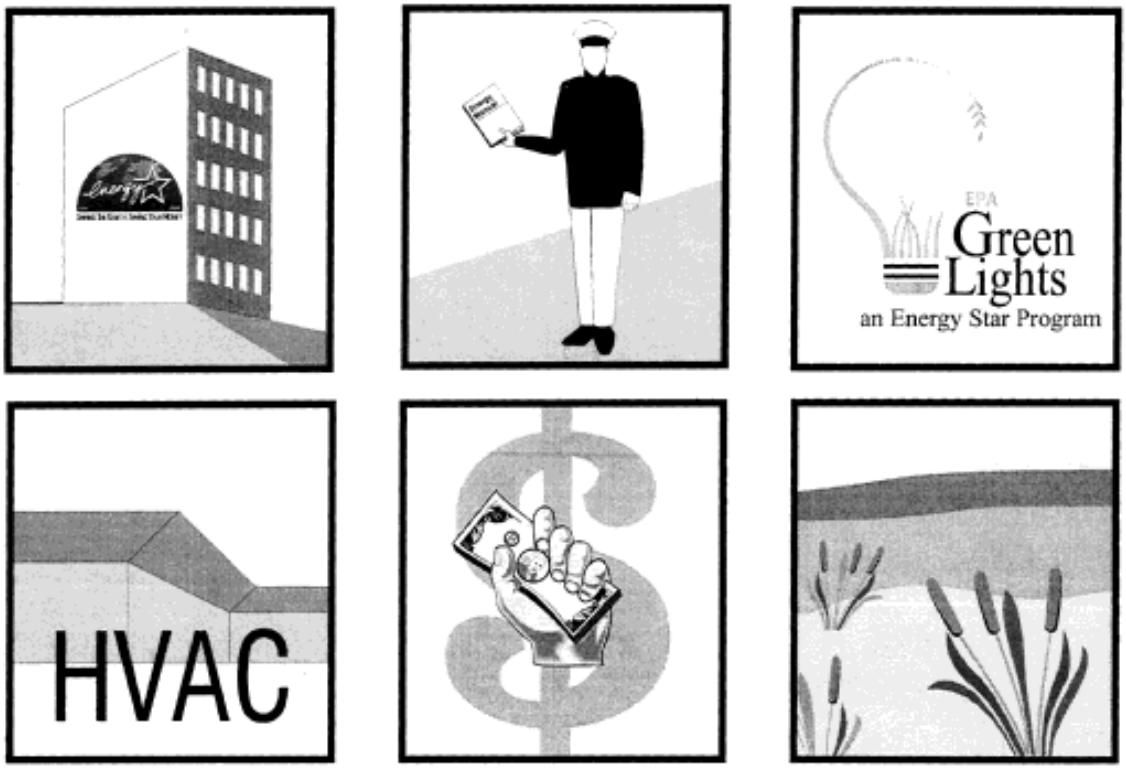
U.S. Department
of Transportation
United States
Coast Guard

COMDTINST M11000.7

Civil Engineering
Facilities Energy Manual



U.S. Coast Guard Headquarters • Systems • Engineering Directorate • Office of Civil Engineering

U.S. Department of Transportation
United States Coast Guard

Commandant
United States Coast Guard

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COMDTINST M11000.7
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COMMANDANT INSTRUCTION M11000.7

Subj: FACILITIES ENERGY MANUAL

1. PURPOSE. This instruction provides overall technical guedance for compliance with the Energy Policy Act of 1992, Executive Order 12902, and the Coast Guard Energy Program's goals and objetives as included in the Facilities Energy Manual, Commandant Instruction (COMDTINST) 11000.7.

2. DIRECTIVES AFFECTED.. This instruction replaces the following:

   a. Energy Conservation Retrofit Handbook, COMDTINST M11000.5
   b. Shore Facilities Energy Management, COMDTINST M11000.6

3. DISCUSSION. Energy expenses represent a significant portion of the overall operating and life cycle costs of Coast Guard facilities. It is in everyone's best interests to manage and control energy. The Facilities Energy Program has been designed to enable us to do just that. Coast Guard facilities provide us with a wealth of opportunities to save energy, save money, improve overall working conditions and provide environmental benefits. This applies across the board from industrial facilities to housing. I encourage all personnel to participate to the fullest extent in making Coast Guard facilities as energy eficient as they can be.

4. ACTION. Area and district commanders, commanders of maintenance and logistics commands, commanding officers of headquarters units, assistant commandants for directorates, Chief Counsel, and special staff offices at Headquarters shall ensure compliance with the provisions of this instruction.

5. REPORTS AND FORMS. See Section VII and Appendix C.

/s/ JOHN T. TOZZI
Assistant Commandant for Systems

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List of Acronyms

AC&I	Acquisition, Construction and Improvement
AFC	Allotment Fund Code
AIA	American Institute of Architects
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
BOAs	Basic Ordering Agreement
CEUs	Civil Engineering Units
CFCs	Chlorofluorocarbons
CFR	Code of Federal Regulations
COMDTINST	Commandant Instructions
CRI	Color Rendering Index
DOE	Department of Energy
ECMs	Energy Conservation Measures
ECO	Energy Conservation Opportunity
EMS	Energy Management System
EO	Executive Order
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 1992
ESCO's	Energy Service Companies
ESPC	Energy Savings Performance Contract
FEs	Facility Engineers
FEDS	Federal Energy Decision Screening
FEEF	Facility Energy Efficiency Funds
FEMP	Federal Energy Management Program
FINCEN	Financial Center
FY	Fiscal Year
G-CPM	Headquarters - Procurement Management Division

GSA	General Services Administration
G-SEC	Headquarters - Office of Civil Engineering
HVAC	Heating, Ventilation, and Air Conditioning
HQ	Head Quarters
IES	Illuminating Engineering Society of North America
LPW	Lumens per Watt
M&V	Measurement and Verification
MLC	Maintenance and Logistics Command
MOA	Memorandum Of Agreement
MOU	Memorandum of Understanding
NIST	National Institute of Standards and Technology
NREL	National Renewable Energy Laboratory
ROI	Return on Investment
SFPDM	Shore Facilities Project Development Manual
USCG	U.S. Coast Guard
U.S.C.	United States Code

GSA	General Services Administration
G-SEC	Headquarters - Office of Civil Engineering
HVAC	Heating, Ventilation, and Air Conditioning
HQ	Head Quarters
IES	Illuminating Engineering Society of North America
LPW	Lumens per Watt
M&V	Measurement and Verification
MLC	Maintenance and Logistics Command
MOA	Memorandum Of Agreement
MOU	Memorandum of Understanding
NIST	National Institute of Standards and Technology
NREL	National Renewable Energy Laboratory
ROI	Return on Investment
SFPDM	Shore Facilities Project Development Manual
USCG	U.S. Coast Guard
U.S.C.	United States Code

U.S. Coast Guard Facilities Energy Management COMDTINST M11000.7

I. Introduction

A. Purpose

This instruction provides overall technical guidance for Coast Guard engineers at shore facilities for compliance with the Coast Guard Energy Program's goals and objectives as included in Energy Management, COMDTINST 4100.2D. The purpose of this manual is to provide Coast Guard engineers with guidance on why and how to comply with Federal energy goals and objectives.

B. Action

Units commanders are ultimately responsible for the energy efficiency of facilities under their command and shall ensure compliance with the provisions of this instruction. The Civil Engineering organization shall provide the support services necessary to perform energy audits and identify, develop and implement energy efficiency improvement projects.

C. Directives Affected

This instruction replaces the following:

- Energy Conservation Retrofit Handbook, COMDTINST M11000.5
- Shore Facilities Energy Management, COMDTINST M11000.6

D. Coast Guard Organizational Responsibilities

COMDTINST 4100.2D on Energy Management, issued 6 March 1997, provides broad guidance concerning organization responsibilities with respect to the energy program. It presents the organization at headquarters and in the field. It also discusses goals, policy, funding, and reporting.

E. Implementation of Energy Projects

Energy projects should be identified, developed and executed as any other shore facility project as identified in the Shore Facilities Project Development Manual COMDTINST M11010.14, and/or the Civil Engineering Manual COMDTINST M11000.2. Appendix A provides a list of phone numbers, addresses, and contacts where additional information on energy related improvements can be obtained. Included in the Appendices is information on manuals, forms, classes and other resources

F. Background

From the technical perspective, there is nothing unique about Coast Guard facilities that requires the development of new standards, operating procedures, equipment or maintenance routines that is different from buildings elsewhere. Rather than "reinvent the wheel", many of the technical aspects of Coast Guard Energy management should be addressed through standards already developed by the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE), the Illuminating Engineering

Society of North America (IES), the American Institute of Architects (AIA), the Environmental Protection Agency (EPA), the Department of Energy (DOE) and the National Laboratories, among others. This manual will make use of references to already established standards and procedures wherever possible.

The Coast Guard technical approach to energy conservation will be to proven technologies to improve energy efficiencies and cut operating costs. Where technically and economically feasible, renewable energy sources should be considered if they represent sound business decisions for the Coast Guard. In fact, all energy investments should be viewed as business decisions which should provide a reasonable return on investment (ROI). The Energy Policy Act of 1992 (EPAct, 1992) requires installation of all energy projects with a payback of 10 years or less. This would indicate there is a point at which energy investments are no longer cost effective.

The most important and effective resource available to conserve energy is our recruits and employees (personnel). The important mission, to conserve energy, is to make all personnel aware of the significance of this endeavor and the potential benefits. Accomplishment of our energy conservation goals will not only reduce operational costs, but provide many improvements in our working environment. The facility engineer must make all personnel aware of their vested responsibility to support the energy conservation program, to achieve goals for controlling energy consumption, and to get the maximum benefit from energy used.

G. Health and Safety, the Environment, and Cost Savings

It is the responsibility of each commanding officer to provide for the safety and health of employees. Care should be taken to ensure that actions to conserve energy are not so zealous as to create hazardous working conditions, create uncomfortable working conditions, create morale problems, or adversely affect mission performance. No employee is to be subjected to unreasonable discomfort, and the individual problems of the physically challenged must be given special attention. Questions of adequate ventilation may also be an issue which can be addressed in ASHRAE 62-89.

Saving energy is good not only from an intrinsic standpoint, but from an environmental one as well. Conserving electricity, for example, saves the consumption of non renewable fuels, such as coal and oil, which provide much of facility power. Conservation also lessens the disposal of ash, a waste byproduct of the combustion process. Further, there is less heated water discharge, fewer air emissions, and so on.

From an economic perspective, saving money on energy charges allows managers to accommodate other needs and improvements. Examples might include improved service function areas, personnel work space enhancements, and automation improvements.

II. Energy Conservation and Cost Savings Goals

The Department of Energy's Federal Energy Management Program (FEMP) was established in 1973 and has been followed by many policies, Acts, programs, requirements, Executive Orders, proclamations, and laws. Listed below are the current requirements that contain goals or guidelines applicable to Coast Guard energy efficiency. The Commandant's energy management goals embrace the Congressional and Executive goals for energy reduction (see the chart in section B.6 that shows the comparison between the goals of the different programs).

