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The Federal Commitment to Green Building:
Experiences and Expectations

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The Federal Commitment to Green Building:
Experiences and Expectations

Summary

This report assesses, for the first time, what the Federal government is doing, in policy and practice, to make its buildings more environmentally sustainable, and provides recommendations for how the Federal sector can make even greater progress.

Why is this important? Green or sustainable building is the practice of designing, constructing, operating, maintaining, and removing buildings in ways that conserve natural resources and reduce pollution. Green building is expanding around the world, and the Federal government is leading by example. This approach is important for the Federal government (and has become one of our office's priorities) for three reasons.

First, buildings affect land use, energy use, communities, and the indoor and outdoor environment. Given the size and scope of Federal buildings – the government owns nearly 500,000 buildings covering 3.1 billion square feet, accounting for 0.4 percent of the nation's energy usage, and emitting about 2 percent of all U.S. building-related greenhouse gases – we have the opportunity and responsibility to reduce these impacts. Using sustainable principles in buildings can reduce these impacts and also improve worker conditions and productivity, increase energy, water, and material efficiency, and reduce costs and risks.

Second, sustainable buildings can be showcases to educate people about environmental issues, possible solutions, partnerships, creativity, and opportunities for reducing environmental impacts in our everyday lives. Hundreds of millions of people visit and work in Federal facilities each year. And third, green buildings represent the application in one place of many of the sustainable concepts the Federal government is working on – such as environmental management systems, waste prevention and recycling, and green product purchases.

We prepared this report because there is no other single source of information about what all the Federal government is doing to "green" its building stock, and, by doing so, we hope to spark discussion and create opportunities for greater Federal stewardship.

How are we doing? The Federal government has several key green building policies in place and have already achieved some great successes.

Tools. The Energy Policy Act of 1992 and Executive Order 13123 require Federal buildings to reduce their energy use by 35 percent by 2010 (compared to 1985). Executive Order 13123 also requires Federal agencies to "apply [sustainable design] principles to the siting, design, and construction of new facilities." The Office of Management and Budget's Circular A-11 encourages agencies to incorporate Energy Star® or LEED™ (the U.S. Green Building Council's Leadership in Energy and Environmental Design rating system) into designs for new building construction and renovations. And nine agencies/departments now use LEED™ or a similar tool for their new projects: General Services Administration, Army, Navy, Air Force, Environmental Protection Agency, National Aeronautics and Space Administration, National Park Service, Department of State, and Department of Health and Human Services.

Results. Through these policies and the efforts of many, Federal buildings have reduced their energy intensity by 23 percent and cut their carbon emissions by 2.8 million metric tons (like removing 2.1 million vehicles from the road in one year), since 1985. Today, more than 110

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Federal buildings are now Energy Star® rated, eight Federal buildings already have been LEED™ certified, and more than 60 Federal buildings are undergoing LEED™ certification.

Where are we headed? The report identifies several barriers to improved progress, none of which appears to be insurmountable. Below are several options for moving forward:

Budget. Statutes and Office of Management and Budget guidelines call for life cycle cost-based analysis (to address such items as long-term energy, water, and other utility operating costs; operation, maintenance and repair/replacements costs; worker health costs; and more) for Federal capital investments, yet first-cost decisions often prevail and impede greener building opportunities. We need clear guidance and implementation policies, increased education of Congress and agency officials, and increased use of performance-based standards and life cycle costing.

Education. We need to inform key audiences more effectively about green buildings. This work should not only target Congress and senior agency officials but also should include development of training and workshops on environmental design, training tools and information for on-line access, and a green building module for agency environmental management systems.

Research. To better understand the benefits and costs of green building, we need to know more about their impact on worker productivity and health and how well they actually perform over time, we need to expand the coverage of additional products by various life-cycle analysis tools, and we need to identify best practices for indoor environmental quality.

Metrics. We need to continue to offer our expertise to standards organizations as they develop and improve green product standards, and to the U.S. Green Building Council in developing and improving their LEED™ rating systems for new commercial buildings, existing buildings, multiple buildings, core and shell, commercial interiors, laboratories, and homes.

Coordination and Integration. To make these improvements, we need to do a better job of coordinating and integrating this work and these opportunities across the Federal government. We should create a senior interagency green building group to lead this work, which group should include at least the Office of Management and Budget, the General Services Administration, the Department of Energy, the Environmental Protection Agency, and the Department of Defense. The interagency group should provide strategic direction to Federal agencies and identify the tools needed for them to effectively develop and implement green building strategies, including consideration of whether an executive order is appropriate. Among other issues, the group should address energy efficiency minimums, healthy indoor designs, water stewardship, building commissioning, improving and meeting LEED™ and using other tools, metrics, and monitoring, benchmarking, and reporting.

My hope is that this report – highlighting the progress that the Federal government already has made and offering recommendations for discussion and action – will serve as a solid foundation for even greater, more sustainable Federal government buildings. Working together, we can achieve this important goal.

John L. Howard, Jr., Federal Environmental Executive

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Introduction

Federal buildings not only provide space for Federal activities and workers—they also serve as symbols of the country's ideals and priorities. Given that these structures and their sites have tremendous impacts on our natural environment, our economy, and worker productivity and health, the Federal government is rethinking how it builds today to enhance the future. Federal building professionals are exploring opportunities to minimize habitat disturbance and optimize energy, water, and materials use during the siting, construction, renovation, and operation of buildings. In addition, the Federal government is striving to create healthier indoor environments by specifying environmentally preferable building products and designing buildings to maximize natural daylighting and ventilation.

The Federal government should provide leadership in environmental design and construction in order to ensure America's future prosperity and resource independence and lay the foundation for environmentally, socially, and economically sustainable development throughout the U.S. and the world.

Recognizing this opportunity, in 2002, the Office of the Federal Environmental Executive (OFEE), a Task Force of the White House Council on Environmental Quality, adopted sustainable building as one of its six priority areas. Created a decade ago, OFEE was originally tasked with focusing on promoting waste prevention, recycling, and the purchase of recycled content and environmentally preferable products by the Federal government. Today, waste prevention, recycling and green purchasing remain a major focus, and OFEE has expanded its effort to embrace the more holistic mission of promoting *sustainable environmental stewardship* throughout the federal government.

Green buildings represent the application of many stewardship concepts on which our office is working. Environmental management systems help an organization realize its priority environmental issues and develop objectives to address them—a perfect opportunity during the siting, design, construction, renovation, or operation of a building. Recycling and the use of green products are critical elements of any green building. And green buildings can embody industrial ecology concepts that encourage us to emulate nature in efficiently using and re-using resources.

Beyond these environmental imperatives, green Federal buildings can also be showcases to educate the millions of people who visit and work in Federal facilities each year about environmental issues and creative solutions.

With these goals in mind, OFEE developed this report to document for the first time green building practices, policies, and tools currently used by the Federal government; identify barriers to Federal green building; and provide recommendations for overcoming those barriers.

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Report Methodology

Earlier this year, OFEE interviewed knowledgeable officials at selected Federal agencies to determine the status of green building within the Federal government. Agencies were chosen based on their size and reputation for actively working to green their facilities. Although most agencies did not have information available to fully answer every question, the questionnaire provided a framework to stimulate discussion about the agency's building inventory and green building programs.

In addition to requesting baseline information, OFEE asked the agencies to list current green building initiatives, discuss barriers to success, and identify requirements for greater progress. Information gained from this survey was supplemented with considerable web-based research on agency building programs. Here are the specific questions we asked within each of the four main areas of the survey:

Baseline Data

- How are responsibilities for green buildings (e.g., construction, facilities management and environmental) divided among different parts of the agency?
- How many buildings do they occupy?
- How much square footage?
- What types of buildings (e.g., operational, industrial, training, administrative buildings) predominate?
- How many buildings are owned versus leased?
- Every year, how many buildings do they:
    - Build?
    - Renovate?
    - Demolish?
    - Sign new leases for (as lessee)?

Current Green Building Initiatives

- What policies, guidelines, directives and programs exist to promote green building across their agency?
- How many buildings have significant green features? Is information (e.g., case studies, design guidelines) available for these buildings?
- What websites, publications, etc., does the agency have about green buildings?

Barriers to Greater Success

What types of barriers (including the following) impeded greater success?

- Bureaucratic
- Financial

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- Technical
- Cultural
- Other (please specify)

Requirements for Greater Progress

- In what ways or areas do you think the Federal government is making the most progress in greening building?
- What do you consider to be lacking in current Federal green building programs?
- Discuss opportunities to do more and better.
- Identify ways to deal with financial issues (make goals attainable).
- Describe how bureaucratic barriers can be addressed.
- What are appropriate goals for the Federal government (e.g., define in terms of LEED™ level)?
- Should goals be set for new buildings only, or for existing and leased space as well?
- Discuss how to institutionalize goals (e.g., through an Executive Order).
- What role can the Office of the Federal Environmental Executive play?
- What additional information, networking, coordination tools are needed?

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Defining Green Building

The green building movement has its roots in the energy crisis of the 1970s and the creative approaches to saving energy that came with it, including the use of active and passive solar design and tighter building envelopes. Today, as a holistic approach in which energy remains a critical component, green design also considers other environmental impacts as they relate to sustainability.[1] Thus, green building requires an integrated design approach: focusing on only one component of a building can have unintended environmental, social, or economic consequences. For example, poorly designed energy efficient building envelopes can result in poor indoor environmental quality. And, some recycled content latex paint could have higher volatile organic compound (VOC) emissions than other environmentally preferable paints. An interdisciplinary team is thus necessary to build a green building.

Zion National Park Visitor Center in Springville, Utah is a sustainable building that incorporates the area's natural features and energy-efficient building concepts into an attractive design that saves energy and operating expenses while protecting the environment.

For the purposes of this report, OFEE defines green building as the practice of (1) increasing the efficiency with which buildings and their sites use energy, water, and materials, and (2) reducing building impacts on human health and the environment, through better siting, design, construction, operation, maintenance, and removal—the complete building life cycle.

[1] Truly sustainable design recognizes the environmental, economic, and social aspects of building. While this report focuses on the *environmental* "leg" of this three-legged stool, the concepts are closely interrelated and the Federal government is approaching many design challenges with *sustainability* in mind.

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The Need For Green Building

Buildings in the United States have a significant impact on the environment and account for:

Energy[2]

- 37 percent of primary energy use
- 68 percent of all electricity use

Materials Use[3]

- 60 percent of non-food/fuel raw materials use

Waste

- 40 percent of non-industrial solid waste[4] or 136 million tons of construction and demolition debris per year[5]
- 31 percent of mercury in municipal solid waste[6]

Water

- 12 percent of potable water use[7]
- 36 billion gallons of water per day[8]
- 20 percent loss of potable water in many urban systems due to leakage[9]

Air Quality[10]

- 35 percent of carbon dioxide emissions
- 49 percent of sulfur dioxide emissions

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[2] Monthly Energy Review, March 2001, Energy Information Administration, U.S. Department of Energy.
[3] USGS Factsheet FS-068-98, *Materials Flow and Sustainability*, June 1998. See <**http://greenwood.cr.usgs.gov/pub/fact-sheets/fs-0068-98/fs-0068-98.pdf**>.
[4] U.S. EPA Characterization of Building-Related Construction and Demolition Debris in the United States, July 1998, and U.S. EPA Municipal Solid Waste in the United States: 2000 Facts and Figures.
[5] EPA, Characterization of Building-related Construction and Demolition Debris in the United States, 1998. See <**http://www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf**>.
[6] U.S. EPA Characterization of Products Containing Mercury in Municipal Solid Waste in the United States, 1970 to 2000, April 1992.
[7] U.S. Geological Service, 1995 data.
[8] USGS, Water Use in the United States, 1995. See <**http://water.usgs.gov/watuse/pdf1995/pdf/domestic.pdf**>
[9] This includes leakage from pipes in the ground, approximately one half of which are owned by the building-owner. Congressional Budget Office. *Future Investment in Drinking Water and Wastewater Infrastructure*. May 2002.
[10]See DOE's Center for Excellence for Sustainable Development website at <**http://sustainable.doe.gov/buildings/gbintro.shtml**>.

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- 25 percent of nitrous oxide emissions
- 10 percent of particulate matter emissions

From siting and construction through operation, maintenance, renovation, and demolition, buildings impact many aspects of the environment. And buildings, where people spend 90 percent of their time, can also adversely impact human health.[11] Green building involves minimizing these negative environmental and human health impacts and enhancing positive results throughout the building's entire life cycle.

The new General Services Administration Federal Building in San Francisco will feature windows that open, shared spaces between offices, lots of natural light, and many energy saving measures. The building has been designed to reduce energy costs by 45 percent and is expected to save $500,000 per year in taxpayer dollars.

In addition to environmental benefits, through integrated design, green buildings can be constructed at the same or lower cost than conventional buildings. According to a Pacific Northwest National Laboratory analysis in which two prototype buildings were compared, energy and water efficiency measures alone can reduce annual costs by almost $10,000 in a 20,000 square foot building.[12] Furthermore, design features that simplify space reconfigurations over the life of the building can result in an additional $35,000 in annual cost savings.[13]

[11] EPA, Indoor Air Pollution: An Introduction for Health Professionals, 1994. See <**http://www.epa.gov/iaq/pubs/hpguide.html**>.
[12] The Business Case for Sustainable Design in Federal Facilities. FEMP. August 2003.
[13] Ibid.

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The Federal Context

The Federal government owns approximately 445,000 buildings with total floor space of over 3.0 billion square feet, in addition to leasing an additional 57,000 buildings comprising 374 million square feet of floor space.[14] And so, while the imagery of the Pentagon or the Capitol may prevail in our minds, the average size of a Federal building is only about 6,700 square feet.

Federal buildings vary widely—including, for example, National Park visitor centers, Army barracks, single-family homes, Air Force hangars, post offices, veterans' hospitals, embassies, laboratories, prisons, warehouses, schools, border stations, data processing centers, and every variety of office building. Military buildings predominate, comprising two-thirds of all Federal buildings and floor space. Within the military, residential structures predominate, followed by buildings used for service, storage, office space, and schools.[15]

The sustainable features of this Navy residential facility in Norfolk, Virginia will include site restoration, additional stormwater-management features, graywater recycling, high-efficiency HVAC and lighting systems, and energy-recovery systems.

The Army represents nearly half of all Department of Defense (DoD) buildings, with the Navy representing another third. With the Air Force, Marines, and Office of the Secretary of Defense accounting for only about one fifth of all DoD buildings, they still represent more buildings than any civilian Federal agency. Among civilian (non-defense) agencies, the Postal Service (USPS) leads in square footage, followed by the General Services Administration (GSA), Department of Veterans' Affairs (VA), Department of Energy (DOE), Department of Justice (DOJ), Department of the Interior (DOI),

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[14]Federal Real Property Profile as of September 30, 2002. General Services Administration, Office of Government-wide Policy.
[15]Ibid.

Department of Agriculture (USDA), Department of Transportation (DOT), and National Aeronautics and Space Administration (NASA). As shown in Table 1, these nine civilian agencies plus DoD represent more than 95 percent of all Federal square footage.[16]

Beyond the military, office space is the predominant use. The Federal government owns an estimated 30,000 office buildings covering 644 million square feet—four percent of all office buildings covering around five percent of all office floor space in the U.S.[17] GSA, "the government's landlord," owns and/or operates more than 8,300 buildings comprising 330 million square feet of office space.[18] Fifty-five percent of GSA's building square footage is government-owned, and the rest is in privately-owned, leased facilities. Individual agencies own or lease the remaining buildings.[19]

The site of this U.S. Courthouse in Youngstown, Ohio was formerly classified as a Brownfield Site. All of the earth excavated from the project site was reused on site; and the roof of the facility was painted white which minimizes the artificial heat impact on the environment.

Table 1:

Federal Facilities for which the Government Purchases Energy
~Preliminary Fiscal Year (FY) 2002 Data[20]~

Federal Agency	Building Sq. Ft. (Thou.)	Percentage of Total Sq. Ft.	Energy Use (Trillion Btu)	Energy Cost (Million $)
Department of Defense	2,183,665.2	64.2%	244.0	$2,614.1
U.S. Postal Service	349,547.0	10.3%	25.8	$465.6
General Services Administration	206,534.3	6.1%	17.4	$275.9
Department of Veterans Affairs	156,359.5	4.6%	26.9	$279.2
Department of Energy	102,201.7	3.0%	29.1	$287.9

[16]Ibid.
[17]DOE, Energy Information Administration, 1999 Commercial Buildings Energy Consumption Survey. See <**http://www.eia.doe.gov/emeu/cbecs/pdf/b12.pdf**>.
[18]See GSA's Public Buildings Service website at <**http://www.gsa.gov/Portal/content/orgs_content.jsp?contentOID=22883&contentType=1005**>.
[19]Ibid.
[20]Annual Report to Congress on Federal Government Energy Management and Conservation Programs: Fiscal Year 2000. FEMP. December 2002.

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Department of Justice	59,436.9	1.7%	10.4	$108.0
Department of the Interior	56,086.4	1.6%	4.9	$61.2
Department of Agriculture	55,612.1	1.6%	4.6	$56.3
Department of Transportation	52,732.4	1.6%	7.4	$142.0
National Aeronautics & Space Administration	38,413.5	1.1%	9.3	$112.1
Tennessee Valley Authority	31,658.4	0.9%	2.1	$36.5
Department of Health & Human Services	26,311.4	0.8%	7.8	$75.3
Department of Labor	21,476.2	0.6%	4.3	$29.3
Department of the Treasury	16,543.3	0.5%	2.6	$38.5
Department of Commerce	11,682.5	0.3%	1.8	$25.3
Environmental Protection Agency	3,232.5	0.1%	1.0	$11.0
Other	27,925.7	0.8%	4.6	$50.3
Total	3,399,419.0	100.0%	404.0	$4,668.6

Given this enormous real estate portfolio, the Federal government is a major contributor to the resource use and pollution associated with buildings. The total Federal facility inventory consumes about 119,000 Btu of energy per gross square foot per year and emit greenhouse gases at a rate of 11.6 million metric tons of carbon equivalent (MMTCE) per year, about two percent of the total for all U.S. buildings.[21] In FY 2002, Federal facility energy use constituted 404 trillion British Thermal Units (Btu), at a cost of almost $4.7 billion or about $10,000 per building on average—making the Federal government the largest single energy user in the country.[22]This amount of energy would provide enough fuel for 6.6 million US cars to each drive once around the world![23] Just five agencies account for 90 percent of all Federal building energy use: DoD (60.4 percent), DOE (7.2 percent), VA (6.7 percent), USPS (6.4 percent), and GSA (4.3 percent). On average, Federal buildings consume 40 percent more energy per square foot than non-governmental buildings, perhaps in part due to the fact that many Federal buildings (such as laboratories) house highly energy intensive operations.[24]

In FY 2002, Federal agencies reported using approximately 250 billion gallons of water.[25] Data on Federal construction and demolition debris generation are not available, although the fact that the Army estimates it has 50 million square feet of unneeded buildings (from planned base closings and renovations) indicates the potential for massive amounts of demolition debris to be generated if waste reduction options are not implemented.[26] Comprehensive data on indoor air quality levels, environmentally preferable building product acquisitions, and other environmental indicators are lacking.

