity in all residential buildings with these fuels available.

8. Interior Lighting - Residential

The efficiency of building lighting can be improved up to 50 percent by retrofitting the existing fluorescent and incandescent fixtures with high-efficiency fluorescent tubes and electronic ballasts. A survey of buildings will determine the potential for savings (need to investigate possibility of audit funded by Georgia Power Company).

9. Interior Lighting - Non-Residential

The efficiency of building lighting can be improved up to 50 percent by retrofitting the existing fluorescent and incandescent fixtures with high-efficiency fluorescent tubes and electronic ballasts. A survey of buildings will determine the potential for savings (need to investigate possibility of audit funded by Georgia Power Company).

10. Renewable Energy Opportunity

Postwide evaluation of renewable energy opportunities and potential funding sources. Energy opportunities exist in utilization of landfill methane, solar technologies, and extended use of wood chips. Methane can be used as a fuel source to power generators for production of electricity. Solar power will be evaluated for possible water heating and a solar wall could be used for space heating of aircraft hangars. Purchase of new equipment that can process wood products into wood chips will also be evaluated.

11. Shared Energy Savings (SES) Basewide Contract

Develop and award a SES basewide energy conservation project where a contractor would evaluate installation conditions and submit energy conservation proposals for evaluation and acceptance by the government. Upon acceptance and implementation, the contractor would receive a share of the resultant savings.

12. Gas Dryers in Barracks

Atlanta Gas Light Company has proposed offering an incentive to replace existing electric clothes dryers in the barracks facilities with natural gas dryers.

13. Transmission and Distribution System

The purpose of this project is two-fold. First, the project examines the existing transmission and distribution (T&D) system for implementing life-cycle cost effective energy efficiency upgrades. Second, the project establishes a plan to ensure that T&D equipment replaced on failure, or for environmental reasons, is the most cost effective based on life-cycle cost analyses. The T&D system is being examined for immediate and replace on failure energy deficiency opportunities. At this time, the plan to ensure equipment replaced on failure is the most cost effective is proposed for development.

Fort Stewart Extended Energy Project Implementation Plan

FY 1996

1. Natural Gas Vehicles

Investigate the feasibility of converting gasoline powered vehicles to natural gas. Recent DOE guidance requires that by 1998, fifty percent of administrative vehicles use alternative fuels. Coordination with GSA and Atlanta Gas and Light is required. Preliminary studies have begun. Huntsville Division provided Fort Stewart with technical analysis. Studies will be funded by FORSCOM.

2. Competitively Purchased Electricity (Wheeling)

Investigate the opportunities available to minimize the cost of purchased electricity in accordance with anticipated federal legislation requiring open access (often referred to as "wheeling") to suppliers of electrical energy. Open access to suppliers of electrical energy could occur as early as FY 96. Open access to gas suppliers currently exists under FERC 636. At this time, project activity involves monitoring federal legislative activities associated with open access to suppliers of electrical energy. Funding is to be determined.

3. High Temperature Hot Water (HTHW) and Chilled Water Distribution

If determined to be feasible, additional buildings will be added to the base wide HTHW distribution network and the base wide chilled water distribution network. Funding is to be determined.

4. Privatization - Sewer and Water

Investigate the economic feasibility of privatizing sewer and water distribution systems. An Independent Government Estimate (IGE) must be prepared to determine the costs/benefits. Funding is to be determined.

5. Peak Shaving - Post Wide Evaluation

Perform a post-wide evaluation of the installation's electric utility rates to determine if additional peak shaving opportunities are available consistent with Fort Stewart's mission requirements and post expansion. This would most likely be implemented as an addition to the post-wide utility monitoring and control system.

Fort Stewart Extended Energy Project Implementation Plan

FY 1997

1. Residential Heating and Cooling

Evaluate and determine the most cost effective types of equipment for residential heating and cooling. Techniques to be considered include high-efficiency furnaces, high-efficiency central air conditioning equipment, natural gas-driven heat pumps, and ground coupled heat pumps.

2. Transmission and Distribution

The potential for growth will mean new and expanded transmission and distribution (T&D) systems. This project will evaluate the T&D systems for energy savings opportunities, including consolidation of substations, voltage reductions, and system redistribution.

3. Exterior Lighting

Electrical savings can be realized by replacing exterior lighting (streetlights, security lights, residential lights, etc.) with more efficient fixtures, and in the case of streetlights, removing some lamps from service and configuring other lamps to be turned off during periods of low traffic. A study of base exterior lighting will determine which is cost effective.

4. Appliance Replacement

In conjunction with the scheduled family housing revitalization projects, an economic analysis will be conducted to determine the most life-cycle cost effective appliance to select for installation and appropriate documents will be prepared which specify the fuel to be supplied with each appliance. High-efficiency refrigerators will be installed and one type to be investigated will be gas-fired refrigerators. Clothes dryer connections will be installed which utilize the most efficient fuel with electricity and natural gas investigated as a minimum. High-efficiency dishwashers will be installed. Gas-fired ranges will be evaluated for life-cycle cost. Funding is to be determined.

5. Privatization - Natural Gas

Investigate the economic feasibility of privatizing the natural gas distribution system. An Independent Government Estimate (IGE) must be prepared to determine the costs/benefits. Funding is to be determined.

Fort Stewart Extended Energy Project Implementation Plan

FY 1998

1. Cogeneration for 3rd Brigade

Power requirements for the 3rd Brigade can be augmented by cogeneration. A conceptual study will determine the feasibility of utilizing excess generators and steam for cogeneration. Funding is to be determined.

2. Propane Plant Expansion

Evaluate adequacy of existing propane-air plant to continue to provide backup for natural gas supply and the interruptible fuel rates that apply to Fort Stewart. If needed, determine additional capacity needed for propane storage and for propane-air mixing. An expansion may be needed to accommodate mission and population growth related to *Vision 2004*. Funding is to be determined.

3. Methane Recovery from Landfill

In 1990/91, the feasibility of recovering methane from the landfill for use as an alternate fuel source was investigated. Reinvestigate the feasibility based on latest environmental abatement requirements and current economics.

Fort Stewart Extended Energy Project Implementation Plan

FY 1999

1. Additional Generation and Cogeneration Capacity

Assess adequacy of electric power supply and feasibility of cogeneration. An analysis in FY 93 showed that cogeneration was not feasible based on existing capital costs, sale price of generated electric power, no new electrical loads, etc. In FY 99, additional information on these items will be available. Growth plans for the new decade will be better known and quantified and economics will be different. Initiate this evaluation in October 1998 for completion in six months. Funding is to be determined.

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