A. The Energy Policy Act of 1992

The National Energy Policy Act (EPAct), H.R. 776/Public Law 102-486, signed into law on 24 October 1992 is a comprehensive energy bill covering areas from gas leasing to nuclear power plant licensing to energy efficiency. The lighting energy-efficiency provisions and building energy-efficiency standards will have the biggest impact on Shore Facilities. EPAct enlists the DOE to adopt procedures to ensure federal buildings meet energy standards. A summary of the applicable requirements, mandates, and regulations of EPAct include the following:

- **Twenty percent reduction** of energy consumption per gross square foot of federal building space by FY 2000, from a FY 1985 baseline.
- Installation of all energy and water conservation measures with **paybacks of less than 10 years** by 1 January 2005.
- EPAct mandates energy efficiency **standards** for **lamps** in terms of lamp efficiency (expressed in lumens per watt [LPW]) and color rendering index (CRI). Several types of fluorescent and incandescent lamps have been affected and are no longer being manufactured. There are dates given by which the manufacture of certain types of lamps must cease. Many of the industry's most commonly used lamp types fail to meet EPAct's requirements and will no longer be manufactured.
- The bill also **regulates other energy systems** including luminaires (light fixtures), office equipment, windows, appliances, electric motors, and plumbing products. EPAct specifically sets new efficiency standards for homes and office buildings and authorizes the DOE to set standards for showerheads, faucets, and toilets.
- EPAct contains provisions which mandate that performance standards and labeling requirements be revised in the future. The bill sets deadlines for **"rule-making procedures"** to determine if the standards in the existing bill should be amended. It also sets further deadlines for amending the amended standards. The intent of the existing regulation will not change and end users who opt for the most efficient solutions available will probably not have problems with future compliance.
- Under EPAct, states will be required to **meet or exceed ASHRAE/ Illuminating Engineering Society (IES) Standard 90.1-1989** for building energy efficiency. Although the U.S. Coast Guard (USCG) is not required to comply with state codes, the policy is to do so if possible and not prohibitively expensive. If the USCG

requires shore facilities to meet or exceed ASHRAE standards, the USCG should be in **compliance** with **State requirements.**

EPAct allows the following:

- **Exclusion from the 20 percent reduction** for buildings in which energy intensive activities are carried out. Coast Guard locations which are exempt from the requirements of EPAct are:
  - Communication stations
  - Receiver/transmitter sites
  - Emergency equipment and alarm systems
  - Others as specifically requested in writing, with reasons for exclusion, to G-SEC.

  In order for an exclusion to work, there must be a means of measuring the consumption of excluded facilities, and accounting for the energy used. MLC's and HQ units shall be responsible for obtaining, in writing, exclusions for appropriate facilities in their AOR's.

- **Waivers** from requirements which place **unacceptable burden** upon the agency after the agency has taken all practical steps to comply. Managers should submit written requests for waivers for facilities they feel are to be excluded for unacceptable burden and the rationale for that designation and G-SEC will review the application.

B. Executive Order 12902

President Clinton signed Executive Order (EO) 12902 on 8 March 1994. This EO provides goals and directives to federal agencies concerning the Energy Policy and Conservation Act as amended by the Energy Policy Act. A federal agency is defined with reference to the United States Code (U.S.C.), 5 U.S.C. Section 105. From the perspective of the USCG, the USCG is responsible for compliance with this EO. Much of the EO reiterates or clarifies the requirements of the law. The EO indicates that the DOE shall take the lead in implementing this order through the Federal Energy Management Program (FEMP). Executive Order 12902 requires the following:

- **Thirty percent reduction** of energy consumption per gross square foot of federal building space by FY 2005, from FY 1985 baseline.
- **Twenty percent increase** in energy efficiency in industrial facilities by FY 2005 based on FY 1990 levels to the extent that these measures are cost effective.
- Energy conservation upgrades, retrofits, and designs should be cost effective. That is, they should have a **pay back period of less than 10 years** to the extent that these measures are cost effective as determined in 10 CFR 436 and 42 U.S.C. 8254 which discusses life cycle costs.
- Implement **all cost-effective water conservation projects.**
- The **procurement of products in the top 25% of their class in energy efficiency,** where cost-effective and where they meet the agency's performance requirements. In addition to available appropriations, agencies shall utilize innovative financing and

contracting mechanisms including, but not limited to, utility DSM and ESPC's to meet the goals and requirements of EPACT and this order. Please see the GSA web site of energy efficient products listed in Appendix A for suggested products.

- Complete a prioritization survey within 18 months of the EO to be used to establish priorities for conducting comprehensive facility audits and to refine the designation of facilities as "exempt" or "industrial". A **10 year audit plan** to conduct or obtain comprehensive facility audits based on the prioritization surveys shall be developed and implemented. Ten percent of the facilities will be audited each year.

- Develop programs to **minimize petroleum-based fuel use** at federal buildings and facilities and significantly increase the use of solar and other renewable energy sources.

- Design new building space to **minimize life cycle costs,** meet or exceed applicable energy performance standards of 10 CFR 435, and utilize passive solar design and adopt active solar technologies where they are cost effective.

- **Negotiate/renegotiate leases** to minimize energy and water costs under life cycle analysis.

- Requirements for Showcase Facilities are presented.

- Use **innovative financing** for energy and water conservation projects including utility demand side management programs, shared energy savings contracts, and energy savings performance contracts (ESPC's).

- **Eliminate procurement barriers** to implementation of EPAct 1992 and EO 12902.

- Include successful implementation of energy efficiency projects in **position descriptions and performance evaluations.**

- Establish **awards and incentives programs** for energy efficiency.

C. **Code of Federal Regulations Title 10, Part 435**

Code of Federal Regulations Title 10, Part 435 (10 CFR Part 435) is titled Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings. 10 CFR Part 435 establishes energy conservation performance standards designed to achieve the maximum practicable improvements in energy efficiency and increases in the use of non-depletable sources of energy. 10 CFR Part 435 emphasizes energy savings in the proper design of lighting, Heating, Ventilation, and Air Conditioning (HVAC), and the building envelope but also discusses the overall building design, water heating systems, and energy management. The following is presented or discussed in 10 CFR Part 435:

- Research indicates that most significant energy uses for any building are generally not accurately identifiable by professional intuition and use should be made of several types of **analysis tools**, some of which are microcomputer-based.

- Consideration of **building attributes** such as building function, form, orientation,

window/wall ratio, and HVAC system types should be made early in the design process of a new building or renovation of an existing building.

- **Lighting** is both a major energy end use in commercial buildings and a major contributor to internal loads by increasing cooling loads and decreasing heating loads.

- A discussion of the design of buildings to take advantage of perimeter daylighting, thermal mass, high performance glazings, and fenestration shading is presented.

D. **Code of Federal Regulations Title 10, Part 436**

Code of Federal Regulations Title 10, Part 436 (10 CFR Part 436), Federal Energy Management and Planning Programs, provides for the reduction of energy consumption and promotes life cycle cost effective investments in building energy systems and energy conservation measures. Life cycle costing under 10 CFR Part 436 is compiled by the National Institute of Standards and Technology (NIST) and DOE. DOE is the lead agency in assisting federal agencies meet the goals identified.

The objectives of 10 CFR Part 436 are the following:

- Promote the methodology and procedures for conducting **life cycle cost analyses** of proposed investments in building energy systems and energy conservation measures,

- Promote efficient use of energy through **general operations plans.**

- Energy conservation measures with a Fiscal Year (FY) 1995 goal and a general 10-year operations plan for the period of FYs 1980-1990 are presented. These milestones have passed but their intent is still applicable as is the remainder of this CFR.

- Each Federal Agency is to submit an **Annual Report on Energy Management** based on fiscal year data to the Secretary of DOE. Items reported include energy consumption reported by functional categories, energy efficiency as calculated in accordance with this subpart or by an equivalent method, and a summary of fuel switching progress.

E. **Environmental Protection Agency/U.S. Coast Guard Memorandum Of Understanding**

In March of 1996, the U.S. Coast Guard became a partner in EPA's Energy Star Building Program by entering into a Memorandum of Understanding (MOU) with the EPA. This partnership builds upon the Coast Guard's previous membership in EPA's Green Lights program. The Green Lights program focuses on pollution prevention and reduced energy demand through the upgrading of inefficient lighting systems. Since lighting affects the energy demands of other building systems (such as HVAC), EPA strongly encourages the initiation of lighting upgrade projects prior to the assessment and upgrading of other energy-demanding building systems. Energy reductions accomplished from lighting improvement projects can significantly impact and reduce HVAC requirements and their associated costs.

Greenlights Memorandum of Understanding Requirements

The Greenlights MOU requires the following:

- **Survey** the lighting in all of the square footage of eligible facilities. **Upgrade** the lighting in eligible facilities in order to reduce lighting energy use by 50% without affecting lighting quality. Lighting surveys of 100% of eligible facilities and upgrades of 90% of the square footage of eligible facilities should be completed by 1 January 2005. The MOU also gives the following recommended schedule for completion of the surveys and upgrades:

Table 1 - Greenlights MOU Survey and Upgrade Goals

Cumulative Percentage of Square Footage		
End of Year	Completed Surveys	Completed Upgrades
1 (March 1997)	5%	1%
3 (March 1999)	90%	40%
5 (March 2001)	100%	90%

- Consideration should be given of the full range of lighting technology, design, and maintenance options that can reduce lighting energy use.

- Surveying and updating of leased space is also discussed, as is incorporating upgrades completed prior to joining the Green Lights Program, and upgrades of new construction (which includes new leases of greater than five years' duration). Other discussions include re-surveys of projects every five years and upgrading as appropriate, employee education, and communication.

- The EPA agrees to provide the following (among other services): 1) best available information about energy-efficient lighting and implementation methods, 2) workshops and training courses, 3) lighting analysis software, 4) directory of utility rebate programs, and 5) informational hotlines.

1. **Energy Star Buildings Responsibilities**

Energy Star Buildings responsibilities include reducing energy consumption in buildings by doing the following:

- Complete at least one pilot upgrade project for each Civil Engineering and Headquarters Unit by March 1998;

- Begin upgrade process in a minimum of 50 percent of eligible facility space by March, 2001 and complete all profitable upgrades in a minimum of 50 percent of space by March 2003. At a minimum, meet the following milestones in carrying out surveys or beginning and completing upgrades of eligible facility space:

Table 2 - Table of Energy Star Building Upgrade Goals

	% of Eligible Space Where Upgrades Have Begun or Surveys Completed	**% of Eligible Space Where Upgrades Are Completed**
March 1997	10%	
March 1998	20%	Complete Pilot upgrades
March 1999	30%	10%
March 2000	40%	20%
March 2001	50%	30%
March 2002		40%
March 2003		50%

- Identify all efficiency upgrade options for eligible buildings;
- Evaluate life cycle cost and internal rate of return for upgrade options;
- Issue annual progress reports to EPA summarizing the status of the program.
- The U.S. Coast Guard is not required to upgrade building space that it occupies under lease or where the U.S. Coast Guard does not have financial control over facility operations, maintenance, and capital investment.
- Other items identified and discussed in the MOU include replacement of major systems upon retirement or failure, building comfort and indoor air quality, new construction, and an energy awareness program for employees.
- The EPA will provide technical support (which includes technical guides, analytical tools, and a technical hotline), educational materials, recognition, a liaison, and an ally program to support the awareness and availability of energy efficient equipment and services.