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[21]Ibid.
[22]Ibid.
[23] Calculations based on EERE/Buildings Data Book. See <**http://buildingsdatabook.eren.doe.gov/tableview.asp?TableID=434&t=xls**>.
[24] DOE/EIA, Commercial Building Energy Consumption Survey, 1999. See <**http://www.eia.doe.gov/emeu/cbecs/pdf/c3.pdf** >.
[25] Annual Report to Congress on Federal Government Energy Management and Conservation Programs: Fiscal Year 2000. FEMP. December 2002.
[26] U.S. Army, Office of the Assistant Secretary, Installations and the Environment, Memo, Deconstruction and Re-Use of Excess Army Buildings, 1/18/01. See <**http://www.cecer.army.mil/sustdesign/RayClarkMemo.pdf**>.

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Argonne National Laboratory, one of the U.S. government's oldest and largest science and engineering research facilities, is at the forefront in implementing new ways to sustainable buildings practices.

The challenge—to make Federal buildings more sustainable—begins in a context of hundreds of thousands of diverse buildings, serving unique purposes, and owned by numerous agencies, with significant environmental impacts and the opportunity for improvement.

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Federal Government-wide Green Building Policies

Although there is no single, comprehensive government-wide green building standard, Federal agencies are required to implement certain aspects of green building, including energy and water efficiency; use of recycled content, biobased, or other environmentally preferable building products; and waste recycling, including construction and demolition debris. In addition, continual improvement in operational performance of Federal buildings is being sought through the implementation of environmental management systems.

The following is a summary of Federal policies that include provisions for green building:

Resource Conservation and Recovery Act. Section 6002 of the Resource Conservation and Recovery Act (RCRA) requires Federal agencies to give preference in their procurement to the purchase of specific U.S. Environmental Protection Agency (EPA)-designated recycled content products. EPA designates products that are or can be made with recycled materials and also recommends recycled materials content ranges for these products. Designated construction products include: building insulation products; carpet; carpet cushion; cement and concrete containing coal fly ash or ground granulated blast furnace slag; consolidated and reprocessed latex paint; floor tiles; flowable fill; laminated paperboard; patio blocks; railroad grade crossing surfaces; shower and restroom dividers/partitions; and structural fiberboard.[27]

The Energy Policy Act (EPAct) of 1992. EPAct, along with its amendments to the National Energy Conservation Policy Act, forms the statutory basis for Federal energy and water conservation activities. Subtitle F of the EPAct orders Federal agencies to reduce their energy consumption per square foot of building, install energy and water conservation features, track energy and water consumption, and institute systems to facilitate the funding of energy efficiency improvements.[28]

Executive Order 13101. E.O. 13101, *Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*, strengthens and expands the Federal government's commitment to recycling and waste prevention. The Pollution Prevention Act of 1990 established a national policy to prefer pollution prevention, whenever feasible. Pollution that cannot be prevented should be recycled; pollution that cannot be prevented or recycled should be treated in an environmentally responsible manner. Disposal should be employed only as a last resort. E.O. 13101 expanded this perspective of pollution prevention by promoting the increased use of green products, particularly recycled content, environmentally preferable, and biobased products. The Environmentally Preferable Purchasing (EPP) Program[29] promotes Federal government procurement of products and services that have reduced impacts on human health and the

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[27]See EPA's Comprehensive Procurement Guidelines website at <**http://www.epa.gov/cpg**>.
[28]See <**http://www.eere.energy.gov/femp/resources/epacintro.html**>.
[29]See EPA's Environmentally Preferable Purchasing Program website at <**http://www.epa.gov/oppt/epp**>.

environment over their life cycle. The goal of the program is to make environmental performance a factor in Federal government purchasing decisions, along with product performance and cost.

Executive Order 13123. E.O. 13123, *Greening the Government Through Efficient Energy Management*, increased and extended energy efficiency goals by requiring each agency to reduce building energy consumption per square foot by 30 percent by 2005 and 35 percent by 2010 relative to 1985. This E.O. also requires agencies to reduce greenhouse gas emissions related to facility energy use by 30 percent by 2010 (from the 1990 baseline), to meet ENERGY STAR® Building criteria to the maximum extent possible, and to expand the use of renewable energy, among other provisions. DOE's Federal Energy Management Program (FEMP) assists agencies in implementing this Order.[30] E.O. 13123 and subsequent guidance issued pursuant to the E.O. require agencies to:

- Optimize life cycle costs, pollution, and other environmental and energy costs associated with the construction, life cycle operation, and decommissioning of the facility;
- Apply sustainable design principles, as outlined in the WBDG, to the siting, design, and construction of new facilities;
- Incorporate energy-efficient criteria, consistent with ENERGY STAR® and other FEMP- designated energy efficiency levels (i.e., in the top 25th percentile of efficiency), into guide specifications and project specifications for new construction and renovation; and
- Consider using Energy Savings Performance Contracts (ESPC) or utility energy-efficiency service contracts (UESC) to aid them in constructing sustainably-designed buildings.

Executive Order 13134 and the 2002 Farm Bill. E.O. 13134, *Developing and Promoting Biobased Products and Energy*, expands Federal procurement activities and requirements related to biobased products and services. Biobased products are made from renewable agricultural, animal, or forestry materials—such as vegetable-based lubricants, biofuels, compost, and biobased construction materials. The E.O. set a goal of tripling the U.S. use of bioenergy and biobased products by 2010.

On May 13, 2002, President Bush signed into law the *Farm Security and Rural Investment Act of 2002*, Public Law 107-171 (commonly referred to as the 2002 Farm Bill). Title IX of the 2002 Farm Bill requires the U.S. Department of Agriculture (USDA) to establish a biobased products designation purchasing program similar to the RCRA buy-recycled requirements. Once USDA designates a biobased product, Federal agencies that purchase the product must give preference to the product containing the highest level of biobased content practicable, considering price, performance, and availability of the product. USDA is also required to develop a voluntary program for labeling "USDA Certified Biobased Products." Biobased construction products are among those under consideration for designation by USDA.

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[30]DOE/FEMP, Executive Order 13123: Greening the Government Through Efficient Energy Management. See <**http://www.eere.energy.gov/femp/resources/exec13123.html**>.

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Executive Order 13148. E.O. 13148, *Greening the Government Through Leadership in Environmental Management*, established a framework for integrating environmental considerations into each Federal agency's mission through a variety of directives and goals, including implementing environmental management systems, reducing releases of toxic chemicals, and eliminating the procurement of ozone depleting substances. The E.O. requires that an EMS be implemented at appropriate Federal facilities by the end of 2005, based on a facility's size, complexity, and environmental aspects. To facilitate awareness and acceptance of the EMS concept at the facility level, agencies were required to initiate EMS pilots at agency facilities in early 2002. In addition, each agency was required to prepare and endorse a written agency environmental management strategy to achieve the requirements and goals of the Order.

Management system accounting concepts, such as life cycle assessment, environmental cost accounting, and return on investment, are also supported by the Order. Additionally, the Order requires Federal agencies to have a program in place to periodically audit facilities' compliance with environmental regulations. Findings from those audits are to be included in the budget and planning activities of the agency—this will be key in achieving continued high performance of facilities, as well as providing a valuable measure of Federal progress.

OMB Circular A-11. In 2002, recognizing that investments in better building design and construction typically return dividends that will save money over the life of the building, OMB revised Circular A-11, Section 55—Energy and Transportation Efficiency Management— to encourage Federal agencies to incorporate ENERGY STAR® or the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ [31] into up front design concepts for new construction and/or building renovations. Agencies must report if they incur or anticipate incurring additional costs for incorporating these standards.

OFEE works with Federal agencies to help them comply with these and other mandates in order to increase environmental practices, including green building, within the Federal government.[32]

[31] See the U.S. Green Building Council LEED website at <**http://www.usgbc.org/LEED/LEED_main.asp**>.
[32] See the OFEE website at <**http://www.ofee.gov**>.

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Federal Agency Green Building Policies

In addition to being subject to government-wide mandates, many agencies and departments have implemented their own green building policies. In fact, the agencies and departments with the most construction activity and largest number of buildings all have policies that address sustainable design and construction.

Several agencies have indicated that sustainable design principles shall serve as the foundation for planning, programming, budgeting, construction, commissioning, operation, maintenance, and decommissioning of new buildings and for major renovation and alteration of existing buildings and facilities. Many of these policies emphasize the need for energy efficiency, water conservation, and life cycle costing. Also, in accordance with policy within some agencies, award programs and training materials have been developed to encourage and raise the awareness of green building.

An increasing number of agencies and departments are turning to the USGBC's LEED™ rating system as the basis for their green design and construction activities. LEED™ is a sophisticated checklist covering five areas of environmental impact: energy and atmosphere, water efficiency, materials and resources, indoor environmental quality, and sustainable sites. A sixth category, innovation and design process, offers points for creative approaches to sustainable construction. The more points that a building gains based on its design and construction, the higher the rating, ranging from LEED™ Certified to LEED™ Silver, Gold, or Platinum.

The Pentagon Renovation Project's unique acquisition approach, rewards the contractor design-build team for meeting LEED criteria, innovative construction and project management techniques and other factors that lead to successfully completing the most complex renovation project ever attempted by the federal government.

Many agencies require LEED™ Certified as a minimum requirement; others encourage LEED™ Silver as a goal. Some agencies have stated that at least 20 percent of all major construction shall be selected as LEED™ pilot projects by fiscal year 2004 (FY 2004), with increasing percentages of projects until FY 2009, when all construction projects are to be capable of achieving LEED certification. However, while several Federal agencies are embracing LEED™ as their standard of performance, neither LEED™ nor any other system has yet been adopted government-wide. And, as will be discussed later in the report, some view LEED™ as inadequate as a green building standard.

Appendix A: Green Building Policies and *Appendix B: Agency Profiles* provide more information about green building policies within various Federal agencies and departments.

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From Policy to Practice: Promoting Green Buildings

The Federal government has been involved in many elements of green building. As shown in Table 2, it has programs covering such areas as energy efficiency, renewable energy, indoor air quality, water conservation, recycled content, and other environmentally preferable building products, construction and demolition debris, heat island reduction, and non-point source water pollution, as well as diverse programs targeting such audiences as residential builders, commercial builders, community planners, homeowners, schools, and the general business community. These programs cover a wide range of environmental design topics and audiences, but have never been coordinated to form a single comprehensive, unified Federal green building program or standard.

Table 2:
Selected Federal Green Building Programs[33]

Agency	Program	Website	Description
Multi-agency effort	Whole Building Design Guide (WBDG)	**www.wbdg.org**	Gateway to up-to-date information on 'whole building' design techniques and technologies
DOE	Federal Energy Management Program (FEMP)	www.eere.energy.gov/femp	Aids Federal agencies to reduce energy and water use and build green
DOE	Building Technologies	www.eere.energy.gov/buildings	Provides resources for energy efficiency and renewable energy
DOE	Smart Communities Network	www.sustainable.doe.gov	Provides resources on sustainability
EPA	Green Building	www.epa.gov/greenbuilding	Portal website to many sites listed here
EPA	Construction Sector Compliance Assistance	www.epa.gov/compliance/assistance/sectors/construction.html	Provides construction industry compliance assistance information
EPA	Indoor Environments	www.epa.gov/iaq	Conducts research and outreach and develops guidelines to improve indoor environments
EPA	Environmentally Preferable Purchasing	www.epa.gov/oppt/epp	Provides resources to aid Federal purchasing of green products
EPA	Water Efficiency Program	www.epa.gov/owm/water-efficiency	Provides resources to increase residential, commercial, institutional, and industrial water efficiency, including WAVE water management software
EPA	Non-point Source Pollution	www.epa.gov/owow/nps/urban.html	Provides guidance on how to reduce stormwater runoff from the built environment
EPA	Construction and Demolition (C&D) Debris	www.epa.gov/epaoswer/non-hw/debris	Provides resources to reduce, reuse and recycle C&D debris
EPA	Comprehensive Procurement Guidelines	www.epa.gov/cpg	Provides information and guidelines on the Federal purchase of recycled-content products
EPA	Brownfields	www.epa.gov/brownfields www.epa.gov/swerosps/bf/sustain.htm	Provides grants and resources for safe development of polluted sites and supports sustainable brownfields redevelopment

[33]This is not meant to be an all-inclusive list of Federal programs related to green building, but rather to highlight those of most relevance to the greening of Federal facilities.

EPA/DOE	EnergyStar®	www.energystar.gov	Partnership and labeling program for energy-efficient commercial and residential buildings and building products
EPA/DOE	Labs 21	www.epa.gov/labs21century	Provides information on improving the environmental performance of labs
USDA	Biobased Products and Bioenergy Coordination Council	www.ars.usda.gov/bbcc/	Provides a forum for coordinating, facilitating, and promoting research, development, transfer of technology, commercialization, and marketing of biobased products and bioenergy
NIST	Building for Environmental and Economic Sustainability (BEES)	www.bfrl.nist.gov/oae/software/bees.html	Measures environmental and economic performance of building products through life cycle assessment and life cycle costing

Some agencies have developed detailed specifications and guidance to put sustainability principles into practice. The military services, for example, are combining their specifications into one set of Unified Facilities Guide Specifications (UFGS).[34] With input from FEMP, the UFGS technical committees are now revising existing standards to incorporate the FEMP and ENERGY STAR® efficiency criteria for installed equipment.[35] In general, however, Federal agencies maintain their own individual sets of master specifications or guidance, incorporating LEED™ or other green building requirements in different ways and to varying degrees.

Recognizing the need for a comprehensive and consistent approach to incorporating green requirements into Federal building, EPA is teaming up with the Whole Building Design Guide (WBDG)[36] to provide model green construction solicitation provisions and specification language. Currently in draft form, the model green construction guides will help Federal building project managers meet various mandates, as established by statute and Executive Orders, as well as EPA and DOE program recommendations (e.g., regarding recycled content products, energy efficiency, indoor air quality, persistent bioaccumulative toxics, and water stewardship.) In addition, model language will assist Federal agencies in using the LEED™ rating system as a metric. Organized according to the Construction Specifications Institute's MasterFormat™, the tool will provide users with multiple, performance-based options, allowing for flexibility in application. Although promising, this work has yet to be completed and put into use throughout the Federal government.

[34]See the Construction Criteria Base at <**http://www.ccb.org/ufgs/ufgs.html**>.

[35]For example, several sections of the Unified Facilities Guide Specs now incorporate, directly or by reference, the FEMP criteria for energy-efficient chillers, lighting and (ENERGY STAR®) exit signs, transformers, and some motors.

[36]The web-based WBDG, a multi-agency effort managed by the National Institute of Building Sciences (NIBS), provides design guidance to Federal agencies in fulfillment of seven design principles, one of which is sustainability. (The others are accessibility, aesthetics, cost-effectiveness, functionality, productivity, and security/safety.) See <**http://www.wbdg.org**>.

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Agency Trends

Beyond government-wide statistics are the stories of individual agencies' progress and the trends that they signify. In fact, anecdotal information suggests that Federal experience to date follows the typical script for the diffusion of new technologies: "innovators" take the first steps toward introducing new technologies; "early adopters" take the lead in diffusing these technologies for popular use; "the early majority" includes those helping bring the technologies into mainstream use; "the late majority" consists of those who only adopt the technologies when they feel that they must; and, finally, come the "laggards" who resist the technologies even after they are broadly accepted.[37]

Design attributes of the U.S. Fish and Wildlife Service's Cusano Environmental Education Center in Philadelphia; focus on energy, construction materials, and water use. The walkway in this photo shows how the building encourages interaction with the surrounding wildlife preserve while causing minimum impact.

In the government context, the earliest *innovators* include those at government labs like the National Renewable Energy Laboratory (founded as the Solar Energy Research Institute in 1977), and Federal programs like FEMP (chartered in 1973), that were the first to introduce green building concepts to the Federal government, with a focus on energy issues. DOE's Departmental Energy Management Program (originally the In-House Energy Management Program) began funding energy efficiency improvements at DOE buildings in 1978.

In the early 1990s, several programs promoting different elements of green building (such as the Green Lights program, now known as ENERGY STAR®) started to focus on how to translate the often theoretical concepts of green building into common practice. And in 1992, the Energy Policy Act mandated that Federal agencies improve their energy efficiency and develop at least one "showcase" facility highlighting advanced energy efficient and/or renewable energy technologies.

[37]Theory and terminology from: Rogers, Everett M (1995). *Diffusion of Innovations*. New York, The Free Press.

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At around the same time, several *early adopters* among the Federal agencies began the process of incorporating green technologies into their facilities. FEMP demonstrated what could be done at Federal facilities with its high-profile "greening" projects, including the Greening of the White House (begun in 1993), and projects at the Pentagon (begun in 1993) and several National Parks, including the Grand Canyon National Park (1994), Yellowstone (1996), and the Presidio (1995). GSA's Federal Courthouse in Denver (1995) provided yet another showcase facility. At the same time, the Navy and the National Park Service began investigating the concepts of green building with such groups as the American Institute of Architects and instituting pilot projects. Similarly, EPA began to design its green laboratory facilities at Research Triangle Park, NC and develop its Green Lease Rider for its Kansas City Regional Office.[38] In addition, EPA's major renovation of the Ariel Rios Building in Washington, DC for its new headquarters demonstrated its commitment to "practice what it preaches."

The new campus at Research Triangle Park embodies the Environmental Protection Agency's commitment to the environment. Cost, functionality and environmental impact were kept in balance when selecting materials and systems. The result is a very green, very functional and very economical facility.

As some of these case studies proved the feasibility of the use of green building techniques and interagency networks began to spread the word, an *early majority* started forming and more agencies began to incorporate green building in their procedures. In the mid-to-late 1990s, as Executive Orders 13123 and 13101 were issued, official agency policy favoring green construction was adopted by EPA (with its Pollution Prevention Strategy), GSA (with the Planet GSA program), and the Navy, followed in the early 2000s by the Army, Air Force, NASA, State Department, USPS, Department of Health and Human Services/National Institutes of Health, several DOE labs, and other agencies. This was about the same time that several agencies (including EPA, Navy, and the

[38]See FEMP's Greening website <**http://www.eere.energy.gov/femp/techassist/greening.html**> and the Greening EPA website <**http://www.epa.gov/oaintrnt**>.

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National Park Service) completed construction of notable green Federal buildings and made extensive case studies available.[39]

Agencies appear to have had diverse motivations for their involvement in green building. Those with environmental and energy missions, such as EPA, DOE, and the Park Service, have had the advantage of internal and external constituencies to promote sustainability concepts and pressure them to live up to their missions. GSA's mission to provide quality workplaces supported healthy and high-performing indoor environments as well. This helps explain why these agencies have been among the earliest adopters. The military services were more likely motivated by an understanding that being proactive might help avoid costly environmental cleanups later in the life cycle of their facilities. In addition, the military has often been more disciplined in enforcing Executive Orders and related goals than other parts of the government. The fact that certain parts of the military, particularly the Navy, and other agencies have chosen to be among the earliest adopters may be attributed to the leadership of certain devoted individuals within these agencies.

Many of these and other Federal green building efforts are captured in case studies, policy statements, training, contract language and specifications, and guidebooks. Given this rich history of pilot projects and individual agency efforts, the Federal government is well poised to disseminate the best of these tools as part of a broader Federal green building effort, and work to promote Federal green building policies from the executive level to the field.

[39]FEMP's Sustainable Design Criteria Index, a CD that includes sustainable development policy links to various agencies.

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Overall Government Performance

Agencies are using a variety of methods to meet these environmental design mandates through the siting, design, and construction of new facilities. Although several agencies are developing promising policy directives and case studies, the efforts are not well coordinated or consistent across the Federal government.

Specific measures of overall Federal performance have been difficult to gather in the absence of standard metrics and reporting requirements. However, energy use is well documented and may provide the best indication of environmental design trends.

Energy Efficiency. Two years after exceeding the 20 percent reduction goal for FY 2000, preliminary data for FY 2002 submitted by agencies to DOE show that energy intensity (Btu-per-square-foot per year) of Federal standard (non-industrial/laboratory) buildings was reduced by 23 percent compared to the 1985 baseline, as shown in Table 3. This improved efficiency helped reduce utility bills for these buildings by 31.3 percent from the 1985 baseline, to $3.6 billion, and also contributed to a reduction of total carbon emissions to 9.8 million metric tons of carbon equivalent (MMTCE)—a reduction of more than 20 percent from the 1990 baseline.[40]

[40]Compiled from Annual Reports to Congress on Federal Government Energy Management and Conservation Programs: Fiscal Years 1985-2002. DOE/FEMP.

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Table 3: Energy Consumption per Gross Square Foot of Federal Standard Buildings from 1985 to 2002, with Executive Order 13123 Goals[41]

Year	Consumption per Gross Square Foot (10^3 Btu/SF)
FY 1985	139.5
FY 1986	129.1
FY 1987	134.7
FY 1988	133.3
FY 1989	131.7
FY 1990	127.4
FY 1991	124.5
FY 1992	127.6
FY 1993	124.4
FY 1994	122.3
FY 1995	118.8
FY 1996	117.0
FY 1997	113.5
FY 1998	110.3
FY 1999	108.7
FY 2000	106.2
FY 2001	106.3
FY 2002	104.9
FY 2005 (EO 13123 goal)	97.6
FY 2010 (EO 13123 goal)	90.7

The ENERGY STAR® program's "portfolio manager," a no-cost, Internet-based energy tracking tool, compares the energy performance of a given building with data derived from a survey of U.S. buildings of that type (i.e., hospital, hotel, school, office, or supermarket/grocery), and then assigns the property a percentile score from 1 to 100. Buildings that achieve a score of 75 or higher qualify to receive the ENERGY STAR® label.[42] A total of 20 Federal hospitals and 102 office buildings have earned the ENERGY STAR® label.[43] In FY 2001, FEMP awarded the first "ENERGY STAR® Building Award for Superior Performance" to GSA for eight Federal buildings that were among the top five percent nationwide in energy performance.

In FY 2002, Federal agencies documented more than $120 million in investments in energy efficiency, renewable energy, and water conservation projects. With the help of alternative financing mechanisms, agencies also implemented 125 energy projects with private sector investment of about $400 million. More than 9 percent of Federal facility space received energy audits in FY 2002. To date, agencies used approximately 663

[41]Ibid.
[42]http://www.energystar.gov/ia/business/comm_real_estate/PortfolioMgr5_25.pdf
[43]See the ENERGY STAR® website for the most up-to-date information <**http://www.energystar.gov**>.

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gigawatt hours of energy from renewable sources, 47 percent of which was in the form of renewable energy purchases; the remainder is from on-site generation.[44]

Buying Recycled. Another indicator of overall Federal performance in meeting green building goals is compliance with EPA's Comprehensive Procurement Guidelines (CPG). The CPG currently includes 12 recycled content construction products, as well as landscaping and park and recreation products, which Federal agencies are required to purchase. Purchasing data collected from seven agencies (DoD, DOE, GSA, NASA, HHS, VA, and USPS) indicate that 42 percent of the concrete purchased by these agencies in FY 2001 contained fly ash from coal combustion, while 42 percent of the insulation purchased also contained recycled content.[45]

Reuse and Recycling. The DoD Measures of Merit include 40 percent non-hazardous solid waste diversion by 2004, including construction and demolition debris.[46] More than ten military bases to date have used "deconstruction," the disassembly of old buildings for reuse or recycling of their valuable components, and other agencies are investigating the practice as an alternative to demolition.[47] Other agencies have developed recycling programs in conjunction with construction and remodeling projects.

Project Team for the Social Security Annex in Baltimore, Maryland employed a stringent waste reduction/prevention program for building elements and construction materials. By opting to reuse both the existing building shell and interior features, and through employing aggressive recycling/salvage tactics for construction materials, the team was able to reuse 77% of the building's exterior, 76% of the interior, and recycle/salvage 79% of construction materials, preventing 4,133 out of 5,239 tons from going to landfill.

[44]All the information in this paragraph was compiled from: Annual Report to Congress on Federal Government Energy Management and Conservation Programs: Fiscal Year 2000. DOE/FEMP. December 2002.
[45]Office of Federal Procurement Policy and OFEE, FY2000-2001 RCRA Report to Congress, <**http://www.ofee.gov/pubs/Final2000-2001report.pdf**>.
[46]See Memo on New DoD Pollution Prevention Measures of Merit at <**https://www.denix.osd.mil/denix/Public/ES-Programs/Pollution/Moms/p2mom.html**>.
[47]See the Building Deconstruction Consortium website at <**http://www.buildingdeconstruction.org**>.

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LEED™ Adoption. The USGBC estimates that registered LEED™ projects constitute 4.6 percent (pro-rated for the year) of all annual new commercial and institutional construction in the U.S. by floor space.[48] In the Federal community, 86 buildings (accounting for 12,218,019 square feet) are currently registered for LEED™ certification,[49] eight have already been certified (see Table 4), and, as mentioned above, several agencies are promoting the use of LEED™ as official policy (see *Appendix A*). Nine Federal projects are currently participating in the LEED™ for Existing Buildings pilot program, which EPA sponsors.[50] And, GSA is sponsoring the LEED™ for Commercial Interiors pilot program.

Table 4: Federal Facilities Certified under LEED™ as of August 2003

Federal Facilities Certified under LEED™ 2.0		
Agency/Department	**Facility**	**Certification**
EPA	New England Regional Lab, Chelmsford, MA	Gold
EPA	Science and Technology Center, Kansas City, MO	Gold
DOE	Argonne National Laboratory's Central Supply Facility, IL	Silver
GSA	U.S. Courthouse, Youngstown, OH	Certified
GSA	Social Security Administration's Child Care Center, Baltimore, MD	Certified
GSA	Social Security Administration's Building, Baltimore, MD	Certified
Navy	Bachelor Enlisted Quarters, Great Lakes Naval Training Center, IL	Certified
Federal Facility Certified under LEED™ 1.0		
Air Force	Air Combat Command's Physical Fitness Center, Barksdale Air Force Base, LA	Bronze

[48] Peter Templeton, USGBC, personal communication, 8/6/03
[49] Peter Templeton, USGBC, personal communication, 7/3/03
[50] Peter Templeton, USGBC, personal communication, 2/24/03

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Federal Forums. Finally, the increasing Federal focus on green building is evident in the number of forums organized in recent years to facilitate information sharing on the topic. These include FEMP's Interagency Sustainability Working Group, the Federal Green Building Listserv, the Federal Facilities Council, the Federal Network for Sustainability, and the USGBC Federal Summit. More information about these and other Federal green building forums is listed in *Appendix C*.

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Barriers to Increased Federal Green Building

All of the agencies interviewed identified major barriers to the greater adoption of green building practices across the Federal government. These barriers are organized into four major categories:

- Financial and Budgetary Structure Challenges
- Education Needs
- Limited Research
- Lack of Clear Federal Policy

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Financial and Budgetary Structure Challenges

A large number of interviewees identified financial challenges as the number one barrier to their greening efforts. In some cases, high-performance features can increase first costs from an average of two to seven percent, depending on the design and extent of added features.[51] However, as many of these features have become more mainstream, there is no longer a difference in cost. So, while at times real financial limits have been the issue, frequently it is the *perception* that green building costs more that leads Federal managers, field staff, contracting officers, and others to insist on more conventional approaches to building. To some extent, this problem of perception is an issue of research and education, two topics discussed below.

A larger and more serious barrier to green building is the budgetary structure of the Federal government. The bottom line is that the long-term savings that a green building can generate, based on energy and water efficiency, potential productivity gains, and other factors, are not factored into the budgeting equation for building construction and renovation. Budget decisions are made on an "initial cost" basis—what it costs to build or renovate a building—rather than "life cycle costs"—how much initial construction or renovation decisions could cost or save over the 30 to 100 year life of a building, considering energy savings, reduced maintenance, and other factors.

Renovation of Building 33 at the Washington, D.C. Navy Yard was a pilot project for the Navy's sustainable development program; and features sustainable and environmental design concepts, including lifecycle cost analysis.

[51]U.S. Green Building Council. 2003. *Building Momentum: National Trends and Prospects for High-Performance Green Buildings.* Washington, D.C.

OMB guidance to Federal agencies does in fact promote the use of life cycle costing techniques. OMB Circular A-11, "Preparation, Execution and Submission of the Budget" states: "New projects must be justified...with the least life cycle costs of all the various possible solutions…."[52]But agencies argue that, in practice, OMB and Congress continually put pressure on them to reduce initial costs of construction projects without regard to life cycle cost savings. Furthermore, easy-to-use tools and targeted training to determine the life cycle costs of Federal buildings are needed.

A related problem is that there is usually not a line item in the budget for operations and maintenance (O&M) of individual buildings, and few agencies track the actual costs. In contrast, new buildings are a line item in the budget that is scrutinized by OMB and Congress. Furthermore, different offices within agencies usually manage construction funds and O&M funds. This makes it very difficult to compare initial costs with life cycle costs and, thereby, to track the results of using different building technologies. In addition, some agencies expressed concern that the Brooks Act[53]has been interpreted to constrain design budgets to six percent of construction costs, and could potentially limit the use of more in-depth environmental design approaches, including charrettes and integrated design strategies.

Individual agency rules often compound these government-wide obstacles. This was noted as a problem particularly with regard to DoD. For example, construction purchases are judged by the DoD pricing guide, which provides historical pricing data that may not reflect the prices of current green technologies.

And so, while some green buildings can be built at no additional first cost, the standard practice, favoring lower first costs, biases agencies toward less expensive, conventional approaches, material, and technologies. Consequently, the government forgoes potentially greater life cycle savings that can come from occasionally more expensive green building design methods and technologies.

[52]Available at OMB website <**http://www.whitehouse.gov/omb/circulars/a11/02toc.html**>.
[53]Available at GSA website <**http://pbs.sunbelt.gsa.gov/idiq/documents/brooksAct_92-582.pdf**>.

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Education Needs

Education is needed to get Federal officials at all levels—top executives, middle management, headquarters, regional and field staff, and contractors—trained, motivated, and involved in implementing actual green building procedures.

Often, green building is considered an exotic "add-on" program, rather than part of an agency's mainstream budgeting, contracting, and other procedures. This creates the perception that green building is "extra credit" rather than a requirement or a worthwhile opportunity. Employees may believe that they are more likely to be punished rather than rewarded for taking risks on a new, green technology—and in some cases, that may be true. Even where environmental design is seen as a requirement, staff often lack adequate resources, tools, and training to get it done right. Some staff have received big picture sustainability training, which may motivate them, but lack the nitty-gritty technical training required to figure out the basic architectural and engineering problems involved in making buildings more healthy and efficient. Furthermore, a lack of detailed case studies makes it hard to pass on lessons learned.

As in other institutional frameworks, Federal government agencies often fail to take advantage of existing knowledge and tools to improve design and implementation of environmentally responsible design processes. The most effective means to deliver the existing knowledge and facilitate its use by Federal government facilities development staff must be identified.

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Limited Research

Making the case to managers and practitioners to build green requires hard data, statistics, and case studies. But identifying the best ways for the Federal government to improve the environmental performance of its buildings, and ensuring that the means employed to do so are effective, requires continued research on buildings' environmental effects and interactions and on technologies and techniques to reduce these impacts. The energy aspects of environmental design and construction have been more thoroughly researched than other aspects, such as water conservation and reuse, recharging of groundwater, construction runoff control, the use of green building products, and indoor environmental quality (e.g., daylighting, ventilation, low emitting materials, and indoor chemical and pollutant source control). In addition, information is required on the business case for green building, including its effect on cost savings, worker productivity, and worker health.

The Federal government does not endorse specific products, but construction and purchasing professionals ultimately need to find reliable sources of green building materials. Therefore, another critical research need is comparable information on the environmental impacts of building products—namely, life cycle assessment (LCA) and building product life cycle inventories (LCI) tools and protocols. LCA is a systematic approach to estimating the multiple environmental, energy, and resource impacts associated with a product or process from "the cradle to the grave." An LCI is the database of information on which LCA is based (e.g., information on how much energy and resources are used to make a product; emissions to land, sea, and air during production and transportation; product performance during its useful life; and its end-of-life impacts). This type of information is necessary to systematically determine which building products and strategies are environmentally preferable in comparison to competing products.

A variety of Federal agencies are working to fill these important research gaps. For example, DOE's Office of Energy Efficiency and Renewable Energy funded the development of technical information on building envelope performance, lighting, and thermodynamics for years. In addition, FEMP has developed life cycle cost analysis tools that help with justifying the energy conservation components of environmental design.[54] These tools can be readily adapted to other components if the cost savings of those components are known. Using these tools, and other methods for documenting business value, FEMP set out to develop *The Business Case for Sustainable Design in Federal Facilities*. The Report, now available in draft, provides an overview of research and case studies that document the economic, environmental, and social costs and benefits of sustainable design choices.[55]

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[54]For example, see FEMP's website on Analytical Software Tools at <**http://www.eere.energy.gov/femp/techassist/softwaretools/softwaretools.html**>.

[55]*The Business Case for Sustainable Design in Federal Facilities*. DOE/FEMP. August 2003. Available in draft at: <**http://www.eere.energy.gov/femp/techassist/sustainability.html#business**>.

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A primary focus of the Commerce Department's National Institute of Standards and Technology's Building and Fire Research Laboratory (NIST/BFRL) is its *Healthy and Sustainable Buildings Program.*[56] NIST/BFRL's Building for Environmental and Economic Sustainability (BEES) tool currently evaluates the life cycle environmental and economic performance of 200 building products.[57] Hopefully, in the future, many more product categories will be added to the tool in order to cover the wide range of products that may be specified in Federal building design. BEES currently has shortcomings. First, there is a lack of more detailed data on the environmental impacts of material production and use and, especially, the impacts on life cycle energy consumption. There is also a need to enhance the indoor air quality analysis incorporated in BEES to reflect better current knowledge and practices such as those adopted and being used by the State of California.[58]Continued research in all of these areas is needed in order to create a complete picture of the costs and benefits of green building.

What is missing in the government's research program is the coordination of these various efforts under common goals and protocols, regular communication among these programs, and the use of government buildings as laboratories to demonstrate and apply new technologies and approaches. Although DOE has taken steps to coordinate research through its various "technology roadmap" efforts, much more work is needed in this area.[59] And, results from completed research needs to be translated into tools and/or guidance that can be easily used by building professionals.

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[56]See the NIST/BFRL website at <**http://www.bfrl.nist.gov**>.
[57]See the NIST/BFRL BEES 3.0 website at <**http://www.bfrl.nist.gov/oae/software/bees.html**>.
[58]See the California Integrated Waste Management Board website at <**http://www.ciwmb.ca.gov/greenbuilding**>.
[59]See DOE Building Technology Roadmaps website at <**http://www.eere.energy.gov/buildings/research/roadmaps.cfm**>.

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Lack of Clear Federal Policy

Policy direction is needed to further encourage and/or require agencies to implement green building as Federal policy; promulgate standards and measurement systems to guide their efforts; and direct agencies to resources and assistance. As previously outlined, there is a mixture of diverse Federal green building mandates in law, regulation, and Executive Orders, but not one definitive, clear, and unified policy statement on environmental design.

Uncoordinated Messages. As some interviewees pointed out, the uncoordinated, narrowly-focused messages from individual agencies and their offices and divisions can be damaging. Buildings staff can be confused and irritated by what comes across as a "flavor of the month" approach—e.g., today agencies promote the use of compact fluorescent light bulbs, tomorrow concrete containing fly ash, the next day green roofs—without any guidance on how these diverse elements interact or which should take precedence. Unfortunately, the overall effect can be to cause these various messages to become discredited in the eyes of their intended audiences, leading to inaction.

For example, although EPA has numerous programs that touch on many aspects of green building—energy, water, waste, indoor air, smart growth, and brownfields redevelopment (See Table 2), only recently has a cross-agency, multi-media green building working group been formed. This coordinated effort hopefully will allow agency programs to share common goals, measurement tools, standards, and outreach materials, leading to a more unified green building message from EPA.

Consistent and robust rating systems and other metrics are needed to provide a larger framework in which to organize and implement green building programs at the Federal level. The use of standards fits well in the government context, considering the Federal government's massive size, hierarchical structure, and typical way of doing business. The use of standards will also make the job of implementation easier, reducing the duplication of background research by the many parties working on green building, and giving an official stamp of approval to justify environmental design and construction work. As such, the National Technology Transfer and Advancement Act (NTTAA) requires Federal agencies to "use technical standards that are developed or adopted by voluntary consensus standards bodies" unless such use is inconsistent with applicable law or otherwise impractical.[60] Under OMB Circular A-119, agencies can also use other technical standards in cases where no voluntary consensus standards exist.[61]

Unfortunately, the major voluntary consensus standard developing organizations, such as the American Society for Testing and Materials (ASTM International) and the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), provide

[60]See the text of the Act at <**http://ts.nist.gov/ts/htdocs/210/nttaa/113.htm**>.
[61]See NIST's NTTAA website at <**http://ts.nist.gov/ts/htdocs/210/nttaa/nttaa.htm**> for further information on the Act and the OMB Circular.

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few green building standards today; however, both of these organizations are doing more and more valuable work in this area.[62]

As previously mentioned, in the absence of a single, unified Federal policy on green building, many agencies are encouraging or mandating the use of the USGBC LEED™ rating system as a checklist to guide the design and construction processes. Others are mandating some portion of their new construction and major renovation to obtain LEED™ certification. In addition to standards or a systematic approach for new construction, the Federal government also needs standards to green its existing building inventory and many leased facilities. Hence, several agencies are participating in the LEED™ for Existing Buildings[63] and Commercial Interiors[64] pilot programs, and GSA worked with an interagency task force to develop model green lease provisions.