F. Energy Management Commandant Instruction 4100.2D Goals

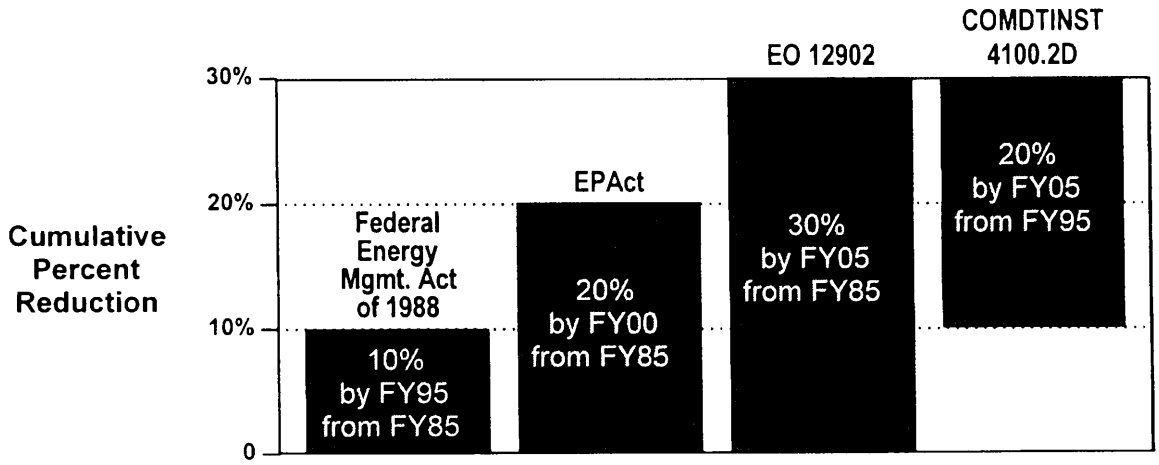
Commandant Instruction 4100.2D, dated 6 March 1997, contains the goals for energy reduction and energy efficiency and for minimizing energy costs. Specifically, COMDTINST 4100.2D sets the following goals (see the chart below for a comparison of the energy reduction goals set by Congress, the President, and the Coast Guard):

- **Reduce** facility energy costs at least 12% and operational energy costs at least 3% from the established (normalized) energy baselines.
- **Achieve a 10%** energy savings by FY95 from FY85 levels. **Reduce** Coast Guard facility remaining energy consumption **20%** by FY 2005 from FY 1995 levels.
- Carry out all other requirements of EPAct, 10 CFR 436, and EO 12902.

COMDTINST 4100.2D also discusses organizational responsibilities and energy management policy which promotes greater energy awareness among all Coast Guard personnel and emphasizes user controlled reductions. The energy management policy

addresses building temperatures, tracking of energy consumption at shore facilities, requirements for leased facilities, audits, energy contracting opportunities, and recognition of success. Funds reporting and funding strategies presented in COMDTINST 4100.2D are discussed in section E.

Summary of Federal Energy Program Requirements



III. Energy Efficiency in Existing Buildings

A. Economic Feasibility/Life Cycle Cost Analysis

The Energy Policy Act requires federal agencies to install all energy projects with a **payback period of ten years or less,** by FY 2005. Further, 10 CFR 436 requires energy project decisions to be made on the basis of life cycle cost. Life cycle cost analysis represents the accepted method of determining whether the cost for an energy improvement is worthwhile. As the term implies, the method looks at the total costs over the life of the proposed improvement. Life cycle costs are computed in present value by adding the costs of purchasing the improvement, less its salvage value at the end of the study period, plus the energy costs, plus other operational and maintenance costs. By comparing the life cycle costs of various alternative improvements, the building manager can determine the optimum alternative as well as the relative payback of a given improvement. Software for performing life cycle cost analysis is available from the DOE's Federal Energy Management Program. For further information, consult 10 CFR, 436.10; NISTIR 85-3273-10; and NBS Handbook 135.

B. Energy Audits

An energy audit is a study to identify all energy sources (i.e., electricity, oil, natural gas, steam, etc.) which are used by a building or group of buildings, and to quantify energy use and costs according to discrete functions, such as heating, lighting, air conditioning, process, etc. Energy audits also identify energy conservation opportunities and quantify energy and cost savings potential associated with those opportunities.

Although the EO calls for a 10-year audit plan and completion of 10% of the audits each year for the 10 years since EPAct was effective, the Coast Guard is looking toward an accelerated completion of those audits by the end of FY99.

1. What is an Audit?

Audits are typically performed by energy professionals trained to scrutinize the building envelope, the building usage, and the associated equipment (e.g., lighting and HVAC) and make recommendations for improvements. Such reviews can be on a fee basis where one pays for the individual's time or it can be done on the basis of sharing future expected savings. Some utilities offer audits at no or minimal cost to their customers. While the incentives to the contractor may vary, the goal remains the same: to save energy and dollars while preserving the Coast Guard's missions.

The Coast Guard's initial thrust has been to address the larger facilities where the savings opportunities are generally greater. The larger facilities comprise roughly half of the agency's building floor area. The remainder of the space will be audited in conformance with the minimum EPA Energy Star Buildings Program requirements identified in Section I.E.1. of this manual and DOE's SAVEnergy Audit protocol, at a minimum. All audits should be complete according to Table 2 in paragraph B.5.b. maintenance and logistics commands and headquarters units will coordinate

the energy audits at all buildings within their areas of responsibility.

2. **Preliminary or Walkthrough Energy Audits**

Preliminary or walk-through energy audits comprise a site visit where the specialist determines basic building configurations, building envelope characteristics, equipment types, and usage. Preliminary or walk-through audits provide general information about the relative state of energy systems and a general set of conservation measures which could be employed to improve efficiencies. Examples include air leakage, lighting types and levels, and water appliances. Generally, only spot readings are taken on lighting or electrical consumption. These audits are typically used for planning purposes, and serve as input for more detailed comprehensive audits and/or feasibility studies.

The EPA Energy Star Buildings Manual provides a series of easy-to-use survey forms to conduct pre-upgrade building surveys. The Energy Star Buildings Program is organized into a five-stage process for conducting building upgrades. Provided below as Table 3 is a summary of the building surveys to be conducted as part of the Energy Star Buildings Program. More detailed information on this program is provided in Section C.16 of this manual.

Table 3 - Energy Star Building Survey Summary

	Survey Item	Resource
Stage 1	Lighting Systems	Green Lights Program *Lighting Upgrade Manual*
Stage 2	Building Tune-Up: • Energy consumption • Temerature and humidity controls • Exterior systems (windows, doors, etc.) • Mechanical equipment (air side and water side) • Operating schedules (lights, office equipment and HVAC equipment)	Energy Star Buildings Manual
Stage 3	Load Reductions • Building exterior systems: windows and roofing	Energy Star Buildings Manual
Step 4	HVAC Distribution Systems • Variable air volume systems	Energy Star Buildings Manual
Setop 5	HVAC Plant • Chillers	Energy Star Buildings Manual

3. **Comprehensive Energy Audits** Comprehensive energy audits involve the same procedures as the preliminary audit, but provide a detailed look at the building and appurtenances and such details as

historic energy use patterns, billing and meter readings, tariff schedules, load calculations, and simulations of various system configurations. Meters may also be installed over a some period of time to verify consumption and output of equipment. The result of a comprehensive energy audit is a detailed list of energy conservation projects, a life cycle cost analysis of those projects, estimates of energy and dollar savings, and a prioritization of projects in order of savings to investment ratio. Financial and technical assistance is available through the DOE SAVEnergy Audits program described in the following section. For more information on a comprehensive energy audit, please also consult the US EPA Energy Star Buildings Manual (EPA 430-B-95-007).

C. Department of Energy SAVEnergy Program

The DOE's National Renewable Energy Laboratory (NREL) provides financial, contracting and technical assistance for comprehensive energy audits at federal facilities. DOE, upon receipt of an application for a SAVEnergy Audit, will select a contractor after receiving bids, and coordinate the audit with the site facility engineer or contact point. All applications for SAVEnergy audits must be coordinated through G-SEC if matching funds through the Facility Energy Efficiency Funds (FEEF) account, described in Section E.2 of this manual, are desired.

D. Federal Energy Decision Screening Analysis

The Federal Energy Decision Screening (FEDS) analysis is not an audit, but a tool for analyzing data collected through an audit. FEDS provides the user with a prioritized list of projects to be accomplished based on an economic analysis, and a means of updating the FEDS computer model as projects are developed. It was developed by DOE's Pacific Northwest Laboratories. The FEDS software, software updates, technical assistance, training and additional information are available by contacting the offices of Pacific Northwest Laboratories which are listed in Appendix A.

E. Energy Project Identification

Through formal energy audits, energy projects should be identified with the goal of reducing energy usage, improving energy efficiencies and cutting operating costs, which can include the cost of energy as well as maintenance and repair. Preferably, projects will be identified which, taken together, will reduce energy consumption, improve the efficiency or reduce the costs for a system or a complex of buildings so that projects can be prioritized. By doing so, funds can be allocated to the projects which yield the greatest return for the investment.

F. Energy Project Prioritization

The Five Stage Energy Star Buildings approach identified in Section C.16 of this manual should be followed in setting energy project priorities. For example, major HVAC improvements should not occur until projects have been implemented to reduce lighting demands, tune up existing equipment, manage load reductions, and improve the overall

distribution system. Once an energy project has been screened and identified, it should be prioritized in accordance with Shore Facilities Project Development Manual (SFPDM), COMDTINST M11010.14, or the Civil Engineering Manual, COMDTINST 11000.11A.

G. Technical Feasibility Generally speaking, the Coast Guard is not seeking out "cutting edge" energy technologies which do not have proven track records for technical or economic performance. Machinery or equipment specified must be readily available and serviceable by in-house personnel or by local service companies. However, there may be occasion to participate with Coast Guard Research & Development, DOE or the National Laboratories, for example, on pilot energy projects which have significant potential and may prove beneficial to the Coast Guard. Such projects should be cleared through Commandant (G-SEC) prior to entering into agreements with other organizations to participate.

1. **Accepted Engineering Practices**

Energy analysis, project development, measurement and verification methodologies should be in accordance with accepted engineering practices as defined by ASHRAE, DOE and other well recognized industry and energy engineering organizations.

2. **Industry/Marketplace Acceptance**

Technology selection should be made with due regard to overall marketplace acceptance. New technologies may not come with the level of support necessary to provide adequate and timely maintenance, e.g. parts and supplies, to allow for reliability of operation.

3. **Energy Efficient Products**

Where cost-effective and where they meet the agency's performance requirements, procurement of products shall be in the top 25% of their class in energy efficiency. Please see the GSA web site of energy efficient products listed in Appendix A for suggested products.

H. Passive Solar Features

Existing structures have the ability to capture solar radiation for both beneficial lighting and heating. The factors which influence the gains include building orientation (e.g., southern exposure); the climate (prevailing sun, humidity and temperatures); window area, insulation and placement; building insulation, color and materials; and adjacent buildings, topography and vegetation. While existing buildings do not present the opportunity to manipulate these features easily and capture solar radiation, modifications are possible and can be productively executed, frequently with workplace enhancement. For example, the selection of materials for a new roof, placement of skylights, or use of window shades or light shelves can improve conditions and save costs. For a more detailed discussion, refer to the DOE's FEMP University class, Designing Low Energy Buildings.

Buildings.

I. Building Envelope

The building envelope represents the containment of the structure including the floor, walls, roof, doorways, windows, and utility passages. There is usually an opportunity to seal the openings and leaks which may exist to better contain the heating and cooling system output. Further, certain components, such as windows and doors, can be upgraded to higher energy efficiency units when replacements are warranted for service reasons. A number of analytic methods are available to measure energy losses in the envelope such as leak testing and infrared photography.

J. Power Consumption

Electric rates frequently vary according to time of use to encourage consumption during off peak periods. Additionally, with the onset of the re-structuring of the electric utility industry, the consumer choice for electrical suppliers is expected to increase significantly. Consequently, facility engineers should look at their options in terms of rates, work scheduling, and supplier. Admittedly, these actions may not conserve electricity, but can certainly have an effect on the costs paid. Selection of electrical motors is another feature worth examining. The kwh consumption values of motors performing the same service can vary. While higher efficiency motors may have higher initial purchase costs, the reduced energy consumption and longer operating life over lesser quality units can justify the investment. Remember, the Coast Guard is trying to reduce it's facilities' life cycle costs.

K. Lighting

Lighting frequently represents the single greatest opportunity in terms of saved energy and dollars. Turning lights off manually or through controls and delamping or relamping fixtures are the preferred methods for reducing energy consumption. Consideration must be given to the cost, color, pulsing, operating bulb life, and lumen yield. Lighting upgrades frequently have the added benefit of improving the employee work environment and increasing safety. Sections C.16.a and D.7. offer more discussion on the choices available for lighting upgrades. The Coast Guard is a member organization of the EPA Green Lights program. As a member, Coast Guard facilities are eligible to receive the EPA Lighting Upgrade Manual, computer software and EPA technical assistance. The Green Lights program provides a comprehensive method for analyzing and upgrading building lighting to achieve maximum energy savings and pollution reduction. The Green Lights lighting upgrade materials should be used when implementing lighting upgrades.

L. HVAC

There are a number of choices in determining the efficiency and improvements to the HVAC system in a building. The chief feature is being able to maintain, consistently, the temperature, humidity, and ventilation necessary to support the activity within the building. Another consideration is whether the climate control system can be a spot unit

or an area application. ASHRAE has set operating standards for boilers, chillers and ventilation systems which will allow the building manager or engineer to compare performance with current standards. The EPA Energy Star Buildings Program provides resources and guidance for the evaluation and upgrading of HVAC systems. For further information on the Energy Star Buildings Program consult the guidance provided in Sections C.16.d and C.16.e of this manual.

M. Instrumentation

The advent of the microprocessor for monitoring of building systems performance has resulted in increased options for controlling lighting, heating, cooling, ventilation and even security systems, sometimes with brief payback periods. Controls can be dedicated to a particular component or in combination with other systems. Consult section C.16.b.2. for the EPA's program summary on energy management systems. Metering requirements for utilities are covered in the Civil Engineering Manual, COMDTINST M11000.11A. Energy meters must be periodically re-calibrated to ensure accurate energy billing and management.

A part of assuring minimal energy consumption is through preventive maintenance. Cleaning of filters, adjusting dampers, and measuring temperatures or lighting levels are examples of requisite good practice. Preventive maintenance is a mainstay of the Coast Guard's other programs and should be for energy initiatives as well.

N. Water Conservation

More utilities are adopting progressive rate structures to encourage conservation where unit costs rise with the volume of water consumed. By conserving water, the cost of water purchased declines, along with the volume of water heated, cooled, pumped, and treated. Reduction of domestic hot water levels is another choice. The use of water saving appliances in reducing process water in operational applications is likewise recommended. Additionally, some reuse opportunities exist where the water quality or treatment is practical.

O. Public Health and Safety

The lighting levels and type, the temperature and humidity, noise levels, and air exchanges are all critical to the building inhabitant. The notion of a safe worker environment is fairly well established. What is more contemporary is the understanding of "sick buildings", which generally refers to unwanted gases, particulates or organisms. There are guidelines under ASHRAE 62-1989 and specialists who can analyze or prescribe corrections when such conditions prevail.

P. Energy Star Building Program

The five stage strategy of the Energy Star Building Program developed by EPA and adopted by the Coast Guard takes into account load-reducing upgrades to lighting and controls at the beginning of the program to provide maximum savings when the heating and cooling systems are upgraded at the end. While it may not be possible in all cases because of previous work or work in progress, it is highly recommended that this strategy

be followed in future energy upgrades. This section provides an overview of the areas that must be considered to maximize building energy efficiency. More detailed information can be obtained from the organizations listed below and by calling the numbers listed in Appendix A:

- The EPA Green Lights Technical Hotline
- The electronic EPA Green Lights bulletin
- The EPA Energy Star Buildings Manual
- ASHRAE Standard 100 - Energy Conservation in Existing Buildings

1. **Stage 1 - Green Lights**

The EPA Green Lights program provides an effective method for analyzing and selecting lighting upgrades. Some excellent tools are available to Green Lights member organizations from EPA. The primary tools include:

- ProjectKalc - a computer software program offering a full analysis of potential lighting upgrades.
- EPA Green Lights Lighting Upgrade Manual - a step-by-step manual for planning and initiating lighting upgrades. The manual addresses the identification of financial needs and resources, selection of a technical approach, and developing and implementing a management plan.

Implementation of the Green Lights Program requires the following actions:

1. Determining appropriate lighting levels - put the correct amount of quality light where it is needed. Improve the effectiveness of the lighting by reducing the glare and improving color rendering;
2. Improving the efficiency of lighting components and luminaires - upgrade with high-efficiency lamps and ballasts to increase the efficiency of converting electricity to light;
3. Implementing controls on operating hours - use automatic or manual lighting controls to turn lights off when they are not needed;
4. Maintaining or improving lighting quality - get more light from a fixture by retrofitting or replacing the fixture with more efficient reflector and shielding materials and through routine fixture cleaning;
5. Maximizing energy savings - analyze lighting configurations to maximize the efficiency of lighting systems. The EPA Lighting Upgrade Manual provides detailed guidance on profitably maximizing energy savings through lighting upgrades.

Detailed guidelines for conducting a lighting upgrade are contained in EPA's Green Lights Lighting Upgrade Manual.

2. **Stage 2 - Building Tune-Ups**

The first step in the building tune-up (also known as "re-commissioning") process is to survey the building and document its overall condition and the conditions under which its various systems are operating. The Energy Star Buildings Manual prepared by EPA contains a detailed form for conducting a Building Tune-Up Survey. Completion of this survey form will allow for familiarization with the condition of all building systems. This information will help determine which systems need to be tuned-up and where energy savings upgrades will be most profitable.

The second step involves developing a building tune-up program. After the building survey has been conducted, the following areas should be evaluated for implementation in the building tune-up program:

- Reheat systems
- Controls and testing and balancing
- Preventive maintenance
- Employee training

Details for each of these components are provided below.

a) **Re-Heat Systems**

Reheat is the mechanical heating of an airflow which has been cooled by an HVAC system to a pre-set minimum temperature. Reheat typically occurs inside ductwork to control the temperature in individual or local building areas. During summer months, it is common with large HVAC systems to have reheat occur simultaneously with cooling. Steps that can be taken to minimize reheat energy consumption include:

1. Monitor reheat year-round and categorize usage into spring, summer, fall and winter;
2. Calibrate thermostats which control reheat;
3. Consider turning reheat off during spring, summer and fall;
4. If reheat must be used in summer to maintain comfort, fix or redesign the system (see stage 4 upgrades);
5. Increase supply air temperature if possible during the cooling season;
6. Perform stage 4 upgrades such as converting to variable air volume or adding central energy management systems to maximize reheat efficiency;
7. Consider alternative dehumidification methods such as desiccant wheels or heat pipes if reheat is used to control humidity.

b) **Controls and Testing and Balancing**

Controls

An Energy Management System (EMS) can greatly improve the performance

of a building or group of buildings. A typical EMS consists of a main computer that receives information from sensors installed throughout the building which feed back information on the performance of energy systems. The sensors automatically record temperatures, pressures, power consumption, humidity, and other parameters. The central computer then uses this feedback to optimize system performance. EMS systems can be used to increase energy efficiency through constant monitoring and adjusting of energy controls. Some typical uses for an EMS might be:

- 7-day Scheduling
- Night setback Direct Digital Control
- Duty Cycling Optimal Start and Stop
- Economic/Enthalpy Control
- Chilled Water Setpoint

Testing and Balancing

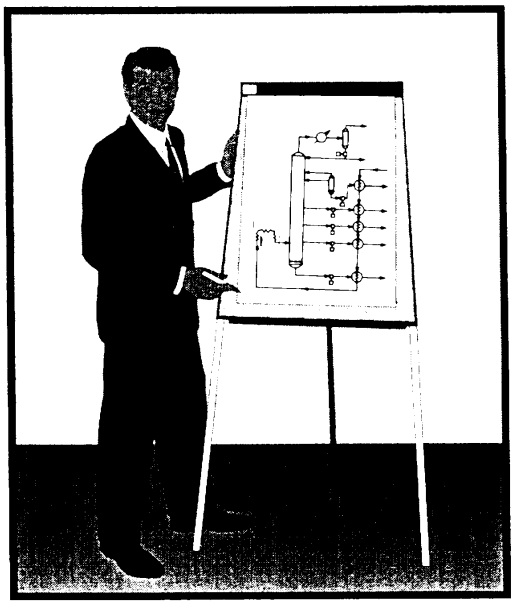
A properly functioning HVAC system must be tested and balanced periodically to eliminate errors that can waste energy. Air-side systems should be tested and balanced when a number of building occupants complain about building temperature, there are hot or cold spaces, or the fan is unable to meet load requirements. Water-side systems should be balanced when the system is unable to meet temperature or pressure requirements in some areas, or the system is modified. In both cases, the system should first be checked to determine if repairs are necessary to correct the condition. All balancing should be conducted by a qualified testing and balancing firm.

Metering

Wherever possible, meters should be installed to help determine how energy is being used in buildings and how efficiencies can be improved. As a general rule, meters should be installed when the annual cost of energy exceeds five times the cost of the meter.

c) **Preventive Maintenance** A well-planned preventive maintenance program is an essential part of the building tune-up. It is much more cost-effective than corrective maintenance, and more than pays for itself in terms of building life-cycle costs. Simple acts such as the regular replacement of air filters and calibrating thermostats can result in significant energy and cost savings.

d) **Training**



Building staff involved with energy-use systems should understand and be well-trained on the operation of all systems. Proper training is also critical to the success of an effective preventive maintenance program.

Consideration should be given to identifying one person to "take ownership" of the training program by serving as a training coordinator. Designation of a training coordinator will ensure that:

- The entire staff is properly trained in all existing procedures and any new procedures developed as part of the building tune-up program.
- The entire staff receives periodic refresher training for updates on new equipment and procedures.
- New employees receive proper training for their areas of responsibility.

The training coordinator should develop and maintain a log to track staff training and outline the training required for various staff positions.

3. **Stage 3 - Load Reductions**

Stage three of the Energy Star Buildings Program focuses on the reduction of building energy loads. Completion of Stages 1 and 2 of the Energy Star Buildings Program (the Green Lights program and building tune-up/preventive maintenance) should result in significant load reductions. Additional load reductions to be considered in Stage 3 include upgrades to building exteriors, specifically walls, windows, and roofs.