Although LEED™ is flexible enough for many agencies to use, some Federal and industry contacts have raised concerns about a government-wide endorsement of the LEED™ rating system. First, although there is value in certification by a third party (e.g., public recognition and contractor compliance assurance), there are incremental costs associated with registration and certification above and beyond the costs to meet LEED™ requirements. Agencies cannot always justify this expense. Second, although USGBC has a consensus process in place to resolve members' comments on the rating systems, trade associations are not allowed to become members, and some members complain they are not able to fully participate in the development of the rating systems. Third, the Federal government may have unique needs beyond the scope of LEED™. Accordingly, the Army used LEED™ as a model and through a Memorandum of Understanding with the USGBC has created its own system, the Sustainable Project Rating Tool, or "SPiRiT," in order to add features such as O&M and flexibility in design

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[62]Within ASTM, much of this work is occurring in Committee E6 "Performance of Buildings" Subcommittee E6.71 "Sustainability." See <**http://www.astm.org**> and go to "Technical Committees." This Subcommittee recently sponsored the publication of a CD-ROM compendium of 127 ASTM standards that address some aspect of green building.
See <**http://www.astm.org/cgi-bin/SoftCart.exe/BOOKSTORE/COMPS/97.htm?L+mystore+etdu1383**>
Within ASHRAE, the Board of Directors and members of the Technology Council have committed to a number of goals for the future. ASHRAE is producing a design guide in conjunction with the New Building Institute (NBI) to achieve 30 percent savings over ASHRAE 90.1-- Energy Code for Commercial and High-Rise Residential Buildings. Within two to three years, the organization will partner with the Illumination Engineering Society of North America (IESNA) and American Institute of Architects (AIA) to develop a design document for achieving a 50 percent savings over the savings achieved as a result of the 90.1 standard. The document will require new calculation methods, research, education, new materials applications, and new types of measuring metrics. Within five years, ASHRAE hopes to develop a guide for achieving 70 percent savings over standard 90.1. In addition, ASHRAE intends to create three documents to meet the specific needs of buildings of various sizes. Whereas ASHRAE 90.1 is a one-size fits all standard, a separate standard will be developed for buildings up to 20,000 square feet in size (which encompasses 70 percent of all buildings), another standard for buildings between 20,000 and 100,000 square feet, and a third standard for buildings over 100,000 square feet in size. (Source: Presentation by Mr. Terry Townsend, a Vice President of ASHRAE, to the Interagency Sustainability Working Group on March 26, 2003.)
[63]See the USGBC website at <**http://www.usgbc.org/LEED/existing/leed_existing.asp**>.
[64]See the USGBC website at <**http://www.usgbc.org/LEED/leed_interiors.asp**>.

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to allow for building modifications as operational needs change. It has the advantage of being cheaper than LEED™, but the disadvantage of lacking third-party verification. The Army's long-term plan is to adopt LEED™ 3.0 when it is released, which is expected to better address the Army's needs.

Fourth, some have concerns regarding the scientific merit of the LEED™ rating system. For example, energy efficiency credits are based on simulating that a building's projected energy use meets or exceeds ASHRAE Standard 90.1 energy code, a standard that some energy experts consider inadequate and unworkable. In addition, while there are a number of required green building practices for attaining LEED™ certification (e.g., erosion and sediment control, commissioning, and storage and collection of recyclables), there are no prerequisites for ensuring water conservation and reuse.

Also of concern is that the only prerequisites for indoor environmental quality (IEQ) in LEED™ are having the ASHRAE outdoor ventilation rate and a smoking policy that prohibits exposures to second hand smoke. Since the ventilation rate is principally the code minimum, and most buildings now have a "no smoking" policy, virtually any new building would meet the IEQ criteria. Furthermore, a number of important potential specifications are not included and some of the standards referenced in LEED™ are not considered credible.

More generally, considering implementation costs and environmental benefits, some believe certain LEED™ credits are inappropriately weighted. For example, installing a vegetated roofing system is rewarded with a single credit, as is installing an outlet for electric vehicles or bike racks in the parking lot. In addition, while LEED™ has certain prerequisites in each individual area, these are often de minimis. As a result, it is possible under the LEED™ rating system to perform relatively poorly (or relatively average) in some areas and still become certified.

Despite these concerns, numerous agencies are finding LEED™ a useful tool in greening their buildings. In addition, the continuing LEED™ development process provides opportunities for Federal officials to provide input and participate in shaping future versions of LEED™ to address at least some of these issues.

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Recommendations

The Federal government has made significant progress with green buildings to date, and none of the barriers discussed above appears to be insurmountable. Several options for working to overcome these barriers and advance the practice of green building in the Federal government were identified through the interviews and are outlined below.

Financial and Budgetary Structure

Numerous interviewees identified the Federal budgeting bias in favor of initial cost decisions, and against the use of life cycle costing, as the number one barrier to the further success of Federal green building. This is an issue that agencies will have trouble addressing on their own because it requires changes in the implementation of OMB policy, and possibly by Congress as well. OFEE, as a White House office with jurisdiction that extends beyond any individual agencies, is well positioned to work through an interagency group with OMB to address this major concern.

Instituting life cycle costing represents the most formidable challenge of all the options discussed, since it would involve changing the heart of Federal budgeting policy. Effective policy improvements would go a long way in promoting environmental design. As such, recommendations include:

- Strengthen LCC Requirements on Environmental Design and Construction. As previously mentioned, existing statutory language and OMB guidelines already call for LCC-based analysis for Federal capital investments, but despite this, first-cost decisions often prevail. A new Executive Order could mandate the development of clear guidance and implementation by OMB as well as by each agency's budget office. Furthermore, making progress in this important area will require more specific procedures and assignment of responsibilities. For example, an Executive Order might require that each capital project be accompanied by a long-term projection (e.g., lifetime or 20-year) of energy and water operating costs. This use/cost projection would be signed off by both the responsible agency official and by OMB, and become a permanent record (benchmark) for that building. In general, agencies should consider the following costs over the full life cycle of the building when weighing design alternatives:

    - Energy, water, and other utility operating costs;
    - Other operation, maintenance, and repair/replacement costs;
    - Reuse, recycling, or disposal of post-use materials and equipment;
    - Occupant health and related costs (e.g., absenteeism, disability, health care for workplace injuries); and
    - Other costs and benefits of environmental design that may be quantifiable in the future, as a result of ongoing research.

  As discussed below, further research quantifying the costs of green building are necessary.
- Collaborate with Chief Financial Officers Council. OFEE and OMB should collaborate with the Chief Financial Officers Council to examine the issue of LCC, recommend solutions, and implement them.

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- Educate Agencies and Congress about Benefits of Integrated, Green Building Design. OFEE and OMB, in coordination with GSA, DOE/FEMP, and EPA, should educate agencies and Congress about the value and the mechanics of incorporating LCC and other environmental design decisions at the building planning and design stage.[66] Education efforts should highlight how integrated design processes and environmental design charrettes save money and improve building design. Training can point out that many design decisions (e.g., siting and building envelope) can mean the difference between a high performance building and a mediocre one, so it is important to invest in smart design. OFEE should assist OMB in developing guidance noting that such charrettes do not infringe upon the limited budget allotment (six percent) in the Brooks Act for design costs, and that the intent of this restriction is to limit the dollars spent on construction documents, not to limit options for integrated design.

- Educate Comptrollers and Procurement Officials about Benefits of Integrated, Green Building Design. OFEE and OMB, in coordination with EPA and DOE/FEMP, should educate comptrollers and procurement officials about the current acquisition philosophy in which performance standards incorporate longer-term costs. Information should highlight the fact that the largest cost to the government is the salaries of the employees in the building and that some environmental design features can potentially improve productivity and health of building occupants (although more research on this topic is needed).

- Train OMB and Agency Staff about Benefits of Integrated, Green Building Design. OFEE, in coordination with EPA and DOE/FEMP, should conduct joint training sessions with both agency capital budget specialists and OMB budget examiners on how to apply the LCC criteria to actual projects (or hypothetical, but realistic case studies). This should include:

  -Training OMB budget reviewers to evaluate agency requests based on LCC and environmental design; and

  -Working with OMB staff to ensure effective implementation of Circular A-11, Part 2, Sec 55, which already calls for LCC and environmental design in agency requests.

- Clarify and Revise OMB Policy. While OMB policy already encourages an emphasis on LCC, these directives need to be promoted much more prominently and implemented more aggressively in the agencies and within OMB. Specifically, OFEE, EPA, and DOE/FEMP should work with OMB to:

  -Clarify OMB Guidance by establishing a strong standard of LCC practice for Federal agencies that includes specific examples of LCC and a definition of LCC, clarifying what costs should be included. ASTM standards developed under Subcommittee E6.81 on Building Economics can provide a starting point for this effort.

[66]The Federal Facilities Council of the National Research Council 2001 report entitled "Sustainable Federal Facilities: A Guide to Integrating Value Engineering, Life Cycle Costing and Sustainable Development" provides a good blueprint for doing so. See <**http://www.nap.edu/books/0309072999/html/5.html**>.

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-Revise OMB A-11's evaluation criteria (used by OMB budget examiners) to include higher point allocations for capital budget submissions that show life cycle costs (including water, energy, and other O&M costs) and incorporate environmental design.

-Explore lease-purchase financing options for certain energy-efficient equipment in new (or existing) buildings. Currently, such leasing for "installed" equipment[67] is unduly restricted because of the method used by the OMB to "score" leases, as required by the Anti-Deficiency Act.[68] At present, OMB requires agencies to set aside funds equal to total future lease payments, which negates the advantage of lease financing. Instead, for energy-saving equipment (i.e., at ENERGY STAR® or FEMP-designated efficiency levels) the OMB set-aside requirement should be based on *net* future costs (i.e., the difference between lease payments and annual energy cost savings).

- Institute and Incentivize Performance-Based Standards. The Federal government should continue to test, demonstrate, and refine the concept of performance-based standards for architects and contractors. Many respondents noted that a fixed percentage fee for building design can be a constraint on investing in sustainability design at the early design stages of a project, when it is often most cost-effective. To date, there have been a few experiments, in the Federal sector and elsewhere, with incentive-based design and construction fees based on the building's actual energy (and other) performance. OFEE could help agencies initiate more pilot projects using incentive-based fees, with careful experimental design and evaluation.

- Link Construction and O&M Budgets. Propose legislation to link agency construction and O&M budgets for buildings.

- Address Individual Agency Budget Issues. An interagency task force, or individual agency leads, can be tasked with tackling individual agency budgeting obstacles, such as those discussed at DoD. Additional training of individual agency's CFO, budget staff, and other relevant personnel may be required.

Education

In some ways, gathering and disseminating information on green building to educate Federal agencies and their employees is among the easiest options to pursue. However, this effort does require an investment in staff time and funding. It also requires adequate thought and planning to ensure that the right message and level of information gets to the right audiences. Furthermore, education in itself is not enough, and more direct actions, such as meetings between OFEE and upper to mid-level management at certain agencies, will be necessary to spur implementation.

[67]In contrast to vehicles, copiers, etc. which can be removed if the lease is terminated.
[68]See the Department of Labor's Anti-Deficiency Act website at: <http://www.dol.gov/oasam/regs/statutes/antidef.htm>.

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- Develop an Education and Information Plan. OFEE, in coordination with GSA, EPA, and DOE/FEMP, should develop an information and education plan that focuses on key audiences and their needs, and determines how to get the right information to them. The plan should also lay the groundwork for a relationship between OFEE and key sustainability workgroups, with whom OFEE should coordinate in the development and implementation of this plan. Specifically,

  -Upper- and middle-level management: Develop clear policy guidance on key environmental design issues; provide examples of green building policy memos from other agencies; garner testimonials from top executives at agencies where green building is most ingrained; and develop brochures on the business case for green building and disseminate other key resources.

  -Facilities staff and contractors: Provide detailed technical training and design guidance on how to make green building succeed; provide detailed case studies and business case information; disseminate detailed construction specs and model contract language from reputable sources; and provide opportunities to share information and experiences with peers from across the government.

  - Develop Associated Training. OFEE, in coordination with GSA, EPA, and DOE/FEMP, should set up training or workshops on environmental design at Federal conferences (e.g., budget conferences, facilities conferences, environmental compliance conferences, and procurement conferences). Compile a list of relevant associations or groups that convene meetings of relevant Federal staff. Integrate environmental design information into these training forums. Information should be targeted and tailored to meet the needs of each specific audience. In addition, on-line training tools could be used by Federal building professionals right at their desks.

  - Develop a Green Building Module for Agency Environmental Management Systems. OFEE, in coordination with EPA, should develop a guide for incorporating green building practices into agency- and facility-level EMSs.

  - Convene a White House Conference. Convene a White House-sponsored conference on Federal green building to raise the profile of the issues in the Federal sector and beyond. Such a conference could also be used to gather input from key stakeholders from the public and private sectors on aspects of a new Executive Order.

  - Disseminate Information Online. OFEE should use its website to help raise the profile of some of the interagency green building efforts (e.g., those listed in *Appendix C*), and perhaps work to bring some Federal green building resources (e.g., policies, case studies, databases, research, and training materials) together. OFEE should also request that other agencies highlight key information on their websites to reach a wider audience.

  - Leverage Existing Tools and Trainings. OFEE should work to leverage existing tools and training to further educate on green building issues. FEMP and EPA, in particular, have a large collection of such resources

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(including training, publications and direct technical assistance), and OFEE should continue to partner with these agencies wherever possible to promote their resources. For example, OFEE and FEMP should collaborate to more fully market the WBDG website as an excellent reference with a wide range of information related to environmental design.

Research

The role of the Federal government as a funder and facilitator of research is extremely important. While such research helps develop technologies and approaches for use both inside and outside of the Federal government, it also creates the opportunity for Federal agencies to become the laboratories and showpieces of cutting-edge green technologies. Therefore, research recommendations include:

- Quantify the Costs and Benefits of Green Building. Data on the life cycle costs of green building are necessary in order to make the business case for green siting, design, construction, O&M, and deconstruction or disposal. Starting with the great work presented in DOE/FEMP's *The Business Case for Sustainable Design in Federal Facilities* and utilizing the enormous amounts of data being collected by the USGBC and others, EPA, DOE, and GSA should begin to quantify the costs and benefits of green building practices, products, and processes.

- Expand NIST's BEES LCA Tool. The BEES LCA tool should be expanded to cover more products to be of greater use to Federal designers.

- Research Indoor Environmental Quality (IEQ) and Its Affects on Worker Productivity and Health. Research to evaluate current best practices for IEQ and to better establish the relationship between IEQ, energy use, human health, and workplace productivity is a high priority. The growing, but diverse scientific literature suggests that substantial benefits in health and human performance are possible with appropriate building design and operational procedures,[69] but research is needed to further quantify these relationships and to evaluate and refine best practices. For example, there are currently competing and sometimes conflicting testing and certification programs dealing with pollutant emissions from products used in buildings. Research is needed to establish generally accepted standards, solidly based on public health criteria. Broad research needs agendas are being developed within the Federal government that can help guide this research.[70]

- Measure Performance. The most important question to answer is not whether a building has environmental design *intent*, but how well it actually performs. And, for many

[69]The estimated value of these benefits range in the tens of billions of dollars. See, for example, Fisk, William J (2000). Health and Productivity Gains from Better Indoor Environments and Their Relationship with Building Energy Efficiency. Annual Review of Energy and the Environment. 25:537-566. For a bibliography or related literature, see Lawrence Berkeley National Laboratory and partners' Indoor Health and Productivity Project website at <**http://www.IHPcentral.org**>.

[70]EPA's Office of Radiation and Indoor Air, in conjunction with other EPA offices, is developing Program Needs for Indoor Environmental Research. The current draft document is anticipated for release in the fall of 2003. Also see the National Occupational Research Agenda developed by the National Institute of Occupational Safety and Health, described in Mendell et al (2002). Improving the Health of Workers in Indoor Environments: Priority Research Needs for a National Occupational Research Agenda. *Public Health Matters, American Journal of Public Health*. Vol 92, No. 9. 1430-1440.

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aspects of green building, we still do not know much about how well LEED™ or other environmentally designed buildings actually perform. An ongoing research and analysis effort is needed to monitor and assess the actual performance of new green federal buildings, based on tracking and benchmarking, to identify important trends (positive or negative) and provide feedback to the policies and procedures governing new construction as well as operation and maintenance. In addition, appropriate performance benchmarks for Federal building types not currently represented in the LEED™ rating system (e.g., homes, conference/training centers, laboratories, hospitals) are needed. One example is the EPA- and DOE-sponsored work on criteria for high-performance laboratory buildings,[71] which the USGBC may soon incorporate in the LEED™ development process.

- Interagency Sustainable Buildings Research Council. OFEE, in conjunction with new and existing interagency councils devoted to issues of sustainability and general buildings research, should convene an Interagency Sustainable Buildings Research Coordination Council, consisting of private, academic, and public sector experts. The purpose of this Council would be to help coordinate, direct, support, and apply Federal sustainable building research.

  To be effective, this Council must garner sufficient high-level commitment from member agencies, have access to resources (directly or through the participating agencies), and build on prior and ongoing work by groups such as the Carnegie Mellon-based Advanced Building Systems Integration Consortium (ABSIC)[72] and the University of California at Berkeley-based Center for the Built Environment (CBE).[73] In addition, the efforts of the National Science and Technology Council (NSTC) Subcommittee on Construction and Building[74] and the relevant R&D activities of the National Research Council Board on Infrastructure and the Constructed Environment (NRC/BICE) Federal Facilities Council[75] are invaluable.

  Such an interagency research council could survey current Federal research that supports making buildings more sustainable, identify what gaps exist and how they could be filled, and identify where Federal building projects could help pilot technologies being researched, thereby leveraging the missions of both the research and building community to serve the needs of both. Depending on the findings and recommendations of such a council, OFEE could pursue various strategies (e.g., Executive Order and/or legislation) to ensure that Federal green building research is coordinated and fully funded.

Robust Rating Systems and Metrics

- Contribute Expertise to LEED™ 3.0 for New Commercial (NC) Buildings. OFEE should work with agencies and USGBC to focus on concerns with LEED™ NC and discuss options to meet these concerns in the next update of LEED™ 3.0. It is not recommended that the Federal government try to develop its own rating system independent of LEED™, as it is clearly more practical to piggyback on the work and

[71] See EPA's Labs for the 21st Century website at <http://www.epa.gov/labs21century/>.
[72] See the Advanced Building Systems Integration Consortium website at <**http://www.arc.cmu.edu/cbpd/html/absic/**>.
[73] See the Center for the Built Environment website at <**http://www.cbe.berkeley.edu/**>.
[74] See the NSTC Subcommittee on Construction and Building website at <http://www.bfrl.nist.gov/860/c_b/>.
[75] See the NRC/BICE Federal Facilities Council website at <http://www7.nationalacademies.org/ffc/>.

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reputation of LEED™ than to duplicate USGBC's efforts to both develop and maintain such a system.

- Contribute Expertise to LEED™ Systems for Other Categories. In addition to working with USGBC on the LEED™ rating system for new commercial buildings, Federal representatives should also work with USGBC, in a coordinated fashion, on relevant new LEED™ systems being developed, including LEED™ for Existing Buildings, for Multiple Buildings, for Core and Shell, for Commercial Interiors, for Laboratories, and for Homes.

Coordination and Integration

As this report illustrates, many within the Federal government are working on green buildings, but additional coordination and integration are needed. OFEE should work with other agencies to help coordinate green building work through an interagency group and, through that group, develop the needed tools to implement effective green building strategies.

- Create Senior Interagency Green Building Council. OFEE can play a critically important role in ensuring that Federal policy and Federal actions are well thought out and well coordinated. In particular, OFEE should work with the Interagency Sustainability Task Force and the various other groups across the Federal government to create a senior policy group to coordinate current Federal efforts on environmental design, including research, education, finance, standards development, measurement, implementation, and policy. Effective coordination will help ensure that Federal environmental design efforts are well integrated and resources are used as effectively as possible.