The first step in Stage 3 is completion of a window and roofing survey. Included in the Energy Star Buildings Manual is a survey form for conducting the survey. This survey form provides a relatively simple process for surveying buildings to identify opportunities for energy savings by upgrading windows and roofs.

Three upgrades to consider include window films, reflective roof coverings, and additional roofing insulation. All of these upgrades have the potential to provide significant energy savings with a high internal rate of return. These upgrades can be implemented individually or in combination to provide maximum savings.

4. **Stage 4 - HVAC Distribution**

This stage of the Energy Star Buildings Program involves upgrading the energy efficiency and cost-effectiveness of HVAC distribution systems. Reduced energy loads achieved from Stages 1 through 3 of the Energy Star Buildings Program will result in less demand being placed on existing HVAC systems. The existing distribution components of the HVAC system may be oversized and inefficient for the reduced energy demands. The Energy Star Buildings Manual provides survey forms and guidelines for analyzing and upgrading both the air-side and water-side HVAC distribution systems.

Air-side, or variable air volume system, upgrades consist of fan system downsizing, installing energy-efficient motors, and retrofitting with variable-speed drives. The Variable Air Volume Survey contained in the Energy Star Buildings Manual should be completed to determine which system upgrades can be profitable. The EPA QuikFan computer program can be used to calculate the economic benefits of Stage 4 upgrades. Much of the information collected for the survey is used as input for the QuikFan program.

Water-side systems use chilled pumps to transport chilled water, condensed water, or refrigerant. Upgrades to water-side systems include downsizing pumps and motors, installing variable-speed drives and converting single-loop configurations to include primary and secondary loops.

5. **Stage 5 - HVAC Modifications/Replacements**

Stage 5 of the Energy Star Buildings Program involves upgrading HVAC plant equipment. The Energy Star Buildings Manual provides guidance on evaluating opportunities for upgrades to the following types of equipment:

- Water-cooled centrifugal chillers
- Boilers
- Packaged air-conditioning units

Water-Cooled Centrifugal Chiller Upgrades

The best opportunities for chiller upgrades include chiller retrofit and chiller replacement. Chiller retrofits are most effective for chillers that are over 10 years old. The first step for Stage 5 of the Energy Star Buildings program is completion of the Chiller Survey provided in the Energy Star Buildings Manual. After completion of the survey, the EPA software tool, QuikChill can be used to perform a full economic and energy analysis of potential upgrade scenarios. Consideration must also be given to the friendlier forms of chloro-fluorocarbons (CFC's).

Boiler Upgrades

The best opportunities for boiler upgrades include replacing older, inefficient boilers with smaller more energy-efficient models and retrofitting existing boilers for more efficient performance. Boiler retrofits options include:

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Boiler Upgrades

The best opportunities for boiler upgrades include replacing older, inefficient boilers with smaller more energy-efficient models and retrofitting existing boilers for more efficient performance. Boiler retrofits options include:

a) Installing new efficient burners to improve fuel combustion and reduce nitrogen oxide emissions. Installing baffle inserts to increase heat transfer.
b) Installing combustion controls to control the fuel flow and air-fuel combustion. Installing warm-weather controls for hot-water boilers.
c) Installing economizers to capture waste heat in the exhaust flue gases for preheating recovery feedwater.
d) Installing a condensate return system to reuse condensate water.
e) Installing a blowdown heat recovery system (this system is only effective for large systems where significant heat can be extracted).

Packaged Air-Conditioning Unit Upgrades

Packaged air-conditioning units are typically used in one-, two- and three-story buildings that have small cooling loads. Packaged units are typically less efficient than chiller systems. Newer packaged units generally have energy-efficiency ratings of less than 9. The use of higher efficiency compressors, larger condensors and evaporators, and variable-speed fan drives can boost the energy-efficiency of these systems to a rating of 13.

Q. Controls

Automation through the use of digital controls and microprocessors can greatly enhance the performance of mechanical equipment and lighting. Such applications as HVAC setbacks during non duty hours, motion sensors for lights, autodimming to account for daylight, electronic ignition for furnaces, standby only lighting, air sensors, zone controls, ambient air use, economizer cycles, are all applications worthy of examination in upgrading an existing building and the product of a comprehensive audit.

R. Preventive Maintenance Frequently the best use of time and resources is to make an existing system functional, especially before contemplating replacement. Improvements of ten to twenty percent are not uncommon in bringing equipment up to its normal operating capacity and efficiency. The development of a schedule for inspection, maintenance and part replacement is an essential ingredient to that end.

IV. New Construction and Major Renovations

In a typical design for new construction or major renovation, the architect designs the building floor plan and shell; the electrical engineer specifies the lighting; and the HVAC engineer determines how to heat and cool the space. This sequence is followed every day in the design of thousands of buildings across the country. Most of these building meet the owner's needs from a functional perspective, but fall short of achieving their potential in energy efficiency. This is because the architect and the engineers are not simultaneously considering all building systems in interaction with each other and with the environment.

This systems evaluation must start early in the design process. The complexity of interactions among building systems and between the building and the environment, must be fully understood in devising energy efficient strategies from the early inception of a project through the completion of construction documents.

From an energy perspective, many things come into interaction to determine the overall energy efficiency and comfort of a building. The way the building is located on the site; the building's size and shape; the orientation of the internal spaces; the location and types of windows; the building materials and finish colors; landscaping - all have an impact on whether the space will be comfortable, functional and energy efficient. Where cost-effective and where they meet the agency's performance requirements, procurement of products shall be in the top 25% of their class in energy efficiency. Please see the GSA web site of energy efficient products listed in Appendix A for suggested products.

The following sections deal briefly with the design considerations which should be explored when approaching a new building or major renovation. Further recommended readings are provided at the end of this instruction.

A. Consolidation of Facilities

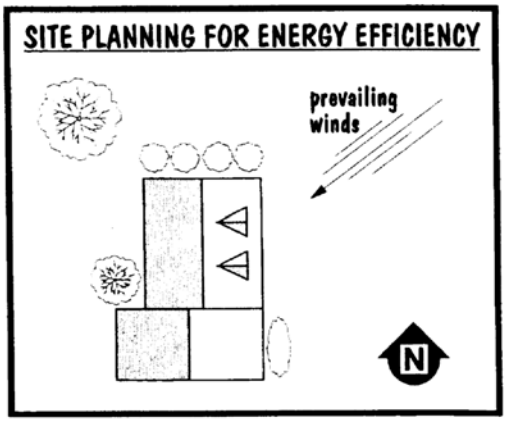
Prior to construction or major renovation, an analysis of the new or renovated building use should be performed to determine if those activities can be performed in existing buildings.

B. Life Cycle Cost Analysis

Refer to the discussion in Section C.1.

C. Site Planning

While many buildings are "locked in" to position by site constraints such as streets, other buildings or geographic features, there are many opportunities to take advantage of orientation and natural features to help heat or cool a building. Solar angles, prevailing breezes, natural landscape features, sloping terrain, and even surrounding buildings can all be used to help improve a new building's energy efficiency.



1. Site and Building Interaction

Opportunities for energy efficiency which are missed during site design are very difficult to reclaim during later stages of the project. If the building is considered as being in interaction with its environment, rather than in competition with it, the designer will open opportunities for energy savings. If the building envelope is treated as a membrane, rather than a barrier, to the outside environment, light and heat can be harnessed at no cost. If the shape and orientation of the building can vary, the designer has a powerful opportunity to capture solar energy when beneficial and block it when undesirable.

2. Building Shape (Footprint)

Generally, an elongated building with a major east-west axis will capture more solar radiation in winter and reduce solar gains during summer months. In colder climates, maximum southern glazing will be advantageous, while in warm climates, north-oriented glazing can achieve lower energy use. Highly glazed and unprotected western exposures should be avoided in any climate because they result in excessive cooling loads. For eastern and western exposures where windows are essential or desirable, shading devices such as overhangs or wing-walls combined with specially tinted or coated glazings should be employed to reduce heat gain while maintaining light levels and outside views. Buildings designed with the same window configuration all around will most likely experience problems in areas of the building all year long.

Consider square buildings in cold but sunny climates, with maximum southern, less east and west, and minimum northern glazing. Also place functions requiring the greatest light levels along the southern exterior walls.

Of course, these are general guidelines and must be validated for each design through the use of building energy analysis tools, some of which are described in Section H.5 of this manual.

3. **Landscaping**

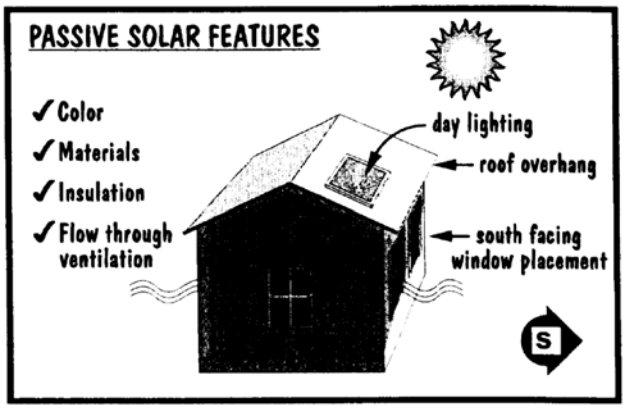
On most sites it is advantageous to place landscaping to protect east and west exposures from summer sun. Trees can hinder energy efficient design if planted where they may shade collection areas, but help if they are planted to keep out summer sun while allowing winter sun to enter. Dense evergreen windbreaks in the path of dominant cold winds, usually on the northern side, will help to reduce winter heating loads caused by cold air infiltration through the building envelope.

Many opportunities also exist to minimize the use of fertilizers and chemicals, and to significantly reduce irrigation requirements through the use of indigenous plant species.

D. **Passive Solar Features** Wherever possible, designers should investigate the many opportunities to reduce building energy consumption through the use of passive solar design. Passive solar design uses daylight, solar heating and natural ventilation in synergy with conventional energy efficient systems to produce buildings with both aesthetic and functional advantages over more conventional designs. A good passive solar design balances all of the energy use in a building: lighting, cooling, heating and ventilation. The following areas should be considered when designing new Coast Guard buildings or major renovations to existing buildings:

1. **South Glazing**

One of the primary features of passive solar building design is the use of south facing glazing for heating. However, simply maximizing southern windows does not constitute a solar building. Consideration must be given not only to solar collection, but to storage through thermal mass, distribution, and control for a good passive solar design to be effective.



2. **Daylighting**

Since lighting costs can account for as much as two thirds or more of a building's electricity expense, every effort should be made to take advantage of natural light in conjunction with automatic dimming control of lighting fixtures. Daylighting techniques include features such as overhangs, light shelves, clerestories, skylights, light tubes, which essentially "pipe" light to interior zones, reflective surfaces, and louvers which allow light to enter a space while reducing or eliminating glare.

3. **Shading**

Unwanted solar gain must be controlled through either natural means such as landscaping or through shading devices which are designed to allow desirable solar gain while keeping it out when it becomes excessive.

4. **Thermal Mass**

Thermal mass is important for any building, and more so in a passive solar design. In winter, thermal mass stores heat for later use, while in summer cooling down at night and absorbing heat by day. Thermal mass can also shift heating and cooling loads to off-peak hours, when electricity is less expensive.