- Identify Additional Tools. The interagency council, as part of its work, should identify the tools needed for the agencies to effectively develop and implement green building strategies, including whether an executive order is appropriate. Among other issues, the council should address energy efficiency minimums, healthy indoor designs, water stewardship, building commissioning, improving and meeting LEED™ and using other tools, metrics, and monitoring, benchmarking, and reporting.

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Appendix A:
Agency/Department Green Building Policies

Office of Management and Budget

- OMB Circular No. A-11 (2002), Section 55 – Energy and Transportation Efficiency Management: Encourages agencies to incorporate ENERGY STAR® or LEED™ building standards into up front design concepts for new construction and/or building renovations. Agencies must report if they incur or anticipate incurring additional costs for incorporating these standards.

Army

- (4/26/00): Sustainable Design and Development (DASA, I&H)
  - Incorporate sustainability into installation planning and infrastructure, balanced with cost and customer requirements.
  - ACSIM to develop implementing policy; USACE to develop technical guidance.

- (5/26/00): Sustainable Design and Development Policy (ACSIM)
  - SUSTAINABLE DESIGN AND DEVELOPMENT defined as "the systematic consideration of current and future impacts of an activity, product or decision on the environment, energy use, natural resources, the economy and quality of life."

- (1/18/01): Deconstruction and Re-Use of Excess Army Buildings (DASA, I&E)
  - The Army will develop policy, provide technical assistance and develop technologies for building deconstruction and reuse, in cooperation with other Federal agencies.

- (5/1/01): Technical Letter ETL 1110-3-491: Sustainable Design for Military Facilities (Chief, Engineering and Construction Division, USACE)
  - Introduction of SPiRiT and additional technical guidance.
  - All USACE military facility design shall phase in SUSTAINABLE DESIGN AND DEVELOPMENT and strive for SPiRiT Bronze.

- (5/4/01): Sustainable Project Rating Tool (SPiRiT) (ACSIM)
  - As of 6/1/01, Army will begin using SPiRiT. Initial goal is for all MACOM and installation projects to achieve a minimum Bronze rating. There will also be SUSTAINABLE DESIGN AND DEVELOPMENT Showcase Projects aiming for higher ratings.

- (6/1/01): SUSTAINABLE DESIGN AND DEVELOPMENT (Director of Military Programs, USACE)
  - All new designs shall strive to achieve Bronze; when District can't achieve this, they must inform HQ.

- (3/18/02): SUSTAINABLE DESIGN AND DEVELOPMENT (Assistant Secretary, I&E)
    - Endorses and emphasizes goal.

- (12/21/02): Sustainable Project Rating Tool (SPiRiT) (ACSIM)
    - All projects beginning with FY06 will achieve Silver level.

- (2/4/03): SUSTAINABLE DESIGN AND DEVELOPMENT (Director of Military Programs, USACE)
    - Reiterates Silver goal.
    - Ten showcase projects in FY03 and increase by two every year after. Showcase projects should aim for Gold.

- (3/18/03): SUSTAINABLE DESIGN AND DEVELOPMENT (Assistant Secretary, I&E)
    - Silver rating minimum requirement for FY 2006 MILCON projects currently under design.
    - Gold rating minimum requirement for all other FY 2006 and future-year MILCON projects.
    - Gold goal for projects under the Residential Communities Initiative.

Navy

- PDPS 98-01 (6/18/98), Design of Sustainable Facilities and Infrastructure
    - Applies to all projects; no increase in first cost or design costs; key is integrated design.

- PDPS 98-02 (6/18/98), Criteria Supporting Design of Sustainable Facilities
    - Industry-based.

- PDPS 98-03 (6/18/98), Procurement of Sustainable Facilities – AE Contracts
    - Architects and engineers must demonstrate "knowledge and demonstrated experience in applying sustainability concepts and principles to facilities and infrastructure problems through an integrated design approach."

- Memo, 7/2/02, Adopting the U.S. Green Building Council's LEED Rating System™, from J.W. Wright, Chief Engineer: LEED™ (at least Certified) required as a tool and metric; submission for LEED™ certification not required.

Air Force

- (12/19/01): Sustainable Design and Development Policy (The Civil Engineer, DCS/Installations & Logistics)
    - Declares "Air Force policy to apply sustainable development concepts in the planning, design, construction, environmental management, operation,

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maintenance and disposal of facilities and infrastructure projects, consistent with budget and mission requirements."

- Calls for "integrated programming and project planning" through the use of multidisciplinary teams and the selection of contractors partly on the basis of their knowledge of environmental issues.

- LEED™ is described as "the Air Force preferred self-assessment metric." At least 20 percent of each major command's projects are to be selected as LEED pilot projects in FY04, with increasing percentages of projects until FY09, when all military construction projects are to be capable of achieving LEED™ certification.

General Services Administration

- Facilities Standards for the Public Buildings Service (PBS-P100) (revised 2000) <http://policyworks.gov/org/main/mp/gsa/index.html>
  - "GSA is committed to incorporating principles of sustainable design and energy efficiency into all of its sustainable building projects." Sustainable design is defined as an "integrated, synergistic approach, in which all phases of the facility lifecycle are considered."

  - "These principles shall serve as the basis for planning, programming, budgeting, construction, commissioning, operation, maintenance, decommissioning of all new GSA facilities, and for major renovation and alteration of existing buildings and facilities."

  - All GSA buildings must be certified through LEED™, and are encouraged to achieve a Silver rating.

National Park Service

- Memorandum of Understanding Between the Secretary of Energy and the Secretary of the Interior (4/27/99) <http://www.nps.gov/renew/mou.htm>
  - Inaugurates a joint "Green Energy Parks" program.

- A98(2450): (7/13/99) Environmental Leadership (Director, NPS) <http://www.nps.gov/renew/leadership.htm>
  - "Environmental leadership" includes full compliance with environmental laws, going beyond compliance with pollution prevention and sustainability, and educating NPS staff, concessionaires and visitors on these concepts.

  - This commitment is to be codified in an implementation plan, performance goals, management policies, guidance, and environmental audits.

Environmental Protection Agency

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- EPA incorporates sustainable building principles into the siting, design, and construction of all new facilities, as well as the renovation and maintenance of existing facilities. The Agency requires Silver LEED™ certification for new significant building construction or acquisition. EPA has a *Green Buildings Vision and Policy Statement* that serves as a guide for sustainable projects. http://www.epa.gov/greeningepa/p2/eppgoals.htm http://www.epa.gov/greeningepa/projects/policy.htm.

- EPA has made an effort to improve environmental performance through green lease riders, i.e., amendments to traditional lease language that emphasize energy, water, and resource efficiency. Following are links to green lease riders for buildings constructed recently in Kansas City, Kansas.
  http://www.epa.gov/greeningepa/content/energy/grider_hq.htm
  http://www.epa.gov/greeningepa/content/energy/grider_stc.htm

- EPA's Office of Administration and Resources Management supports the Laboratories for the 21st Century Program (Labs21), which assists Federal government and private laboratories in the design and operation of environmentally sustainable laboratories and is helping the U.S. Green Building Council develop environmental performance criteria for labs. http://www.epa.gov/greeningepa/labs21/index.htm

Department of Energy

- DOE Order 430.2A, Departmental Energy and Utility Management, on April 15, 2000. While emphasizing the energy efficiency strategies of Executive Order 13123, DOE Order 430.2A directed the application of sustainable design principles to new buildings and recommended the application of sustainable design principles to major alterations of existing buildings.

National Aeronautics and Space Administration

- The National Aeronautics and Space Administration (NASA) is committed to implementing sustainable designs in its Construction of Facilities (CoF) program. NASA policies stating their requirements for implementing sustainable designs recently established goals for CoF projects to meet the LEED™ rating of Silver. NASA encourages its designers to strive for the LEED™ Gold rating, if cost effective. NASA has included sustainable design factors in its overall corporate prioritization and rating process, for approving projects and obtaining CoF funding.

- NPG 8570.1, Energy Efficiency and Water Conservation Technologies and Practices: Provides guidance for accomplishing cost and energy efficient, renewable energy, and water conservation measures in NASA facilities and operations.

  - NPG 8570.1.P.1.2: "NASA Procedures and Guidelines (NPG) has been prepared to assist NASA Headquarters, Centers, and Component Facilities, Strategic Enterprises,

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and Institutional Program Offices in implementing the requirements of Federal law, Executive Orders, and NASA policy related to energy and water conservation and efficiency management. This NPG serves as a practical reference and source of guidance for use by NASA managers and other responsible staff in ensuring that NASA facilities and related operations comply with the letter and spirit of NECPA and EO 13123."

  - NPG 8570.1.3.1.1: "Energy efficiency and conservation management ensure that energy and water are used effectively and judiciously. A successful program not only involves energy conservation and engineering, but every area of institutional management, including facilities and maintenance management, procurement, administration, and communications and public affairs."

  - NPG 8570.1.3.7.2: "The purpose of an energy awareness program is to eliminate energy waste by making energy users more energy conscious. An awareness program attempts to influence energy users' attitudes and behavior to reduce energy waste, promote energy efficiency, prevent pollution and reduce costs. Potential savings from awareness depends on the Center's current level of efficiency and the motivation of its personnel. An effective program targets specific audiences, involves as many energy users as possible, is widely publicized, and makes energy-saving actions and goals as concrete as possible. The program should be creative, consistent, continuous, and informative."

- NPG 8500.1, NASA Environmental Management: Provides guidance for overall environmental stewardship in NASA facilities through resource conservation, waste reduction, waste management, and remediation of toxic sites.

  - NPG 8500.1.f: "Actively partner with Federal, State, and local regulatory agencies, as appropriate, to leverage available resources and comply with environmental requirements, prevent pollution, reduce waste generation, and manage natural resources in the most efficient and effective manner possible."

- NPG 8820.2C, Facility Project Implementation Handbook (FPIH):

  - Provides a ready reference to pertinent policy and guidance for management of facility planning, budgeting, design, construction, and activation.

  - Committed to making "provisions for alternate energy sources for reasons of reliability, economy, and/or pollution control."

Department of Health and Human Services:

- Beginning in FY 2000, the HHS Energy Program and the HHS Environmental Quality Program began specifically addressing Green Buildings and sustainability. Applicable Executive Orders, directives, and initiatives were analyzed and integrated into the existing policies, programs, and projects. Policy memorandums and directives were

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issued by the Assistant Secretary addressing alternative financing, renewable energy applications, Energy Star® buildings and hospitals, state funding for renewables and clean energy, and training. The operating divisions in turn incorporated the information into the existing energy and environmental programs and goals.

- Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA) and the National Institutes of Health (NIH) Design Policies and Guidelines include the mandated use of life-cycle costing, Energy Star and energy efficient product specification and procurement, sustainable design and development principles included in the *Whole Building Design Guide* and in the LEED™ rating system, and the analysis of renewable energy systems.

- In FY 2002, CDC joined the U.S. Green Building Council (USGBC) and is actively promoting the use of the *Whole Building Design Guide* and LEED™ rating system. Three new major construction projects were registered with USGBC in FY 2002, with a goal of achieving a LEED™ certification for these new buildings. In addition, HHS OPDIVs participate in the EPA Labs for the 21st Century program with the intent of designing and constructing more sustainable laboratories.

Department of State

- The State Department includes sustainable and green building language in its Requests for Proposals (RFPs) and is also incorporating it into the Standard Embassy Design contract requirements.

- RFP C.4.5 Sustainable Design:
  "The Contractor shall utilize the LEED Green Building Rating System (Version 2.1) as developed by the U.S. Green Building Council to earn a minimum LEED Certified Rating (26 points) for the office building(s) and compound sitework. Refer to C.5.5.1.5.2 for associated reporting requirements."

- RFP C.5.5.1.5.2 Sustainable Design Rating:
  "The Contractor shall complete the LEED™ 2.1 Reporting Format (Attachment J.2.11) for the Design Development Submittal. The Contractor shall prepare the LEED™ Certification documentation for the minimum 26 LEED™ points being earned as defined under LEED™ 2.1. When LEED™ documentation is complete, the Contractor shall transmit two copies to the USG for acceptance."

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Appendix B: Federal Agency Profiles

Office of the Secretary of Defense

I. Organization

The Office of the Deputy Under Secretary of Defense for Installations and Environment (DUSD (I&E)) <http://www.acq.osd.mil/ie>, within the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics (USD, AT&L) is in charge of infrastructure, installation and environmental matters. Within the DUSD (I&E), the Director of Utilities and Energy <http://www.acq.osd.mil/ie/utilities/energy/energy_use/main.htm> is in charge of sustainable building issues, with a focus on energy efficiency and renewables.

The Installations Policy Board, which includes the DUSD (I&E) and Assistant Secretaries for Installations and Environment from the services, military Chiefs of Staff, and the Comptroller, among others, provides guidance on energy issues. The Engineering Senior Executive Panel, which includes Chief Engineers from the armed services (whose offices include architecture responsibilities as well), provides design and construction guidance, e.g., populating the Whole Building Design Guide <www.wbdg.org>.

Contact: Dr. Get Moy, Director, Utilities and Energy, 703-697-6195, Get.Moy@osd.mil.

II. Baseline Data

Total DoD buildings include 621,850 "structures" with 2.2 billion square feet, but Federal Energy Management Program (FEMP) "standard" buildings constitute a total of 331,092 buildings comprising 2.0 billion square feet. This means that DoD represents approximately two-thirds of the Federal government's buildings and square footage.

Building types vary widely, depending on an installation's mission – ranging from a base servicing troops to a naval shipyard to an air hangar. Within the military, residential structures predominate, followed by buildings used for service, storage, office space and schools. DoD does not own all of its housing, as only about a third of the armed forces are housed on-base; many have been moved off base into private housing, although that trend is being reversed due to force protection concerns.

III. Policies and Resources

- Unified Facilities Criteria Program, Whole Building Design Guide
    - The Department of Defense (DoD) and the military services have initiated a program to unify all technical criteria and standards pertaining to planning, design, construction, and operation and maintenance of real property facilities.
    - Previously, each service had its own publication system resulting in criteria being disseminated in many different formats.
    - http://www.wbdg.org/ccbref/pa_dod.php?category=pa

- Sustainable Planning: A Multi-Service Assessment, 1999
    - A feasibility study for implementing sustainable development concepts and principles in the Army, Navy, Air Force, and Marine Corps Land and Facilities Planning Processes and Programs.
    - The Report addresses the importance of sustainable building at the policy level within the DoD.
    - http://www.hq.usace.army.mil/isd/librarie/RP/Sustainability/Sustainable%20Planning%20Stdy.pdf

- Defense Environmental Network and Information Exchange (DENIX 2002)
    - DENIX serves as a central platform for the dissemination of environment, safety and occupational health (ESOH) news, policy, and guidance within DoD activities worldwide, in support of the national defense mission.
    - https://www.denix.osd.mil/

IV. Results and Case Studies

- Pentagon Renovation sustainable design information is available at <http://renovation.pentagon.mil/sustainabledesign.htm>

- For additional case studies, see profiles of Army, Navy and Air Force

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U.S. Army

I. Organization

The Office of the Assistant Secretary of the Army for Installations and Environment (ASA-I&E) <https://www.asaie.army.mil/Public/IE/default.html> is in charge of matters related to both buildings and the environment. Within ASA-I&E, building and installation issues fall under the Office of the Deputy Assistant Secretary of the Army for Installations and Housing (DASA-I&H), with installation policy guidance and program management provided by the Office of the Assistant Chief of Staff for Installation Management (ACSIM) <http://www.hqda.army.mil/acsimweb/homepage.shtml>. The Installation Management Agency <http://www.ima.army.mil/index.asp> actually manages installations, through six Regional Directorates (plus two overseas).

Army design and construction services are primarily conducted by the Army Corps of Engineers (USACE), which is commanded by the Army Chief of Engineers<http://www.usace.army.mil>. The Corps employs private architectural, engineering and construction firms for most design and all construction work. USACE's Construction Engineering Research Laboratory (CERL) (part of the Engineer Research and Development Center) <http://www.cecer.army.mil> supports the Army's effort to design, construct, operate and maintain its infrastructure. The Corps' military program receives appropriations of about $7.2 billion per year. USACE also performs most construction services for the Air Force.

Several Army environmental offices also have influence over sustainable design and construction policy, particularly, the Army Environmental Policy Institute (AEPI) http://www.aepi.army.mil**,** and the Army Environmental Center (AEC) <http://aec.army.mil/usaec>, through its Sustainability Advocacy Team. The Office of the Director, Environmental Programs <http://www.hqda.army.mil/acsimweb/env/>, through its Sustainability Division, is in charge of the Army Sustainability Initiative, which involves a process through which installations establish sustainability goals looking 25 years into the future. It has been implemented at Forts Bragg, Hood, Lewis, and Carson to date.

Contact: Mr. Harry Goradia, USACE, 202-761-7170, harry.goradia@usace.army.mil.

II. Baseline Data

The Army Real Estate Portfolio includes more than 4,100 installations – approximately two-thirds of all DoD installations. More than 3,000 of these installations are Army Reserve National Guard Readiness Centers, and about 900 are Army Reserve Centers, while about 80 are overseas. These installations include 165,289 buildings comprising 1.1 billion square feet and covering 14.4 million acres. These properties are estimated to have a plant replacement value of $219 billion and annual maintenance costs of $2.1 billion. Environmental cleanup is being conducted at 1,576 active Army sites, 363 Base Realignment and Closure sites and 2,233 Formerly Used

Defense Properties . [3] The Army is estimated to have 50 million square feet of excess buildings, on bases slated for either closure or renovation.[4]

Comparing Army data with FEMP data, the Army represents about half of DoD buildings and square footage, and nearly one-third of the total buildings and square footage of the entire Federal government. This makes the Army by far the largest Federal building owner and manager.

III. Policies and Resources

As memos listed below indicate, the Army and Army Corps of Engineers have been officially committed to implementing sustainability since Spring 2000. They have developed their own rating tool, based on LEED™, called the "Sustainable Project Rating Tool" or SpiRiT. Unlike LEED™, SPiRiT includes operations and maintenance issues and flexibility in design to allow for building modifications as needs changes; it also differs from LEED™ in that it is a self-rating tool without third-party confirmation. The Army is working with the U.S. Green Building Council on LEED™ 3.0 and hope it will incorporate the Army's needs sufficiently that LEED™ 3.0 can replace SPiRiT – but that prospect is still several years away.

All military construction projects originally were required to strive for at least a Bronze SPiRiT rating as of FY 2006, at which point a Silver rating will be required. There are also required to be 10 Showcase projects in FY 2003, 12 in FY 2004, and a number increasing by two every year thereafter, which should aim for Gold or Platinum ratings. To date, the Army has focused particularly on greening family housing.

The Army recently also has focused on the deconstruction of buildings intended for removal, with research and implementation being spearheaded by USACE and CERL. Official endorsement, is provided in the January 18, memo cited below.

- (4/26/00): Sustainable Design and Development (DASA, I&H)
    - Incorporate sustainability into installation planning and infrastructure, balanced with cost and customer requirements.
    - ACSIM to develop implementing policy; USACE to develop technical guidance.

- (5/26/00): Sustainable Design and Development Policy (ACSIM)
    - SDD defined as "the systematic consideration of current and future impacts of an activity, product or decision on the environment, energy use, natural resources, the economy and quality of life."