5. **Heat Distribution**

Special considerations arise in passive solar structures, as well as others, because one side of the building can become overheated while the other is cold. In a passive solar structure, this condition can be exacerbated because the building has been designed to maximize solar gain. Distribution systems must have the ability to move excessive heat from one part of the building to others.

6. **Natural Cooling Considerations**

New Coast Guard building designs should take advantage of natural ventilation, economizer cycles which bring in outdoor air when temperature and humidity requirements are met, building thermal mass, and shading - through architectural devices and through natural features or landscaping and trees.

7. **Active Solar**

While passive solar has the greatest obvious advantage, active solar methods for heating, water heating and electrical generation may be practical. Certainly for remote electrical needs, photovoltaics are a proven commodity.

E. **Building Envelope**

1. **Construction Materials**

New buildings should be designed with construction materials which enhance the energy performance of the building. Thermal mass can greatly reduce wide temperature swings from day to night, and act as thermal storage for heat to be gathered during the day and released at night, and vice-versa.

2. **Insulation**

Levels of insulation in all Coast Guard buildings must at a minimum, conform to applicable local, state or national building energy codes, and where cost effective, exceed those levels.

3. **Vapor and Infiltration Barriers**

Barriers beyond normal walls have become an essential component in terms of reducing infiltration, exfiltration and moisture loss. The effectiveness of such systems allows for pressure testing structures and/or use of smoke pencils to detect unwanted losses. With such tight systems, consideration must be given for adequate air makeup to prevent stale or unhealthy conditions. Examples of unwanted gases include those that outgas from synthetics such as plastics, adhesives in new construction, carbon dioxide, and radon which emanates from geologic sources underneath the structure.

4. **Windows and Doors**

Doors and windows have their own inherent insulation values which can be enhanced by the use of additional barriers, such as shutters/curtains, storm windows/doors, vestibules, tinting, films, double glazing and shading. Sealing around doors and windows remains an important element to both efficiency and comfort. Verification of seals can be accomplished through the use of pressure testing and infrared photography.

F. **Internal vs. External Load Domination**

1. **Building Use**

The use of a building not only affects the energy demand in terms of lighting or heat, but also can provide sources of energy. Examples of the latter are the ambient heat from computers, engines, and lights which can augment the requirements for the HVAC system both positively and negatively. Consolidating activities in certain areas can save on generation as well as distribution systems. Further, placing the consolidated activities along a south wall can take advantage of solar heat and light values. Consequently, accounting for a structure's use in the design process can produce energy savings.

2. **Occupant Behavior**

The type of activity that takes place affects the energy demand. Clearly, the requirements for a computer operator varies from that of a equipment repair specialist. Tailoring the environmental conditions, therefore, will influence not only the energy supply system, but also worker satisfaction. For some applications, spot lighting, heating or cooling may be sufficient. As stated in the previous section, scheduling use requirements for a building as part of the design effort can produce significant savings and still preserve the mission.

G. **G. Lighting Choices**

Achieving energy efficiency in lighting requires examination of the following five (5) elements:

1. **Controls**

The use of manual or automatic switching, or a mix, is the choice for the engineer. Photocells, motion detectors or timers may have a higher initial cost, but can frequently yield enough savings to justify the investment, especially when the cost is rolled into the total re-lighting project.

2. **Lamps**

Types of lighting vary greatly by color, bulb life efficiency and cost. Another opportunity is to delamp in which the total number of lamps is reduced. A more complete discussion of lamp choices and uses is presented in the Green Lights Lighting Upgrade Manual, available from U. S. EPA. Detailed information on energy -efficient lighting products is available from the National Lighting Product Information Program and the International Association for Energy-Efficient Lighting (see Appendix A for contact information). Fluorescent and High Intensity Discharge (HID) lamps contain mercury and require special disposal and recycling procedures. Coordinate with HQ G-SEC, EPA, and state and local hazardous waste officials as required to ensure proper compliance when disposing of these lamps.

3. **Ballasts**

Ballasts have a useful life and when replaced can improve the efficiency of the lighting system. Replacement units should be selected based upon their compatibility with the newer high efficiency tubes. Fluorescent and HID ballasts manufactured through the late 1970's used polychlorinated biphenyl's (PCB's) as an insulating material. Specific federal, state, and agency regulations regarding disposal of toxic substances should be followed.

4. **Fixtures**

It is practical in some instances to modify existing fixtures to accommodate higher efficiency lamps. Another possibility is to modify the diffusers to improve light distribution.

5. **Fixture Arrangement**

In many instances when relamping results in an over-lit condition, delamping or rearrangement of the fixtures becomes practical. Light level readings should be taken and lamps placed according to work requirements. Task, zone or accent lighting are other ways to provide lighting in an efficient manner.

H. **Lighting, Heating and Cooling Interrelationships**

The interrelationship among air, lighting, equipment and personnel in an efficient structure is a critical one in establishing load conditions and equipment requirements. The offsets are numerous and changing one element can often affect another. There are a number of automation programs that allow changes to be made and the tradeoffs

identified rather quickly.

I. **HVAC Equipment Choices**

Life cycle cost, not first cost, should prevail in making HVAC equipment decisions. Designers must, by law, compare a number of alternatives, including high efficiency systems, on the basis of life cycle costs and select the one with the lowest life cycle cost as the preferred alternative.

Specific technical guidance for choosing mechanical equipment is available in many forms, with ASHRAE providing overall industry standards and design procedures for HVAC systems design. This instruction will not attempt to duplicate already accepted industry standards.

J. **Energy conservation awareness programs**

Customer acceptance is key to successful operation. The customer includes not only the building users, but also the equipment operators. General instruction, operating procedures, posting of desired practices, and even reward systems can enhance the likelihood of saving energy consistently over the long term.

K. **Controls**

Much of the efficiency of mechanical systems relies on a system of controls which allows the system to operate at optimum levels, delivering the right heating or cooling to those areas which need it at the right times. Obviously, if these controls are not functioning properly or have been improperly designed, the price will be paid in reduced energy efficiency.

For a discussion of Computerized Energy Management Systems, see the discussion in Section C.17.

L. **Periodic maintenance for energy efficiency**

Preventive maintenance more than pays for itself in terms of building life cycle costs; without it expenses are higher for energy, repairs, corrective maintenance, and equipment replacement.

1) All energy systems in Coast Guard facilities must undergo regular preventive maintenance in accordance with the guidance provided in applicable ASHRAE Standards and USCG Manuals.
2) Facility Engineers shall maintain records of preventive maintenance procedures.

M. **Office Equipment**

All newly purchased computers, monitors, fax machines and copiers must comply with the EPA's Energy Star requirements. CG office managers must ensure that all Energy Star features are activated, and that all office equipment is turned off overnight and on weekends or when not in use for long periods of time.

Energy conscious use of computers can save considerable energy dollars. The cost of

running a computer that is turned off overnight is one-third the cost of one left running all night. This is true even for Energy Star computers that have a sleep feature. Personnel should be instructed to shut off their computers if not at their desk for long periods of time, at least overnight. Energy Star features of all Coast Guard computer and office equipment must be activated when the equipment is installed

V. Energy Project Funding

Individual facilities have the choice of how they want to proceed with any project. It is their responsibility, through the Civil Engineering Units or their own Facility Engineering staffs, to get the project into the internal funding stream, initiate an Energy Savings Performance Contract (ESPC), or take advantage of a utility rebate. Field units may submit projects to G-SEC through the MLC/CEU chain of command for funding through the Facility Energy Efficiency Funds (FEEF) on an annual basis. G-SEC will issue an annual call for FEEF projects. Please see COMDINST 41002.D for a further discussion of FEEF. G-SEC, MLC's, CEU's, Facility Engineers (FE's) and Unit Commanders shall fund energy projects in accordance with criteria in the Financial Resources Management Manual (FRMM) and the Civil Engineering Manual. Additional information on funding can be obtained from the Appendices of the EPA's Energy Star Buildings Manual. Below are discussions of some of the more common funding vehicles.

A. AFC-43

Many energy-related projects can meet the definition for AFC 43 funding. POP boards should consider the economic and energy efficiency aspects of projects when making funding prioritization decisions. Projects which reduce life cycle costs through improvements in energy efficiency and/or reductions in maintenance costs should be given a high priority for funding.

B. AFC-30, Facility Energy Efficiency Funds (FEEF)

The FEEF is an AFC-30 account set up to provide funding for small energy conservation retrofit projects up to $25,000. It can be used for energy auditing and metering projects, low cost Energy Conservation Opportunities (ECO's), and for training and administration of the energy program. MLC's and HQ Units shall notify G-SEC annually upon G-SEC request, of projects they wish to fund out of the FEEF during the next fiscal year. G-SEC will prioritize these projects and provide a list of recommended projects for funding for the FEEF administrator, G-CFP.

C. Energy Savings Performance Contract (ESPC)

An ESPC provides for outside financing of federal energy projects by Energy Service Companies (ESCO's), in exchange for payments over a period of years out of energy savings, which are guaranteed by the ESCO. The ESCO typically maintains the equipment during the term of the contract at which point ownership is transferred to the agency. The contractor undertakes the cost of implementing energy savings measures in exchange for a share of any energy savings that result during the term of the contract. The structure of each performance contract is different, varying as a function of the unique energy service needs and conservation potential of the facility, the immediate and ultimate ownership of the capital investments, the distribution of the dollar savings, and the contractual requirements between the parties.

The primary benefit of this type of contracting is that projects can be funded outside of

normal funding channels (AFC 43, Acquisition, Construction and Improvement). Another benefit is that the ESCO is responsible for system performance and has guaranteed certain levels of performance. If that level is not met, the agency is reimbursed by the contractor for any shortfall.

Disadvantages are that positive cash flow is not apparent until the end of the contract, or the payments must be spread out over a longer term to see a positive cash flow. Additionally, it will be a more expensive proposition than outright funding for a project because of finance charges and O&M costs. A major advantage is that they can be bought down as funding becomes available

ESPC's can be difficult, complicated and time-consuming to negotiate and are not for everyone, but nonetheless may have applications in larger Coast Guard facilities where financing very large energy systems projects is not feasible under current budget conditions.

Before entering into an ESPC, program offices must be assured that all internal funding possibilities have been explored to ensure optimum use of available financial resources, and that the ESPC falls within the guidelines set forth by DOE.

All Coast Guard ESPCs must be coordinated through Commandant (G-SEC) who will provide HQ coordination for contracting, financial, or other matters to be resolved relating to ESPC's as needed. However, the overall responsibility for ESPC project management remains at the Unit level where the project originated in close coordination with the CEU/MLC/FDCC/HQ Unit. **Due to the sensitive nature of ESPC's with regard to long-term, level funding commitments and contractual obligations, G-CFP will be the final approval authority for all ESPC's. G-CFP will provide guidance concerning the information needed to approve an ESPC proposal, and the process by which the decision is made.**

D. **Acquisition, Construction and Improvement**

Energy projects which will do not fit the requirements of AFC 43 projects as specified in the Civil Engineering Manual, COMDTINST 11000.11A, or are not being considered for alternative means of financing such as the FEEF or ESPC's should be treated as AC&I projects in accordance with the Shore Facility Project Development Manual, COMDTINST M11010.14, and the Financial Resource Management Manual, COMDTINST M7100.3A.

E. **Utility/Energy Service Company**

Wherever possible, facility engineers and unit commanders shall identify and make maximum use of utility rebate programs related to energy retrofits. CEU's shall perform an annual survey of utility companies serving their area of responsibility and make rebate programs known to Unit Commanders. Additionally, many utility companies have negotiated area-wide agreements with GSA. Information on these area wide contracts can be found in Section F.2.

VI. Contracting for Energy Projects

A. Direct Coast Guard Contracting

The most well-defined methods of contracting for energy services are already widely used for all types of contracting. Local contracting officers, for the most part, are well suited to handling any of these needs. G-CPM will provide advice on special energy-related contracting issues as needed.

B. B. Area-Wide Utility Agreements/Basic Ordering Agreements

Many utility companies have negotiated area-wide agreements with the GSA whereby they are able to provide a variety of energy services directly to government agencies without the agency's having to go through competitive bidding processes. These utilities have already satisfied competition requirements and can move quickly to provide or subcontract energy services to Coast Guard units. A list of these utility companies is available from the GSA web site listed in Appendix A. MLC's shall work with utility companies in their areas of responsibility to make the best use of these GSA area-wide agreements to expedite the completion of energy projects. Should the GSA agreement not be satisfactory, HQ contracting will work with the MLC's on a revised agreement, as needed

C. Memoranda Of Agreement/Memoranda Of Understanding

These documents are not contracts, but expressions of two or more parties intentions to work towards some specified goals. A signed Memoranda Of Agreement/ Memoranda Of Understanding (MOA/MOU) implies a commitment among the parties to provide the resources necessary to complete the actions agreed upon in the MOA/MOU. They typically contain an escape clause which allows either party to back out without penalty. While not usually legally binding, MOA's/MOU's should not be entered into lightly without full consideration of the obligations implied.

D. Energy Savings Performance Contract

Described in Section E.3, the ESPC is an alternative means of procuring energy services through outside financing, the cost of which is then repaid through energy savings over a period of years. All other means of contracting and financing must be explored in full before entering into ESPC agreements, because they result in long term financial commitments and reduced cash flow compared to direct financing and contracting.

VII. Energy Program Measurement, Reporting, and Incentives

Congressional and Presidential directives require a 20% and 30% reduction in energy consumption, respectively, against a base year of 1985. The Coast Guard has been working diligently to establish a reporting system to document such changes through the Finance Center (FINCEN). FINCEN is in the process of installing a Coast Guard-wide energy accounting and reporting software package which will eventually enable tracking and reporting of energy costs and consumption, and the ability of CG unit commanders and engineers to view energy data via the Coast Guard Intranet.

Facility managers must review billing records back to 1985 to document consumption and savings to date. If records are available back to 1985, care must be taken to account for consumption increases that are the result of a changed mission or a building changes. If records are not complete back to 1985, and the 1985 baseline cannot be readily established given a reasonable effort, the earliest following year should be selected. At a minimum, managers should use the results of comprehensive energy audits as a means of establishing an accurate baseline which can be used as a comparison for future performance.

Energy program reports will be developed by MLC's and HQ Units and submitted in accordance with the schedule in Appendix C. G-SEC will review and forward the information for submission to DOE and EPA.

A. DOE Measurement and Verification (M&V) Guideline for Federal Energy Projects

The DOE Measurement and Verification (M&V) Guideline for Federal Energy Projects, DOE/GO-10096-248, provides procedures and guidelines for quantifying savings that result from the implementation of Energy Conservation Measures (ECM's). It provides an overview of M&V options and procedures and standardized M&V methods for common types of ECM's. The M&V Guidelines help to provide verification of energy savings at a minimum of cost, and are intended for use with ESPC and utility program projects. The M&V Guidelines address a wide range of project complexities by allowing the user to select one of three approaches. Factors affecting costs of measurement and verification include: (1) number of energy measures implemented; (2) size and complexity of energy conservation measures; (3) number of interactive energy conservation measures; and (4) risk allocation issues.

B. ASHRAE Handbook

Work is underway at ASHRAE on proposed Guideline GPC-14P - Measurement of Energy and Demand Savings. This guideline will provide for reliable measurements of energy and demand savings due to building energy management projects. It will use pre-retrofit and post-retrofit data to quantify the billing determinations used for calculation of energy and demand savings payments to energy service companies, utilities, and others. It

will encompass all forms of energy including electricity, gas, oil, and district heating/cooling. The procedures will encompass residential, commercial, and industrial buildings.

Additional information on monitoring energy performance in buildings can be found in the ASHRAE 1995 Handbook on HVAC Applications, and on the ASHRAE Internet site

C. Energy Program Reporting

The Coast Guard is required to report energy consumption and general progress towards the federally mandated energy reduction goals to the Department of Energy and the Environmental Protection Agency on an annual basis. This reporting requires a variety of information from MLC's and HQ units, from the FINCEN and from G-CFM And G-SEC regarding progress on a number of fronts. MLC's and HQ Units will report to G-SEC as noted in Appendix C. G-CFM and G-SEC shall coordinate and consolidate field reporting, and keep additional data calls to a minimum level.

D. Awards and Incentives

A number of award and incentive programs are available through federal government and Coast Guard programs. These award programs are designed to recognize the achievements of individuals and facilities in the implementation of conservation measures and the efficient use of energy and water. Provided below in the following sections are brief summaries of some of the award programs participating for which Coast Guard facilities are eligible.

1. Annual DOE energy efficiency and water conservation awards

DOE's Federal Energy Management Program (FEMP) in conjunction with the Federal Interagency Energy Policy Committee offers annual Federal Energy and Water Management Awards. These awards are presented to individuals, small groups, and organizations for outstanding performance in the following categories:

- Energy Efficiency/Energy Management
- Renewable Energy
- Energy Savings Performance Contracting
- Mobility Energy Efficiency
- Water Conservation
- Cost-Beneficial Landscaping Practices

The Coast Guard may submit up to 30 nominations annually for these awards. In addition, FEMP offers Special Awards for Exceptional Service to individuals responsible for creating and instituting energy or water conservation projects, programs, or technologies. The Coast Guard may submit only one nomination for the Exceptional Service Award. MLC's and HQ units shall submit all energy-related award nominations to G-SEC, who will review and forward them to the appropriate

agency.

Nomination forms and criteria for the awards are available from DOE's FEMP world-wide-web page (see Appendix A for the Internet address). Generally, nominations are due in May for awards for the current fiscal year, but these awards will be based on performance during the previous fiscal year (i.e. nominations for FY 98 awards are due in May 1998 for accomplishments during FY 97). G-SEC shall issue an annual call for nominations.

2. **EPA Energy Star Buildings Award**

Each year EPA selects a number of Energy Star Building and Green Lights Participants for the Energy Star Buildings and Green Lights Partner and Ally of the Year awards. These awards are presented to participants whose upgrade and communications efforts "exemplify true environmental leadership". Applications for the awards are mailed to participants in September of each year. The deadline for applications is generally early December. MLC's and HQ units shall submit all energy-related award nominations to G-SEC, who will review and forward them to the appropriate agency. Additional information is available on the Energy Star Buildings internet page (see Appendix A for the Internet address).

3. **USCG Civilian & Military Personnel Awards**

All Coast Guard managers are strongly encouraged to recognize energy leaders through the well established civilian and military personnel awards programs. Awards can take the form of cash personnel performance awards, on-the-spot cash awards, military awards, letters of recognition, commendations, or step increases. Supervisors should also consider time-off as an incentive award or non-monetary awards such as letters of commendation or appreciation and departmental or Coast Guard honorary awards, in accordance with the Coast Guard Civilian Awards Manual, COMDTINST M12341.1B

Managers shall include energy management where appropriate in civilian and military job descriptions, particularly for facility engineering staff and personnel at CEU's, MLC's and HQ Units with energy responsibilities, and recognize performance through critical job elements and Officer Evaluation Reports (CG-5310).

agency.

Nomination forms and criteria for the awards are available from DOE's FEMP world-wide-web page (see Appendix A for the Internet address). Generally, nominations are due in May for awards for the current fiscal year, but these awards will be based on performance during the previous fiscal year (i.e. nominations for FY 98 awards are due in May 1998 for accomplishments during FY 97). G-SEC shall issue an annual call for nominations.

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Managers shall include energy management where appropriate in civilian and military job descriptions, particularly for facility engineering staff and personnel at CEU's, MLC's and HQ Units with energy responsibilities, and recognize performance through critical job elements and Officer Evaluation Reports (CG-5310).

VIII. References

A. Laws, Regulations, and Orders

10 CFR 435, Energy Conservation Voluntary Performance Standards for New Buildings; Mandatory for Federal Buildings

10 CFR 436, Federal Energy Management and Planning Programs

Energy Policy Act of 1992 (EPAct), PL-102-486, Oct. 24, 1992

Executive Order 12902

U.S. Department of Transportation, U.S. Coast Guard Commandant Instruction 4100.2D. Energy Management.

U.S. Department of Transportation, U.S. Coast Guard Greenlights Memorandum of Understanding.

U.S. Department of Transportation, U.S. Coast Guard Shore Facilities Project Development Manual - COMDTINST M11010.14

U.S. Department of Transportation, U.S. Coast Guard Civil Engineering Manual COMDTINST M11000.11A

B. Applicable ASHRAE standards:

ASHRAE Standard GPC-14P, Measurement of Energy and Demand Savings.

ANSI/ASHRAE Standard 55-1992, Thermal Environmental Conditions for Human Occupancy

ASHRAE Standard 62-1989, Ventilation for Acceptable Indoor Air Quality.

ASHRAE/IESNA Standard 90.1-1989 (and addenda), Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings (IESNA cosponsored)

ASHRAE Standard 90.2-1993, Energy Efficient Design of New Low-Rise Residential Buildings

ASHRAE Standard 100-1995, Energy Conservation in Existing Buildings

ASHRAE Standard 105-1984 (RA 90), Standard Methods of Measuring and Expressing Building Energy Performance (ANSI approved)

C. Department of Energy/FEMP Guidelines and Workshops

U.S. Department of Energy, Office of Federal Energy Management Programs (FEMP). Measurement and Verification (M&V) Guideline Federal Energy Projects, DOE/GO-10096-248, February, 1996.

U.S. Department of Energy, Office of Federal Energy Management Programs. SAVEnergy Action Plan Specific Requirements. FEMP Architect's and Engineer's Guide to Energy Conservation in Existing Buildings, Volumes

1 and 2, DOE/RL/01830P-H4

Measurement and Verification (M&V) Guideline for Federal Energy Projects, DOE/GO-10096-248, February, 1996.

North American Energy Measurement and Verification Protocol, DOE/EE-0081, March 1996.

Financing Federal Energy Efficiency Projects

FEMP University classes:

1) Operations and Maintenance Management
2) Facility Energy Decision Screening (FEDS)
3) Water Resource Management
4) Renewable Energy Projects
5) Energy Savings Performance Contracting
6) Federal Energy Management
7) Federal Relighting Initiative
8) Designing Low Energy Buildings
9) Life-Cycle Costing/ASEAM PowerDOE

TeleFEMP Broadcasts - part of an ongoing educational outreach program by FEMP designed to get the word out on saving energy and money. Information on the next broadcast can be obtained by calling the number in Appendix A.

D. **EPA Guidelines**

USEPA Energy Star Buildings Manual. A Guide For Implementing The Energy Star Program. EPA 430 B-95-007. July 1995.