- (1/18/01): Deconstruction and Re-Use of Excess Army Buildings (DASA, I&E)
    - The Army will develop policy, provide technical assistance and develop technologies for building deconstruction and reuse, in cooperation with other Federal agencies.

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[4] From 1/18/01 DASA (I&E) memo <http://www.cecer.army.mil/sustdesign/RayClarkMemo.pdf>

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- (5/1/01): Technical Letter ETL 1110-3-491: Sustainable Design for Military Facilities (Chief, Engineering and Construction Division, USACE)
    - Introduction of SpiRiT and additional technical guidance.
    - All USACE military facility design shall phase in SDD and strive for SPiRiT Bronze.

- (5/4/01): Sustainable Project Rating Tool (SPiRiT) (ACSIM)
    - As of 6/1/01, Army will begin using SPiRiT. Initial goal is for all MACOM and installation projects to achieve a minimum Bronze rating. There will also be SDD Showcase Projects aiming for higher ratings.

- (6/1/01): SDD (Director of Military Programs, USACE)
    - All new designs shall strive to achieve Bronze; when District can't achieve this, they must inform HQ.

- (3/18/02): SDD (Assistant Secretary, I&E)
    - Endorses and emphasizes goal.

- (12/21/02): Sustainable Project Rating Tool (SPiRiT) (ACSIM)
    - All projects beginning with FY 2006 will achieve Silver level.

- (2/4/03): SDD (Director of Military Programs, USACE)
    - Reiterates Silver goal.
    - 10 showcase projects in FY 2003 and increase by two every year after. Showcase projects should aim for Gold.

- (3/18/03): SDD (Assistant Secretary, I&E)
    - Silver rating minimum requirement for FY 2006 MILCON projects currently under design.
    - Gold rating minimum requirement for all other FY 2006 and future-year MILCON projects.
    - Gold goal for projects under the Residential Communities Initiative.

IV. Results and Case Studies

There are not many completed case studies yet, as FY 2002 projects, the first to use SPiRiT, are just now nearing completion. However, there is preliminary information available:

- USACE's SDD website <http://www.cecer.army.mil/sustdesign/ArmyProjects.cfm> includes links to, among other resources:
    - SPiRiT submissions from Forts Carson and Hood (TX);
    - A Sustainable Design Charrette report from Fort Monmouth (NJ);
    - A report on deconstruction at Fort McCoy (WI).

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- ACSIM's SDD website <http://www.hqda.army.mil/acsimweb/fd/linksSDD.htm> includes links to:
    - A *Public Works Digest* article on the Fort Hood and Fort Monmouth green facilities;
    - A Sustainable Design study of several facilities at Fort Bragg (NC);
    - Case study of Fort Lee (VA) Energy Star Housing;
    - A list of planned SDD Showcase Projects

- Fort Carson Training Facility profile <http://aec.army.mil/usaec/publicaffairs/update/win03/win0312.html> and <http://www.hqda.army.mil/acsimweb/fd/docs/GrnBldgFactSheet03.pdf>

- Arizona National Guard EcoBuilding case study <http://www.azecobuilding.com>

- Fort Bragg sustainability goals, including designing all new construction to LEED™ Platinum by 2006, discussed at: <http://aec.army.mil/usaec/publicaffairs/update/fall01/fall0115.html>

- Fort Hood Environmental Training Facility profiles:<http://www.cecer.army.mil/EARUpdate/NLFiles/2002/TurnGreen.cfm> and <http://www.ci.austin.tx.us/greenbuilder/nl_may_newsletter.htm>

- Fort Huachuca's Water & Energy Management Program (winner of a 2003 White House Closing the Circle Award for Sustainable Design/Green Buildings) <http://www.energy.wsu.edu/ten/ss_huac.htm> and <http://ofee.tteam.com/query/results2.cfm?id=55&agencyid=5>

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U.S. Navy

I. Organization

The organizational lead on construction for the Navy and Marine Corps, including green building, is Naval Facilities Engineering Command (NAVFAC). <http://www.navfac.navy.mil>
The Office of the Chief Engineer has the lead on sustainable development policies and standards. <http://www.navfac.navy.mil/cheng>
Also, NAVFAC Engineering Services <http://navyenergy.nfesc.navy.mil> hosts a Navy Energy Website <http://navyenergy.nfesc.navy.mil>.

Contact: Mr. Dennis Talton, NAVFAC, 757-322-4211, <taltondo@efdlant.navfac.navy.mil>

II. Baseline Data

The Department of Navy (DoN), which includes the Marine Corps, has total facility space of approximately 612 million square feet. In 2001, DoN had 91 new building design and construction projects. DoN also leases 57.5 million square feet.[5] Of DoD's 6,425 locations worldwide, DoN has 488 or seven percent of them.

Compared to FEMP estimates, DoN has 30 percent of DoD's square footage, and about 20 percent of the total square footage of the Federal government. This puts DoN second only to the Army in the size and extent of its property portfolio.

III. Policies and Resources

DoN began on a course toward sustainable building 10 years ago. At that time, the Navy started conducting research on the topic with the American Institute of Architects, USGBC, and Rocky Mountain Institute and launched an eight-building pilot.

In 1997, DoN began the Whole Building Design Guide (WBDG) <http://www.wbdg.org>, which now has eight Federal agency partners (including DoD) and has been managed by the National Institute of Building Sciences since 2000. The WBDG follows DoN's philosophy of incorporating sustainability requirements into its mainstream specifications and guidelines, rather than leaving them as a unique add-on. Within the WBDG, the Construction Criteria Base includes DoN building standards, specifications and guidance.

The sustainable systems management initiative also demonstrates this philosophy by combining the concept of environmental management systems and business management systems, covering several "business lines", including Capital Improvements, Real Estate, Engineering, Environmental, Base Development, and Base Operations Support. Another element of the DoN

[5] http://navyenergy.nfesc.navy.mil/

approach to sustainable building is the goal of greening Navy facilities without adding to design and construction costs.

Policy Memos:

- PDPS 98-01 (6/18/98), Design of Sustainable Facilities and Infrastructure
  - Applies to all projects; no increase in first cost or design costs; key is integrated design

- PDPS 98-02 (6/18/98), Criteria Supporting Design of Sustainable Facilities
  - Industry-based guidance.

- PDPS 98-03 (6/18/98), Procurement of Sustainable Facilities – AE Contracts
  - Architects and engineers must demonstrate "knowledge and demonstrated experience in applying sustainability concepts and principles to facilities and infrastructure problems through an integrated design approach."

- Memo, 7/2/02, Adopting the U.S. Green Building Council's LEED™ Rating System, from J.W. Wright, Chief Engineer: LEED™ (at least Certified) required as a tool and metric; submission for LEED™ certification not required.

IV. Results and Case Studies

- Bachelor Enlisted Quarters (MCPON Plackett Manor), Great Lakes Naval Training Center, IL <http://www.epa.gov/opptintr/epp/pilot/navybeqcase.htm>
  - LEED™ 1.0 Certified; CTC 2000 award; ES 2001 showcase award; CTC 2000 award; 2001 Federal Energy Saver Showcase Award
  - $55 million, 365,000 square feet ($150/sq ft)
  - Exceeds ASHRAE 90.1-1989 by 24 percent with high insulation and reflective roofing.

- Washington Navy Yard, DC
  - Building 33 renovation
    - $95,000 investment yielded $58,000 savings per year – less than two-year payback.
    - Features include moving from ambient to task lighting.
    - Monitoring energy use closely.

  - Naval Sea Systems Command HQ
    - Three structures, 1 million square feet, $165 million budget
    - Low Impact Development Pilot Projects
    - Bioretention strips and cells, tree box filters at paved areas, constructed wetlands, stormwater detention strips

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- Navy's Energy Demonstration Facility, Building 850, Port Hueneme, CA (completed 2001) <http://www.nbvc.navy.mil/PublicWorks/energy_showcase/bldg850.htm> http://www.ctg-net.com/Energetics/CBC-showcase/Web%20Site/history/showcase.htm.
    - Zero energy building, photovoltaics, natural ventilation
    - AIA/COTE 2002 Top Ten Green Projects
    - Completed 2001

- Naval Academy Academic Complex Repairs (completed 2001)
    - Renovation of two buildings; $30 million budget;
    - Added skylights, raised ceilings.

- P-293/Sailor Ashore Program, Norfolk, VA
    - $54 million budget, 95,000 square feet.
    - Seeking LEED™ Silver.

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U.S. Air Force

I. Organization

The Office of the Civil Engineer provides guidance on design and construction issues to the Air Force. The Air Force Center for Environmental Excellence (AFCEE) <http://www.afcee.brooks.af.mil>, a field operating agency of the Civil Engineer, provides technical support as requested to Air Force Commands. AFCEE also provides architectural design guidance, including the Sustainable Facilities Guide and various design guides for different facility types. The Sustainable Facilities Guide translates the LEED™ guidance into specific actions for design teams to take. Some of the Design Guides already include sustainability concerns, while others are being updated.

The Air Force Reserve Command (HQ AFRC), one of several Air Force Major Commands, is involved in a broader sustainable development program that creates policies and action plans designed to guide entire AFRC installations toward operational sustainability. AFCEE provides technical and contracting support to HQ AFRC for this program.

Air Force Civil Engineer Support Agency (AFCESA) <http://www.afcesa.af.mil>, also a field-operating agency, provides expertise for design criteria, construction standards, life cycle and sustainable costs, energy and water conservation, and operations and maintenance issues. AFCESA's Facility Energy Program (part of the Technical Support Directorate's Mechanical/Electrical Engineering Division) has a web page at <http://www.afcesa.af.mil/directorate/ces/mechanical/energy>. AFCESA also has a Water Conservation page at <http://www.afcesa.af.mil/directorate/ces/civil/water/waterconserv.htm>.

Contact: Ms. Karen Kivela, AFCEE, (210) 536-4191, <Karen.Kivela@brooks.af.mil>

II. Baseline Data

The Air Force has almost 1,300 installations or locations on U.S. territory and almost 300 additional locations overseas. As per last years Real Property Inventory, Air Force facilities comprise of 563 million square feet.

III. Policies and Resources

The Air Combat Command (ACC) and AFCEE both started focusing independently on sustainable design in 1995.

- (12/19/01): Sustainable Design and Development Policy (The Civil Engineer, DCS/Installations & Logistics)
    - Declares "Air Force policy to apply sustainable development concepts in the planning, design, construction, environmental management, operation,

maintenance and disposal of facilities and infrastructure projects, consistent with budget and mission requirements."

- Calls for "integrated programming and project planning" through the use of multidisciplinary teams, and the selection of contractors partly on the basis of their knowledge of environmental issues.

- LEED™ is described as "the Air Force preferred self-assessment metric." At least 20 percent of each major command's projects are to be selected as LEED™ pilot projects in FY 2004, with increasing percentages of projects until FY 2009, when all military construction projects are to be capable of achieving LEED™ certification.

Guidance documents:

- Air Force Sustainable Facilities Guide <http://www.afcee.brooks.af.mil/dc/dcd/arch/rfg/index.html>

- Air Force Construction and Demolition Waste Management Guide <http://www.afcee.brooks.af.mil/eq/programs/summary.asp?rscID=870>

- Air Combat Command Sustainable Facilities Guide <http://www.afcee.brooks.af.mil/green/case/accsfguide.pdf>

- AFCEE's Web University: Sustainable Development Training – introductory course for sustainable planning, design, construction and management of facilities: <https://webu.brooks.af.mil/webu/secure/onlinecourse.asp>

IV. Results and Case Studies

- Sustainable Development Case Study: Air Force Space Command (HQ AFSPC) Military Family Housing Construction, Vandenberg AFB, CA <http://www.afcee.brooks.af.mil/green/case/vandenburg.asp>

- Sustainable Development Case Study: Air Combat Command (HQ ACC) Squadron Operations Facility at Seymour Johnson (AFB), NC <http://www.afcee.brooks.af.mil/green/case/acc.asp>

- The Sustainability Action Plan for March Joint Reserve Base, California: <https://wwwmil.afrc.af.mil/HQ/CE/cev/cevq/Sustainability/Sustainability.htm> (This is a secure site, accessible to DoD personnel only; all others please contact the HQ AFRC program manager, Mr. Bret Donegan, <bret.donegan@AFRC.AF.MIL>)

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Appendix B: Federal Agency Profiles

General Services Administration

I. Organization

Within the General Services Administration's (GSA) Public Buildings Service (PBS), the Office of Business Operations' Environmental Business Strategies Division works with PBS building professionals to apply green building design to GSA buildings. <http://www.gsa.gov/Portal/content/orgs_content.jsp?contentOID=22883&contentType=1005>

Within PBS, the Office of the Chief Architect provides architectural, engineering and construction services. GSA's Office of Realty Services also offers a Green Leasing program. <http://www.gsa.gov/Portal/content/offerings_content.jsp?contentOID=113404&contentType=1004>

Contact: Mr. Don Horn, 202-501-4525, <donald.horn@gsa.gov>

II. Baseline Data

GSA controls a total inventory of more than 8,300 buildings comprising 330 million square feet of workspace. This includes 1,700 government-owned buildings comprising around 200 million square feet, and around 6,500 buildings in which the government leases privately-owned space.[6] Ninety percent of GSA square footage is office space.[7]

III. Policies and Resources

- Facilities Standards for the Public Buildings Service (PBS-P100) (revised 2000) <http://policyworks.gov/org/main/mp/gsa/index.html>
    - "GSA is committed to incorporating principles of sustainable design and energy efficiency into all of its sustainable building projects." Sustainable design is defined as an "integrated, synergistic approach, in which all phases of the facility lifecycle are considered."
    - "These principles shall serve as the basis for planning, programming, budgeting, construction, commissioning, operation, maintenance, decommissioning of all new GSA facilities, and for major renovation and alteration of existing buildings and facilities."

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[6] GSA Public Buildings Service web site <www.gsa.gov/Portal/content/orgs_content.jsp?contentOID=22883&contentType=1005>

[7] FEMP CD

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- All GSA buildings must be certified through LEED™, and are encouraged to achieve a Silver rating.

- Awards programs include the Demolition Derby for best practices in construction debris reduction.

IV. Results and Case Studies

At least 70 GSA-owned facilities, and at least one GSA-leased facility, have earned the Energy Star Buildings label. Numerous GSA facilities are seeking LEED™ ratings. (Note: EPA GSA buildings will be listed in the EPA agency profile.) Information on the following case studies is available to GSA employees through GSA's Insite intranet site.

- **U.S. Courthouse and Federal Building, Youngstown, OH**
  - LEED™ Certified
  - Completed 2002, $16 million, 49,000 sq. ft. ($326/sq. ft.)
  - Highest scores were for sustainable sites (brownfield, reduce stormwater and heat islands) and IAQ (reduce emission, daylighting); local manufacture, xeriscaping

- **Social Security Administration Annex, Baltimore, MD**
  - LEED™ Certified
  - Completed 2002; $50 million; 447,000 sq. ft. ($112/sq. ft.)
  - Increased lighting performance
  - The installation of a new HVAC system meeting the requirements of ASHRAE62-1999 prevented the development of indoor air quality problems in the building, maintaining the health and well-being of the occupants.
  - Reused 77 percent of the building's exterior, 76 percent of the interior, and recycle/salvage 79 percent of construction materials, preventing 4,133 out of 5,239 tons from going to landfill.

- **Federal Campus, Oklahoma City, OK**
  - Expected completion in mid-2003; 179,051 square feet
  - Waterless urinals, faucet aerators, and low flow showerheads conserve water
  - High efficiency lighting
  - 30 percent less energy consumption costs than the baseline building
  - Built with local materials, recycled steel and plastic products, and fly-ash concrete
  - Features low VOC paints, adhesives, and sealants, and oversized windows to increase day-lighting and enhance worker comfort and productivity

- **Border Station, Sault Saint Marie, MI**
  - 179,051 square feet

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- Features a vegetated roof
- Low-flow and water efficient fixtures and appliances
- High efficiency lighting
- Used local and recycled materials in construction of new facility

- **National Oceanic and Atmospheric Administration, Boulder, CO**
  - Completed in March 1999; $61.5 million; 371,500 square feet
  - Retention pond water used for irrigation
  - Greater use of skylights and solar energy
  - Used recycled content ceiling and carpet tiles and low VOC materials in construction

- **Federal Building, San Francisco, CA**
  - Expected completion in Fall 2005; $144 million; 575,000 square feet.
  - Ultra low-flush toilets and restricted flow fixtures
  - Sensors turn off lights in unoccupied areas and areas lit by sufficient daylighting
  - Built with 30 percent fly ash concrete and recycled content carpeting

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Appendix B: Federal Agency Profiles

U.S. Department of the Interior
National Park Service

I. Organization

The Associate Director for Park Planning, Facilities and Lands, who reports directly to the Director of the National Park Service (NPS), is in charge of buying, designing, building and maintaining property. This Directorate has almost a $1 billion budget. This Associate Director chairs the Design Board, which includes other Associate Directors and engineers, and reviews all budget items worth more than $500,000. NPS receives more than over $100 million for design and construction annually from Congress. NPS also has a National Leadership Council comprised of Regional and Associate Directors. NPS is highly decentralized, with park supervisors having some independent management authority.

Contact: Mr. Shawn Norton, Environmental Leadership Coordinator, (202) 354-1835 <shawn_norton@nps.gov>

II. Baseline Data

The NPS includes 385 parks located on more than 80 billion acres of land.

III. Policies and Resources

NPS first began implementing the concept of sustainable design in 1993, with its first sustainable design charrette in the Virgin Islands. At the time, NPS developed a number of resources and encouraged numerous national parks to implement greening activities. This program was reinvigorated in 1999, as NPS management committed to the concept of "environmental leadership," which includes sustainable design.

Today, as part of the NPS Design Board's review process, all construction projects valued at more than $500,000 must submit a LEED™ checklist, although they don't have to register for LEED certification, depending on cost feasibility. NPS is developing a broad service-wide policy directive on environmental leadership, including concepts of greening and sustainability. A series of greening workshops are being held at interested parks. To allow for corporate and other partners to support green operations, outreach and training, NPS also is starting a Green Parks Partnership Program through the Park Foundation.

- Memorandum of Understanding Between the Secretary of Energy and the Secretary of the Interior (4/27/99) <http://www.nps.gov/renew/mou.htm>:
    - Inaugurates a joint "Green Energy Parks" program

- A98(2450): (7/13/99) Environmental Leadership (Director, NPS) <http://www.nps.gov/renew/leadership.htm>

- "Environmental leadership" includes full compliance with environmental laws, going beyond compliance with pollution prevention and sustainability, and educating NPS staff, concessionaires and visitors on these concepts.

- This commitment is to be codified in an implementation plan, performance goals, management policies, guidance, and environmental audits.

IV. Results and Case Studies

- NPS has an older website at <http://www.nps.gov/renew> and a newer website at <http://www.nps.gov/sustain>. Both contain extensive case studies.

- There are also extensive case studies of two buildings at Zion National Park at <http://www.eere.energy.gov/buildings/highperformance/case_studies>.

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Appendix B: Federal Agency Profiles

U.S. Environmental Protection Agency

I. Organization

The U.S. Environmental Protection Agency's (EPA) Office of Administration and Resources Management (OARM) is responsible for both facility management and ensuring that the Agency lives its mission to protect human health and the natural environment.

EPA design and construction services are overseen by the Architectural, Engineering and Asset Management Branch (AEAMB) within the Facility Management Services Division (FMSD) under the Office of Administrative Services. AEAMB employs private architectural, engineering and construction firms for most design and all construction work.

In 2000, EPA created the Sustainable Facilities Practices Branch (SFPB) within FMSD to reflect the importance that the Agency places on green building design and construction. Staffed by a branch chief, architect, national energy coordinator, and mechanical engineers and supported by contractors specializing in green building issues, SFPB serves as an advocate, coordination point, and technical advisor on sustainable practices, policies, and project implementation to EPA's facility-related organizations and personnel. SFPB also manages a Web site on EPA's own green building efforts.
<http://www.epa.gov/greeningepa/index.htm>

Contact: Mr. Bucky Green, SFPB, 202 564-63771, <green.bucky@epa.gov>

II. Baseline Data

EPA occupies more than 140 buildings across the country, as well as two research vessels. EPA facilities account for approximately 8.9 million square feet of building space. EPA owns only 17 percent of its facilities; the rest are owned or leased by GSA.

III. Policies and Resources

As part of its mission to protect human health and the environment, EPA incorporates sustainable building principles into the siting, design, and construction of all new facilities, as well as the renovation and maintenance of existing facilities. The Agency requires Silver LEED™ certification for new significant building construction or acquisition, but strives for higher. EPA has a *Green Buildings Vision and Policy Statement* that serves as a guide for sustainable projects.
<http://www.epa.gov/greeningepa/p2/eppgoals.htm>
<http://www.epa.gov/greeningepa/projects/policy.htm>

For leased space, EPA works with GSA to incorporate its holistic, systems approach to building design and renovation wherever possible. The Agency has made an effort to improve

environmental performance through green lease riders, or amendments to traditional lease language that emphasize energy, water, and resource efficiency. Following are links to green lease riders for buildings constructed recently in Kansas City, Kansas.
<http://www.epa.gov/greeningepa/content/energy/grider_hq.htm>
<http://www.epa.gov/greeningepa/content/energy/grider_stc.htm>

In addition to Headquarters and Regional Offices, many of EPA's buildings are laboratories devoted to environmental research in support of the Agency's mission. Although laboratories are typically more energy-intensive than other facilities, EPA works to ensure that energy conservation and other sustainable features are incorporated into the design and operation of its laboratories. OARM supports the Laboratories for the 21st Century Program (Labs21), which assists Federal government and private entities in the design and operation of environmentally sustainable laboratories and is helping the U.S. Green Building Council develop environmental performance criteria for labs.
<http://www.epa.gov/greeningepa/labs21/index.htm>

IV. Results and Case Studies

Over the past two years, EPA completed construction of several buildings and campuses that are models of green buildings. These projects are described in the following documents:

- *EPA's Green Future for Laboratories*: A Case Study of the Kansas City Science & Technology Center:
<http://www.epa.gov/greeningepa/content/kc_brochure.pdf>

- *Off the Shelf*: EPA Regional Headquarters, Kansas City, Kansas:
<http://www.epa.gov/greeningepa/content/projects/off_shelf.pdf>

- *Green Building*: EPA New England Regional Laboratory:
<http://www.epa.gov/ne/lab/pdfs/greenlab.pdf>

- *Leading by Example*: Two Case Studies Documenting How the Environmental Protection Agency Incorporated Environmental Features into New Buildings: <http://www.epa.gov/oppt/epp/pubs/grnbldg.pdf>

- *The Greening Curve*: Lessons Learned in the Design of the New EPA Campus in North Carolina: <http://www.epa.gov/rtp/new-bldg/environmental/thegreeningcurve-new.pdf>

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Appendix B: Federal Agency Profiles

U.S. Department of Energy

I. Organization

Ultimate responsibility for the buildings at Department of Energy (DOE) sites rests with the major DOE Program Offices and Field Offices. Most sites are contractor managed and operated. Many of the larger sites are designated as National Laboratories. Either the DOE field office or contractors managing and operating the sites hire private architectural, engineering and construction firms to accomplish most design and construction work.

Within DOE, the Office of Engineering and Construction Management <**http://oecm.energy.gov/**> within the Office of Management, Budget and Evaluation provides corporate processes and oversight of the Department's construction projects and real property; advocates value added change in the Department's project and facilities management systems; integrates sound fiscal acquisition and business practices into the management of projects and facilities, and supports DOE's project managers.

Also, the Assistant Secretary for Energy Efficiency and Renewable Energy (EERE) <**http://www.eere.energy.gov/**> is responsible for advocating policy, programs, and new initiatives to take appropriate actions to conserve energy at DOE facilities. Within EERE, the Federal Energy Management Program (FEMP) <**http://www.eere.energy.gov/femp.html**> supports DOE Field Offices with complying with energy-related requirements such as Executive Order 13123 and the Presidential Directive of May 3, 2001, *Energy Conservation at Federal Facilities*. FEMP also provides Departmental Energy Management Program funding support for energy efficiency retrofit projects at the sites.

Contact: Ms. Beth Shearer, FEMP, 202-586-5772

II. Baseline Data

DOE owns or leases more than 12,000 buildings at more than 50 sites throughout the United States. Currently occupied buildings comprise 96.2 million square feet, which is divided into laboratory space (23 percent), production space (34 percent), office space (14 percent), and other activities such as storage and service space (29 percent). Environmental cleanup is being conducted at many DOE sites and several large sites are scheduled for closure. One major DOE program, the National Nuclear Security Administration, has concluded that 50 percent of its buildings are at least 50 years old and that 70 percent are inadequate or in poor condition. About 20 percent of DOE's building inventory has been declared surplus because of changing missions.

III. Policies and Resources

DOE Order 430.2A, Departmental Energy and Utility Management, April 15, 2000, emphasizes the energy efficiency strategies of Executive Order 13123, directs the application of sustainable design principles to new buildings, and recommends the application of sustainable design principles to major alterations of existing buildings.

DOE sponsored or co-sponsored the following resources for sustainable design include:

Whole Building Design Guide, <http://www.wbdg.org/>

Roadmap for Integrating Sustainable Design into Site-Level Operations, <http://www.pnl.gov/doesustainabledesign/>

Laboratories for the 21st Century, <http://www.epa.gov/labs21century>

DOE Energy Efficiency and Renewable Energy, Buildings Technology Program, High Performance Buildings, <http://www.eere.energy.gov/buildings/high_performance/>

FEMP Technical Assistance: Greening Federal Facilities, <http://www.eere.energy.gov/femp/techassist/green_fed_facilities.html>

IV. Results and Case Studies

DOE promotes sustainable building design practices by offering seed funding to DOE sites to include sustainable principles in their site design/construction programs and document LEED™ certification. Participating sites include Lawrence Livermore National Laboratory, Idaho National Engineering and Environmental Laboratory, Sandia National Laboratory, National Renewable Energy Laboratory, and Oak Ridge National Laboratory. In addition, DOE is encouraging several of its sites to become partners in the EPA/DOE Laboratories for the 21st Century initiative. Three DOE laboratories became pilot partners in FY 2002: Lawrence Berkeley National Laboratory, Sandia National Laboratory, and the National Renewable Energy Laboratory. Pilot partners receive design assistance and preferential project funding consideration.

The Sandia National Laboratory – New Mexico (SNL-NM) is reviewing and revising its standard construction specifications and Design Manual to incorporate sustainable design. SNL-NM is also training its design professionals and will be providing lessons learned to other DOE sites. Sandia's Process and Environmental Technology Laboratory is featured as a case study on the Laboratories for the 21st Century website.

The Los Alamos National Laboratory produced a Sustainable Design Guide that provides a foundation to integrate sustainable design into the architecture, construction, operation and maintenance of the site.

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The Idaho National Engineering and Environmental Laboratory (INEEL) provided sustainable design recommendations for the conceptual design of the Subsurface Geosciences Laboratory. As part of that effort, INEEL evaluated the design using the LEED™ software analysis package.

The Lawrence Berkeley National Laboratory and the National Renewable Energy Laboratory are in the process of registering laboratory buildings with the U.S. Green Building Council to undergo the LEED™ certification process.

The Argonne National Laboratory-East became the first DOE site to certify a building under the LEED™ rating system. Argonne's Central Supply Building achieved a LEED™ Silver rating.

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Appendix B: Federal Agency Profiles

National Aeronautics and Space Administration

I. Organization

The National Aeronautics and Space Administration (NASA) is committed to implementing sustainable designs in their Construction of Facilities (CoF) program. NASA policies stating their requirements for implementing sustainable designs recently established goals for CoF projects to meet the LEED™ rating of Silver. NASA encourages its designers to strive for the LEED™ Gold rating, if cost effective. NASA has included sustainable design factors in its overall corporate prioritization and rating process, for approving projects and obtaining CoF funding.

NASA employs an extensive NASA Procedures and Guidelines (NPG) manual that stipulates NASA's commitment to green building and resource conservation. Within the NPG, a Facility Project Implementation Guide provides guidance to incorporating sustainable design principles in facility construction. NPG also includes guidance for evaluating and implementing cost-effective energy efficiency, renewable energy, and water conservation measures in NASA facilities and operations. The NPG also includes policy for incorporating sustainable design in facility-type projects under agency authority and control.

NASA offers training on Sustainable Design to its field centers on a continuous basis. These courses provide information on the overall principles of sustainability in design and construction, as well as an introduction to LEED™ certification. Through additional education and exposure on Sustainable Designs, such as its Sustainable Design course, NASA is raising the level of awareness at its centers. NASA emphasizes that sustainable designs cover the full cost of a facility from planning through de-construction.

Contact: Calvin Williams, 202-358-2322

II. Baseline Data

NASA owns 2,824 buildings comprising of more than 44.5 million square feet. Nearly all NASA buildings are owned, with only 33,000 square feet of leased space.

III. Policies and Resources

NPG 8570.1, Energy Efficiency and Water Conservation Technologies and Practices: Provides guidance for accomplishing cost- and energy-efficient, renewable energy, and water conservation measures in NASA facilities and operations.

- NPG 8570.1.P.1.2: "NASA Procedures and Guidelines (NPG) has been prepared to assist NASA Headquarters, Centers, and Component Facilities, Strategic Enterprises, and Institutional Program Offices in implementing the requirements of Federal law,

Executive Orders, and NASA policy related to energy and water conservation and efficiency management. This NPG serves as a practical reference and source of guidance for use by NASA managers and other responsible staff in ensuring that NASA facilities and related operations comply with the letter and spirit of NECPA and EO 13123."

- NPG 8570.1.3.1.1: "Energy efficiency and conservation management ensure that energy and water are used effectively and judiciously. A successful program not only involves energy conservation and engineering, but every area of institutional management, including facilities and maintenance management, procurement, administration, and communications and public affairs."

- NPG 8570.1.3.7.2: "The purpose of an energy awareness program is to eliminate energy waste by making energy users more energy conscious. An awareness program attempts to influence energy users' attitudes and behavior to reduce energy waste, promote energy efficiency, prevent pollution and reduce costs. Potential savings from awareness depends on the Center's current level of efficiency and the motivation of its personnel. An effective program targets specific audiences, involves as many energy users as possible, is widely publicized, and makes energy-saving actions and goals as concrete as possible. The program should be creative, consistent, continuous, and informative."

NPG 8500.1, NASA Environmental Management: Provides guidance for overall environmental stewardship in NASA facilities through resource conservation, waste reduction, waste management, and remediation of toxic sites.

- NPG 8500.1.f: "Actively partner with Federal, State, and local regulatory agencies, as appropriate, to leverage available resources and comply with environmental requirements, prevent pollution, reduce waste generation, and manage natural resources in the most efficient and effective manner possible."

NPG 8820.2C, Facility Project Implementation Handbook (FPIH): provides a ready reference to pertinent policy and guidance for management of facility planning, budgeting, design, construction, and activation.

- Committed to making "provisions for alternate energy sources for reasons of reliability, economy, and/or pollution control."

- About Sustainability at NASA <http://www.hq.nasa.gov/office/codej/codeje/je_site/sustainability/about_sustainability.html>

IV. Results and Case Studies

NASA notes that more centers are implementing sustainable designs in their projects. The following list of projects demonstrates that NASA remains committed to improving the environment and conserving energy and natural resources through the CoF program:

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- Marshall Space Flight Center, Huntsville, AL - Construct Replacement Office Building (139,000 square feet, $23 million, Completion Date: Fall 2004); LEED™ Certification
- Goddard Space Flight Center, MD - Space Science Building, (350,000 square feet, $65 million, Completion Date: June 2007) LEED™ Silver Certification
- Kennedy Space Center, FL - Construct Operations Support Building II (189,000 square feet, $26.8 million Completion Fall 2004) considering LEED™ Certification
- Kennedy Space Center, FL - Construct Technology Development Complex (100,000 square feet, $24 million Completion mid 2007) LEED™ Silver Certification
- Ames Research Center, Moffet Field, CA – Replacement Office Building 266, (60,000 square feet, $13 million, Completion Date Fall 2006) LEED™ Silver Certification
- Dryden Flight Research Center, Edwards, CA- Construct Solar Heating System, $1.5 million, Completion Date: Spring 2007

NASA Energy Star® Buildings:

Building Name	Building Type	Building Owner	Location	Years Labeled
Child Development Center (M6-883)	Office	National Aeronautics and Space Administration	John F. Kennedy Space Center Kennedy Space Center, FL 32899	2000
Commander, Naval Meteorology and Administration Facility (Building 1020)	Office	National Aeronautics and Space Administration	John C. Stennis Space Center Stennis Space Center, MS 32529	2000

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Appendix B: Federal Agency Profiles

U.S. Department of Health and Human Services

I. Organization

The U.S. Department of Health and Human Services (HHS) is comprised of 11 Operating Divisions (OPDIVs), six of which manage real property. These six are the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), the Indian Health Service (IHS), the National Institutes of Health (NIH), the Office of the Secretary (OS), and the Program Support Center (PSC). Each OPDIV is responsible for the program and project implementation regarding green buildings, under the direction of the Division of Real Property Policy and Management Programs (DRP), Office for Facilities Management and Policy, Assistant Secretary for Administration and Management, and the Office of the Secretary.

DRP establishes program policy and oversight, generates reports on activities, and provides information to the OPDIVs on Executive Orders, directives, and initiatives set forth regarding real property, such as green buildings and sustainability. The two primary programs developed to meet these responsibilities are the HHS Energy Program and the HHS Environmental Quality Program. The Energy Program specifically addresses the improvement of energy and water efficiency in HHS facilities, through the design and construction of new buildings or renovations, the installation of projects, and the implementation of energy awareness programs. The HHS Environmental Quality Program coordinates the environmental program of the OPDIVs, disseminates information from Federal and private resources, and ensures that environmental regulations are upheld.

Typically, green building initiatives and strategies are coordinated under the HHS Energy Program and the HHS Environmental Quality Program, with support from HHS procurement offices. These programs are designed to provide a framework for the OPDIVs regarding sustainable principle; each OPDIV has developed its own structure for carrying forth the goals of green guildings and sustainability. Due to the diversity and missions of HHS sites, detailed aspects of functions such as the design and construction of new buildings or renovations, the maintenance of indoor air quality, the removal of solid and hazardous waste, the improvement of energy and water efficiency, and the procurement of products are addressed separately by each OPDIV, and often each site. However, best management practices and lessons learned are shared through the HHS Energy and Environmental Quality Programs.

Contact: Scott Waldman, HHS Energy Office, 202-619-0719, <scott.waldman@hhs.gov>

II. Baseline Data

HHS has 25.4 million square feet of facility space located in an array of diverse facilities throughout the country. Eighty-nine percent is classified as energy intensive facilities including laboratories, hospitals, health clinics, and animal housing space. The remainder is office buildings and warehouses.

III. Policies and Resources

Beginning in FY 2000, the HHS Energy Program and the HHS Environmental Quality Program began specifically addressing green buildings and sustainability. Applicable Executive Orders, directives, and initiatives were analyzed and integrated into the existing policies, programs, and projects. The Assistant Secretary issued policy memoranda and directives addressing alternative financing, renewable energy applications, Energy Star® buildings and hospitals, state funding for renewables and clean energy, and training. The OPDIVs in turn incorporated the information into the existing energy and environmental programs and goals.

CDC, FDA and NIH Design Policies and Guidelines include the mandated use of life-cycle costing, Energy Star® and energy efficient product specification and procurement, sustainable design and development principles included in the *Whole Building Design Guide* and in the LEED™ rating system, and the analysis of renewable energy systems.

In FY 2002, CDC joined the USGBC and is actively promoting the use of the *Whole Building Design Guide* and LEED™ rating system. Three new major construction projects were registered with USGBC in FY 2002, with a goal of achieving a LEED™ certification for these new buildings. In addition, HHS OPDIVs participate in the EPA Labs for the 21st Century program with the intent of designing and constructing more sustainable laboratories.

IV. Results and Case Studies

The following outlines green building or sustainable projects implemented by the HHS OPDIVs.

CDC

- Solar Power Project, Kenya, Africa. The solar project will eliminate the extensive use of diesel fuel and provide a reliable source of energy for a laboratory clinic. <http://www.eere.energy.gov/femp/newsevents/cfm/fempfocusarticle.cfm?newsID=6>

- Clifton Road Campus Building 21 Design and Construction, Atlanta, Georgia. The laboratory is being designed and constructed under the LEED™ rating system. <http://www.eere.energy.gov/femp/newsevents/cfm/fempfocusarticle.cfm?newsID=249> http://www.eere.energy.gov/femp/newsevents/cfm/fempfocusarticle.cfm?newsID=249.

FDA

- Jefferson Laboratories Energy Program, Jefferson, Arkansas. This facility surpassed energy reduction mandates as the result of a strong energy program that centered on Utility Energy Services Contract (UESC). The greening efforts on the campus have decreased energy consumption by 39 percent, energy costs by 24 percent, and greenhouse gas emissions by 27 percent on a square foot basis.

- White Oak Campus Design and Construction, Maryland. This new, GSA-leased campus will include a 10-kW photovoltaic system, cogeneration, absorption chiller, variable frequency drives on chilled and condenser water pumping and cooling tower fans, reduced lighting loads, variable air volume systems with variable frequency drives,

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demand control ventilation, night-setback strategies, and an economizer cycle.

- Irvine Laboratory Design and Construction, Irvine, California. The design of this new laboratory utilized basic sustainable design principles such as the construction of a tall and narrow building to take advantage of natural lighting and walls constructed of architectural concrete that will not require insulation and drywall. In addition, native vegetation was planted to reduce maintenance and irrigation requirements of the landscaping, and reclaimed water will be used for those plants.

IHS

- Ground Source Heat Pump Application in Residential Housing in Rosebud and Pine Ridge, South Dakota. <http://www.eere.energy.gov/femp/newsevents/femp_focus/feb01_groundsource.html>

- Albuquerque Indian Hospital (AIH) Energy Improvement Project, Albuquerque, New Mexico. This ongoing renovation project includes a ground source heat pump heating and cooling system consisting of roughly 60 heat pumps of various sizes serving the entire hospital 24 hours per day. More than 100 wells located beneath the parking lot provide the ground source temperature exchange and a new direct digital controls system provides precise control of each zone. Conservative and preliminary studies estimate that natural gas consumption has been reduced by 30 percent or $10,000 per year, and more significantly, maintenance man-hours have been decreased by 45 percent.