USEPA Green Lights Lighting Upgrade Manual. US EPA office of Air and Radiation 6202J. EPA 430-B 95-003. January 1995.

E. **Energy Analysis Software**

Please see Appendix D for a listing of commonly available software.

F. **Journals and Trade Magazines**

ASHRAE Journal
Energy Engineering Journal

G. **Associations**

Air-Conditioning and Refrigeration Institute (ARI)
Air Movement and Control Associates, Inc. (AMCA)
American Gas Association (AGA)

American National Standards Institute (ANSI)

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)

Association of Energy Engineers (AEE)

International Association for Energy-Efficient Lighting (IAEEL)

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

The American Society of Mechanical Engineers (ASME)

Underwriters Laboratory, Inc. (UL

Appendix A. List of Contacts for Additional Information

In addition to the contacts provided in this appendix, please visit the Coast Guard Facilities Energy Web Page under the CG Intranet, G-SE site.

ASHRAE standards and other publications

Address: American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
1791 Tullie Circle NE
Atlanta, GA 30329-2305

Telephone: 404-636-8400
Toll Free: 800-527-4723
Fax: 404-321-5478
World-Wide-Web: http://www.ashrae.org

DOE: **Energy Efficiency and Renewable Energy Clearinghouse**
Address: P.O. Box 3048
401 M Street, SW (6202J)
Merrifield, VA 22116-0121
Telephone: 800/DOE-EREC
800-363-3732
Fax: 703-893-0400
TDD: 800-273-2957
World-Wide-Web: http://www.eren.doe.gov

Federal Energy Management Program (FEMP):
DOE/FEMP guidelines and other publications:
Address: U.S. Department of Energy
Federal Energy Management Program, EE-90
100 Independence Avenue, SW
Washington, DC20585-0121
Telephone: 202-586-5772
or: 202-586-7755
Fax: 202-586-3000
World-Wide-Web: http://www.eren.doe.gov/femp

FEMP University classes:
Address: FEMP Training Programs/Workshops
Telephone: 202-586-8017

TeleFEMP Broadcasts: (part of an ongoing educational outreach program by FEMP designed to get the word out on saving energy and money).
Telephone: 202-289-2201

EPA: **Energy Star Buildings Program:**
Address: Manager, Energy Star Buildings Program
US EPA Atmospheric Pollution Prevention Division
401 M Street, SW (6202J)
Washington, DC 20460
Telephone: 202-775-6650
Fax: 202-233-9575
Toll Free: 888-STAR YES
888-782-7937
World-Wide-Web: http://www.epa.gov/energystar.html

Green Lights Program:
(for information on EPA books, software, and training opportunities)
Address: Manager, Green Lights Program
US EPA Atmospheric Pollution Prevention Division
401 M Street, SW (6202J)
Washington, DC 20460
Telephone: 202-775-6650
Fax: 202-233-9575
Toll Free: 888/STAR YES
888-782-7937
World-Wide-Web: http://www.epa.gov/greenlights.html

EPA Green Lights Technical Hotline:
Telephone: 202-862-1145
Fax: 202-862-1144

Other Useful Numbers:

NREL:
(To apply for a SAVEnergy Audit)
Telephone: 202-651-7536.

Association of Energy Engineers:
(for a catalogue of energy-related books and journals)
Address: Association of Energy Engineers
4025 Pleasantdale Road
Atlanta, GA 30340
Telephone: 770-925-9558
To order "Catalogue of Energy Saver Bulbs"
Telephone: (800) DLA-BULB
(800) 352-2852

Pacific Northwest Laboratories:
To Order **"FEDS Software"**
World-Wide-Web: http://www.pnl.gov

GSA: **Energy Efficient Products**
World-Wide-Web: http://www.gsa.gov/
List of Utility Companies with Area-Wide Agreements
World-Wide-Web: http://www.gsa.gov/pbs/xu/puindex.htm

Appendix B. ESPC Guidance
(To be developed by G-CFP)

Appendix C.

Annual Energy Program Reporting Requirements for MLC's and HQ Units
Energy Reporting Summary

Reporting	Information Summary	Reporting Period	Report Deadline1	Reporting Format

DOE Reporting Program:	• Energy Audit Activity (sq. ft. & % of s.f. completed)
	• Projected completion dates for remaining audits
	• # of Energy Projects Completed this FY
	• Cost of projects implemented this FY
	• Calculated Annual Energy Savings Calculated Annual Dollar Savings
	• ESPC's Completed
	  • Location
	  • Contract $ amount
	  • Term of contract
	• Other ESPC's planned
	• $ amount of utility rebates received
	• # of meters installed
		Fiscal Year	15 October	MS Excel Spreadsheet

EPA Energy Star Pilot Buildings Program Reporting:	• Upgrade Cost Information • Annual Energy Use and Costs • Completed Stages of Energy Star Buildings Program • Changes Relative to Baseline Years	Fiscal Year	15 October	Energy Star Buildings Annual Facility Report Form
Energy Program Implementation Schedule	• List of all energy projects with 10 year or less simple payback • Cost of project • Fiscal Year of project implementation • Projected annual energy and dollar savings • Source of funding	Fiscal Year	15 October	MS Excel Spreadsheet
FEEF Projects Implemented	• List of projects implemented • Project costs Estimated annual energy Savings • Estimated annual dollar savings	Fiscal Year	15 October	MS Excel Spreadsheet
New FEEF Projects	• List of projects for next FY	Fiscal Year	15 August	MS Excel Spreadsheet

Note: Electronic spreadsheet templates for energy program reporting shall be provided to MLC's and HQ Units by G-SEC.

Appendix D
Energy Analysis Software

Software	Distributor/Author	Function	Summary
	Lennox	Building energy efficiency	Analysis of energy efficiency in buildings.
AIRMASTER	Washington State University (WSU/CE) For more information, contact the AIRMASTER Website 800-373-2139	Microsoft Excel-based software for analyzing the cost-effectiveness of a particular compressor configuration	Helps users to determine when it is cost-effective to reduce plant air leaks, install or adjust unloading controls, reduce system pressure, sequence compressors, and reduce run time.
ASEAM		Building energy use and building design analysis	Parametric Simulations for Building Design Analysis. Analyzes energy use in commercial and residential buildings.
ASHRAE 90	ASHRAE	Building energy efficiency	Analysis of energy efficiency in buildings.
BALLASTMASTER	Washington State University Cooperative Extension (WSU/CE) Energy Program 800-373-2139	Provides a catalog of over 4,600 fluorescent lighting ballast combinations	Allows users to compare the cost of two alternative ballasts, taking into account the savings that result from better energy efficiency.
BLAST	Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign 217-333-3977 Email: support@blast.bso.uiuc.edu	Building Load Analysis and System Thermo-dynamics	Predicts heating and cooling energy consumption in buildings and analyzes energy costs. Contains three subprograms: Space Load Predicting, Air Distribution System Simulation, Central Plant Simulation.
BLCC	NIST. Available from DOE FEMP Office at 800-363-3732 or http://www.eren.doe.gov/femp	Building Life-Cycle Cost Analysis	
BTU Analysis PLUS	Enchanted Tree Software 910-882-6255 A trial SHAREWARE version can be down-loaded	Heat load calculation	Utilities on easy-to-learn user interface to do comprehensive heat load studies with hardcopy printouts of the results. Designed for heating, air-conditioning, heat pump, and commercial studies.
DOE II			

Appendix D
Energy Analysis Software

Software	Distributor/Author	Function	Summary
ENACT	Illinova Energy Partners (ownership of this software has been transferred to Illinova from WSU/CE Energy Program)	Energy Accounting Software	
ENVSTD		Building envelope performance analysis	
FEDS	DOE FEMP Office Order from 800-363-3732 or http://www.eren.doe.gov/femp	Program to analyze and optimize proposed building energy technologies	Federal Energy Decision Screening. Takes into account the effects of interactive technologies and can simultaneously analyze the mutual effects of hundreds of energy conservation opportunities.
HAP	Carrier E20-11	HVAC System Analysis	Energy analysis and hour analysis program.
HBLC	Department of Mechanical and Industrial Engineering, University of Illinois at Urbana-Champaign 217-333-3977 Email: support@blast.bso.uiuc.edu	Interactive program for producing BLAST input files.	Heat Balance Loads Calculator. Allows to visualize the building model as it is developed and modify previously created input files. Makes process of developing BLAST input files more initiative and efficient.
HEATMAP	Washington State University (WSU/CE) 360-956-2016 360-956-2014	Performs a comprehensive simulation of existing and proposed district heating and cooling (DHC) systems. Uses an AutoCAD map of the facility for input.	Provides extensive technical, economical, and air emission information about a DHC application that may be used to evaluate existing system performance, model alternative system strategies, or plan the development of a new project. Helps determine the savings from insulation, steam trap replacement, pipe replacement, steam to water conversion, and summer shutdown.
LTGSTD		Lighting performance analysis	Lighting performance for ASHRAE 90.1
MOTORMASTER+	DOE 800-862-2086	Provides price and performance information for over 10,000 currently available NEMA Design B motors.	Allows users to quickly and easily list electric motors that meet the criteria for a particular application and to compare the cost of an energy efficient motor to that of a standard motor.
POWERDOE	DOE		
ProjectKalc	US EPA	Lighting upgrade analysis	Provides full analysis of lighting upgrades including

Appendix D
Energy Analysis Software

Software	Distributor/Author	Function	Summary
	1-888-STAR-YES or download from www.epa.gov/energystar.html		comprehensive energy and economic analysis of upgrades involving controls, relamping, delamping, etc.
QuikChill	US EPA 1-888-STAR-YES or download from www.epa.gov/energystar.html	Chiller upgrade analysis	Provides assessment of centrifugal chiller upgrades. Performs full economic and energy analysis of potential upgrade scenarios. Can handle upgrades to complex chiller plants without needing complex building data.
QuikFan	US EPA 1-888-STAR-YES or download from www.epa.gov/energystar.html	Variable air volume system upgrade cost analysis	Easy-to-use software tool for assessing cost-effectiveness of upgrades to variable air volume systems. Does not require complex building data.
QuikPlan	US EPA 1-888-STAR-YES or download from www.epa.gov/energystar.html	Building upgrade planning and tracking for ***EPA ENERGY STAR Building*** Partners	Planning, managing, tracking and reporting building upgrades. Provides quick and simple method to organize multiple projects and track aggregate benefits. Produces reports to fulfill reporting requirements of ENERGY STAR Buildings program.
ReportKalc	US EPA 1-888-STAR-YES	Reporting program for ***EPA Green Lights*** program	Electronic reporting program for Green Lights Partners. Organizes project data and fulfills reporting requirement. Inputs hardware information and provides wattage data for common lighting hardware combinations.
TRACER	Trane	HVAC System Analysis	Budget and HVAC system analysis.
WATTSUN	Washington State University 800-373-2139	Calculates building heat loss and annual space heat energy use.	Documents energy code compliance for new residential buildings. Helps evaluate options for insulation, building tightness, passive solar design, and heating system efficiency. Widely used program in the Pacific Northwest.
WINLCCID 96	Department of Defense	Life-Cycle Cost Analyses (LCCA)	Allows an analysis based on standard DoD procedures and annually updated escalation factors as well as Energy Conservation Investment Program (ECIP) LCCA.

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Shore Facilities Energy Manual

COMDTINST M11000.7