- Alaska Native Medical Center Ground Water Cooling Project, Anchorage, Alaska. A ground water cooling project is currently under construction for the Alaska Native Medical Center, and is expected to be completed in FY 2003. The estimated savings of the project is $50,000 annually.

- IHS Blackfeet Hospital 2002 Energy Star® Label, Browning, Montana. In 2002, only three other private or public hospitals nationwide received the Energy Star7 label. The Blackfeet Hospital was able to earn this honor by maintaining indoor environment requirements for air quality, thermal comfort and lighting. It has not only the distinction of being the first HHS building to receive the label, but the first hospital in the nation to receive a "Mark of Excellence in Energy Performance."

NIH

- Louis Stokes Laboratory/Building 50 Design and Construction, Bethesda, Maryland. This state-of-the-art laboratory was designed to incorporate the latest energy efficient technologies. The facility will use roughly 40 percent less energy than a comparable, standard design laboratory. <http://www.eere.energy.gov/femp/techassist/pdf/029413m_BR_Labs21C.pdf>

- NIH Bethesda Campus 23-MW Cogeneration Plant, Bethesda, Maryland. This project is a prime example of a highly efficient energy system with an approximate efficiency rating of 85 percent, which will save more than 640 billion Btu and approximately $3.6 million per year. In addition, the plant will reduce greenhouse gas emissions by roughly 100,000

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tons per year, and other pollutant emissions and particulate matter by close to 600 tons per year.
<http://www.eere.energy.gov/femp/newsevents/femp_focus/aug00_cogeneration.html>

- NIH Animal Center (NIHAC) Non-Potable Water Distribution System, Poolesville, Maryland. This innovative non-potable water (NPW) distribution system recycles treated effluent from the NIHAC Waste Water Treatment Plant to be used for cage wash flushing operations at the Animal Center and for cooling tower make-up water. The annual water savings is estimated at 10.4 million gallons that would normally have been supplied by well water. The NPW system will be the first of its kind in the State of Maryland.

- NIH Bethesda Campus Recycling Program, Bethesda, Maryland. The NIH Bethesda Campus has established an extensive solid waste recycling program covering white and mixed paper, plastic, glass, aluminum cans, cardboard, scrap metal, wooden pallets, alkaline batteries, polypropylene research racks, toner cartridges, computers and other office equipment, yard waste, and chemical/solvent waste. Currently, the campus is recycling 30 percent of the solid waste stream.

PSC

- PSC Parklawn Building, Rockville, Maryland. An alternative financing contract with the local utility allowed for the installation of energy efficient lighting and water saving plumbing fixtures. The projects' annual savings is $211,000, equating to nine percent of annual electricity consumption and 6.3 million gallons of water.

OS

- OS Hubert H. Humphrey Building, Washington, DC. Many energy conservation measures have been installed including energy efficient lighting, window solar film, water saving fixtures, and an automated building control system.

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Appendix B: Federal Agency Profiles

U.S. Department of State

I. Organization

The State Department's Architectural Design Branch (ADB) is currently pushing all new office buildings to achieve LEED™ Certification. The ADB is a branch of the State Department's Overseas Building Operations (OBO), which directs the worldwide overseas buildings program for the Department of State. The OBO sets worldwide priorities for the design, construction, acquisition, maintenance, use, and sale of real properties and the use of sales proceeds. Additionally, Standard Delivery Systems (SDS) and Standard Embassy Designs (SED) are in place to promote sustainable building across State Department projects. Three NOBs are currently being developed to meet LEED™ Certified standards, and information regarding current green building programs can be gleaned from *State Magazine,* published monthly by the State Department.

Contact: Donna McIntire, 703-875-5336

II. Baseline Data

The State Department controls more than 15,000 buildings comprising of 59.2 million square feet. The predominate State Department building types are residential, offices/embassies, and functional, of which 30 percent are owned and 70 percent are leased.

III. Policies and Resources

The State Department includes sustainable and green building language in its Requests for Proposals (RFPs) and is also incorporating it into their Standard Embassy Design (SED) contract requirements.

- RFP C.4.5 Sustainable Design:

"The Contractor shall utilize the LEED™ Green Building Rating System (Version 2.1) as developed by the U.S. Green Building Council to earn a minimum LEED™ Certified Rating (26 points) for the office building(s) and compound sitework. Refer to C.5.5.1.5.2 for associated reporting requirements."

- RFP C.5.5.1.5.2 Sustainable Design Rating:

"The Contractor shall complete the LEED™ 2.1 Reporting Format (Attachment J.2.11) for the Design Development Submittal. The Contractor shall prepare the LEED™ Certification documentation for the minimum 26 LEED™ points being earned as defined under LEED™ 2.1. When LEED™ documentation is complete, the Contractor shall transmit two copies to the USG for acceptance."

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The above information comes from State Department LEED™ -specific RFP language. For complete sources, contact Donna McIntire at 703-875-5336.

IV. Results and Case Studies

Three new office buildings are currently being developed to the LEED™ Certified standard, and the ADB is pushing to have all NOBs achieve LEED™ Certification.

- ADB has conducted an analysis of which LEED™ credits are easiest and most appropriate for State Department buildings to meet (about 30 points total). Examples of credits embassies might be able to meet: Brownfields, alternative transportation, daylighting (many embassies have day-lit atriums). Some examples of credits embassies often cannot meet are urban area, white roofs, light pollution, reuse of buildings, certified wood, rapidly renewable materials, ventilation effectiveness, and operable windows.

- There are currently three green embassies being constructed in Sofia, Bulgaria; Abidjian, Ivory Coast; and Yerevan, Armenia. These embassies were contracted under the older SDS requirements, which are being phased out by the more streamlined SED. The design stage is almost complete, and construction should be completed in another year or two.

The new SED is more streamlined, and LEED™ Certification is less emphasized than it was under SDS. On paper, the requirement to meet LEED™ requirements remains in force, but architects often do not seem to know or understand it.

- Although SED initially de-emphasized LEED™ requirements, ADB notes that in FY 2003, RFP language has been revised to renew the importance of meeting LEED™ requirements.

- There are seven buildings being constructed under SED right now. Being SDS contracted projects, the three embassies being built in Armenia, Bulgaria, and Ivory Coast are not included in these seven.

- The design-built approach, which is how the State Department contracts SED projects, emphasizes initial costs, not lifecycle costs (though this seems to be changing in FY 2003). Green roofs were an example of a feature put in one of the pilots and later taken out for cost reasons.

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Appendix C:
Federal Green Building Forums

General Sustainable Building Networks

X **Interagency Sustainability Working Group**
- S **Membership**: Representatives of over a dozen Federal agencies, led by DOE's Federal Energy Management Program (FEMP).
- S **Products**: FEMP's Sustainability Initiative and Greening Program webpage, http://www.eere.energy.gov/femp/techassist/sustain_green.html. Developing "The Business Case for Sustainable Design in Federal Facilities" (draft)
- S **Notes**: Began monthly meetings in 2001, for agencies to share information and experiences regarding implementing sustainable design in their facilities, in accordance with Executive Order 13123.

X **Federal Network for Sustainability**
- S **Membership**: Mostly Western Regional offices of: Army, Navy, Air Force, DOE, EPA, NASA, NPS, USPS and Bonneville Power Administration
- S **Products**: http://www.federalsustainability.org
- S **Notes**: Started in 2000, with a focus on a variety of issues, including recycled paper procurement, electronics product stewardship, environmental management systems and green power. Green building is an emerging concern.

X **Federal Green Building (FedGB) Listserv**
- S **Membership**: Over 300 Federal employees involved in green building
- S **Products**: EPA Green Building website <www.epa.gov/greenbuilding>
- S **Notes**: Run by EPA Office of Solid Waste and Office of Pollution Prevention; started in 2000.

X **U.S. Green Building Council (USGBC) Federal Summit**
- S **Membership**: Federal members of USGBC
- S **Products**: Annual summit in DC
- S **Notes**: Opportunity for Federal officials to share information and network on green building issues. Started in 1997.

X **National Research Council (NRC)'s Ad Hoc Task Group on Integrating Sustainable Design, Life-Cycle Costing and Value Engineering into Facilities Acquisition**
- S **Membership**: Senior architects and engineers from several agencies; led by State and National Park Service

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– **Products**: *Sustainable Federal Facilities: A Guide to Integrating Value Engineering, Life-Cycle Costing and Sustainable Development* (2001)

S **Notes**: Part of NRC's Federal Facilities Council, which in turn falls under its Board on Infrastructure and the Constructed Environment.

X **Whole Building Design Guide (WBDG)**

S **Membership**: Developed and sponsored by DoD, DOE, EPA, FEMA, GSA, NASA, HHS/NIH, DVA, and other Federal agencies.

S **Products**: WBDG at www.wbdg.org

S **Notes**: Provides design guidance in fulfillment of seven design principles, one of which is sustainability. (The others are accessibility, aesthetics, cost-effectiveness, functionality, productivity and security/safety.) Some agencies maintain their design specifications at the WBDG's Construction Criteria Base, including the armed services, which are combining them into Unified Facilities Guide Specifications. Begun by the Navy in 1997 and managed by the National Institute of Building Sciences (NIBS) since 2000.

X **Federal Agency Housing Partnership**

S **Membership**: Members of Federal agencies involved with housing issues

S **Products**: None to date.

S **Notes**: Formerly the Federal Agency Working Group (FAWG) under HUD's Partnership for Advancing Technology in Housing (PATH). Although the FAWG previously operated for several years as an information-sharing opportunity, the new Partnership has just come together at the end of 2002.

Single-Issue Networks

X **Interagency Energy Management Task Force**

X **Membership**: Managed by DOE's FEMP program, this group includes the chief energy managers of the major Federal agencies.

X **Products**: The FEMP website includes more information and meeting minutes at: <http://www.eere.energy.gov/femp/aboutfemp/coordination/agencycoord.html>

X **Notes**: Established by the Federal Energy Management Improvement Act of 1988 to stimulate increased energy efficiency in the Federal sector. This Task Force also serves as a technical advisor to the Federal Interagency Energy Policy Committee ("656" Committee), a group of high-level managers (e.g., Assistant Secretary level) that meets infrequently.

X **Building Deconstruction Consortium**

X **Membership**: EPA, Army Corps of Engineers Construction Engineering Research Lab (CERL), Army Environmental Policy Institute, USDA

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Forest Products Lab, Habitat for Humanity, University of Florida, Building Science Corporation

- X **Products**: www.buildingdeconstruction.org
- X **Notes**: Formed in 2001 to focus on research, information dissemination and institutionalization of deconstruction practices. To date, primary focus has been on military base deconstruction.

X **Federal Interagency Committee on Indoor Air Quality (CIAQ)**

- X **Membership**: Co-chaired by CPSC, DOE, EPA, NIOSH, HHS, OSHA, and DOL; with about 15 additional Federal agency members.
- X **Products**:
  - S Website: http://www.epa.gov/iaq/ciaq/ includes minutes of CIAQ meetings
  - S Current Federal Indoor Air Quality Activities" EPA-402-K-99-001, March 1999 http://www.epa.gov/iaq/ciaq/publications.html
- X **Notes**: In 1989, EPA established the Federal Interagency Committee on Indoor Air Quality (CIAQ) to coordinate the activities of the Federal government on issues relating to Indoor Air Quality, under the authority of Title IV, Section 403(c) of the Superfund Amendments and Re-authorization Act (SARA) of 1986.

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Appendix D:
Federal Green Building Case Studies

General Sources

- **DOE High Performance Buildings Case Study Database**
  <http://www.eere.energy.gov/buildings/highperformance/case_studies>

- **DOE Federal Energy Management Program (FEMP)**
  Greening projects: <http://www.eere.energy.gov/femp/techassist/greening.html>
  Energy projects:<http://www.eere.energy.gov/femp/prodtech/successstories.html>

- **Federal Energy Star Buildings**
  <http://estar4.energystar.gov/estar/cpdprofilesNEW2_0.nsf/ProfilesByRegion?OpenView&Start=1&Count=20&Collapse=1#1>

- **The U.S. Green Building Council LEED™ Certified projects**
  <https://www.usgbc.org/LEED/Project/project_list.asp>

- **Laboratories for the 21st Century:**
  <http://labs21.lbl.gov/cs.html>

Agency-Specific Sources

- **National Park Service**
  <http://www.nps.gov/renew/case.htm> and <http://www.nps.gov/sustain>

- **Environmental Protection Agency**
  <http://www.epa.gov/oaintrnt/facilities/index.htm>

- **Department of Defense**
  <https://www.denix.osd.mil/denix/Public/Library/Air/Climate_Change/EE/pnsebook.html>

- **Army Corps of Engineers**
  <http://www.cecer.army.mil/SustDesign>

- **Navy**—Building 850
  <http://www.nbvc.navy.mil/PublicWorks/energy_showcase/bldg850.htm>

- **Postal Service**
  <http://66.150.114.114/emp/catalog/folder.asp?UserID=2&ID=414&ShowDocDesc=1&FolderMode=1>

Appendix E:
Agency/Department Green Building Resources and Tools

- **Environmental Protection Agency**

  - EPA Green Building website:<http://www.epa.gov/greenbuilding>

  - Laboratories for the 21st Century: <http://www.epa.gov/labs21century>

  - Energy Star: <http://www.energystar.gov>

  - WAVE water management software: <http://www.epa.gov/owm/water-efficiency>

  - Environmentally Preferable Purchasing: <http://www.epa.gov/oppt/epp>

  - Non-point Source Pollution: <http://www.epa.gov/owow/nps/urban.html>

  - Construction and Demolition (C&D) Debris: <http://www.epa.gov/epaoswer/non-hw/debris>

  - Comprehensive Procurement Guidelines: <http://www.epa.gov/cpg>

  - Indoor Environmental Quality:
    - Comprehensive guidance, data, and tools for commercial buildings. <http://www.epa.gov/iaq/largebldgs/>
      (a) I-BEAM Software: Indoor Air Quality Building Education and Assessment Model.
      (b) Analysis of Energy and IAQ compatibilities and tradeoffs in ventilation systems and controls. Modeling analysis.
      (c) BASE study: Building Assessment Survey and Evaluation (BASE) provides comprehensive IAQ data on commercial buildings.
    - Comprehensive guidance, tools, and activities for IAQ in schools
      (a) Comprehensive IAQ guidance for schools <http://www.epa.gov/iaq/schools/toolkit.html>
    - School Advanced Ventilation System Software (SAVES). Software to evaluate ventilation and humidity control performance of energy recovery ventilation systems and to calculate their cost effectiveness. Available at <http://www.epa.gov/iaq/schooldesign/saves.html>

- **Department of Defense**

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- Sustainable Planning: A Multi-Service Assessment, 1999: <http://www.hq.usace.army.mil/isd/librarie/RP/Sustainability/Sustainable%20Planning%20Stdy.pdf>

- Defense Environmental Network and Information Exchange (DENIX): <https://www.denix.osd.mil/denix/Public/Library/Sustain/sustain.html>

- Pentagon Renovation sustainable design information: <http://renovation.pentagon.mil/sustainabledesign.htm>

- **U.S. Army**

  - The Army Facilities and Housing Directorate website (Army policy documents on sustainable design): <http://www.hqda.army.mil/acsimweb/fd/linksSDD.htm>

  - The USACE Sustainable Design & Development website: <http://www.cecer.army.mil/sustdesign>

  - Planning, Engineering, and Design of Sustainable Facilities and Infrastructure: An Assessment of the State of the Practice <http://www.cecer.army.mil/td/tips/pub/details.cfm?PUBID=2208&RESEARCH=2>

- **U.S. Air Force**

  - AFCEE's Sustainable Development website: <http://www.afcee.brooks.af.mil/eq/programs/progpage.asp>

  - Air Force Environmentally Responsible Facilities Guide: <http://www.afcee.brooks.af.mil/green/facilitiesguide/erfguide.pdf>

  - ACC Sustainable Facilities Guide (March 2000)–a more condensed version: <http://www.afcee.brooks.af.mil/green/case/accsfguide.pdf>

  - AFCEE's C&D Waste Management Guide: <http://www.afcee.brooks.af.mil/eq/programs/summary.asp>

  - Air Force Water Conservation Guidebook (May 2002) (AFCESA): <http://www.afcesa.af.mil/Directorate/CES/Civil/Water/AF%20Water%20Conservation%20Guidebook.pdf>

  - AFCEE's Web University: Sustainable Development Training – introductory course for sustainable planning, design, construction and management of facilities: <https://webu.brooks.af.mil/webu/secure/onlinecourse.asp>

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- **General Services Administration**

    - GSA Sustainable Design webpage: <http://www.gsa.gov/sustainabledesign>

    - Real Property Sustainable Development Guide (general sustainability principles): <http://policyworks.gov/org/main/mp/gsa/index.html>

- **U.S. Department of the Interior - National Park Service**

    - NPS has an older website at <http://www.nps.gov/renew> and a newer website at <http://www.nps.gov/sustain>. Both contain extensive resources and case studies.

    - The NPS periodical *Sustainability News* features information on sustainable National Park facilities and additional resources that parks can use.

    - Guiding Principles of Sustainable Design: <http://www.nps.gov/dsc/dsgncnstr/gpsd/toc.html>

- **Department of Energy**

    - Roadmap for Integrating Sustainable Design into Site-Level Operations: <http://www.pnl.gov/doesustainabledesign>

    - DOE Energy Efficiency and Renewable Energy, Buildings Technology Program, High Performance Buildings website: <http://www.eere.energy.gov/buildings/high_performance/>

    - Greening Federal Facilities website: <http://www.eere.energy.gov/femp/techassist/green_fed_facilities.html>

- **National Aeronautics and Space Administration (NASA)**

    - NPG 8820.2E, Facility Project Implementation Guide: <http://nodis-dms.gsfc.nasa.gov/Draft_NPGs/N_PG_8820_002E_.doc>

    - NPG 8570.1, Energy Efficiency and Water Conservation Technologies and Practices: <http://nodis3.gsfc.nasa.gov/library/displayDir.cfm?Internal_ID=N_PG_8570_0001_&page_name=main>

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- NPD 8820.3, Facility Sustainable Design: <http://nodis3.gsfc.nasa.gov/library/displayDir.cfm?Internal_ID=N_PD_8820_0003_&page_name=main>

- **Nongovernmental Tools & Resources**

  - The **New Buildings Institute** has created an industry-leading set of energy efficiency guidelines, called the Energy Benchmark for High Performance Buildings (E-Benchmark™ - see http://www.newbuildings.org/ABG.htm). These guidelines, intended for use in designing, constructing and operating commercial buildings to exceed national model codes by 30-50+ percent, emphasize actual building performance as well as design, through start-up commissioning and continuing monitoring, benchmarking, and a performance warranty. The guidelines also provide an explicit link to the energy credits under LEED™.

  - **Building Green**, publishers of *Environmental Building News*, has an on-line database of more than 1,600 screened and reviewed green building products with guideline specifications, called the GreenSpec Directory, available through subscription only. EPA provided funding to research and tag materials that meet the Comprehensive Procurement Guidelines for recovered content.

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