Greening the White House: A Comprehensive Energy and Environmental Retrofit

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The White House, which recently celebrated its 200th birthday, has a long tradition of demonstrating technological innovation. In keeping with that tradition, the Clinton Administration has initiated a comprehensive analysis, design, and implementation program to improve the energy and environmental performance of the White House and Old Executive Office Building. The effort, led by an Inter-Governmental-Agency Team, consists of six components—audit, feasibility study, early actions, demonstration spaces, long-term initiatives, and technology transfer/outreach. Some of these components have been completed and others are being implemented to improve energy and water efficiency, make appropriate use of renewable energy sources, reduce waste streams, improve indoor air quality, and improve building comfort and performance. All of the measures are to be implemented without disrupting the facility's operations and in a way that respects the historic and security concerns of America's most famous house.

Introduction

"For as long as I live in the White House, I want Americans to see it as a symbol of clean government, but also a clean environment . . . . We're going to identify what it takes to make the White House a model for efficiency and waste reduction, and then we're going to get the job done."
President William Clinton, *Earth Day Address,* April 1993

The White House, which celebrated its 200th birthday in 1992, is an unchanging symbol of America even though the building itself has undergone dramatic changes. The White House is one of a complex of buildings that has constantly evolved to meet the needs of the President, his staff and the American people. The Greening the White House builds on a long tradition of installing state-of-the-art technologies into the White House complex. The introduction of new technologies is quite different from the cosmetic makeovers made by each new administration. From the central heating installed during President Van Buren's term, to the water closets, gas lighting, elevators, and air conditioning added later, and even the solar water heater installed during President Carter's term, the White House has frequently been a showcase for technological innovations.

The Greening the White House Project was announced as part of President Clinton's Earth Day Address in April of 1993. The Office on Environmental Policy initiated the project with the advice of eighteen environmental and energy organizations. An Inter-Governmental-Agency Team led by the Office on Environmental Policy, and the Department of Energy's Federal Energy Management Program was charged with the task of analyzing the energy and environmental performance of the buildings, studying feasible measures to improve performance, and then implementing recommendations for the White House and Old Executive Office Building (OEOB).

The Greening project is interesting and challenging because of the diversity of uses and managers in the White House complex—the East and West Wings, Executive Residence, and the Old Executive Office Building. The facility includes roughly a half million square feet of office space, a museum with 1.2 million visitors annually, three restaurants (two of which are fast food, one four star), a conference center with several events daily, an 18-acre botanic garden, a private bed & breakfast, and a private residence. It has four key agencies that manage aspects of the complex—the General Services Administration, the National Park Service, the Office of Administration, and the Executive Residence staff. There are a number of organizations housed in the complex. It is also the office of the Vice President, and the office and home of the President and his family. The project is further

complicated since all the work must be done without interfering with the buildings operations and without disturbing The President, Hillary, Chelsea and Socks.

The age of the buildings in the White House complex varies. George Washington laid the corner stone of the White House in 1792. The building was, however, not completed in time for the first President to take occupancy. President John Adams became the first occupant of the house in 1800. The White House was burned to a shell in 1814, and rebuilt in 1815. In 1902, a temporary West Wing building was constructed. It was substantially expanded in a more permanent form in 1909, and underwent a major renovation in 1934. The East Wing was built in 1902 and substantially expanded in 1941. The East Wing expansion was intended to serve partially as a museum; however, with the outbreak of World War II it was converted to offices, a use that continues today. In President Truman's term, the White House was completely gutted down to the original sandstone walls because of structural instabilities, and the interiors were rebuilt between 1948-1952.

The White House Executive Residence is what most people think of as the White House. The first family, of course, lives in the Executive Residence. In addition, the Executive Residence contains the ceremonial spaces used for visits and special events with dignitaries and officials. These are also the primary museum spaces and the location of public tours. In addition, there are several meeting spaces and rooms for special events. Finally, in order to support the operation of the building, there are many service and maintenance spaces. These areas include kitchens, laundries, even a paint shop. The East Wing which is primarily office spaces also includes a theater. The West Wing contains meeting spaces, offices, the White House media office, the Navy Dining Mess, and the Oval Office.

The grounds of the White House also have many uses and functions. In addition to the well-known Rose Garden, there is the First Ladies' garden which also serves as a source of organic produce for the Executive Residence. Several Presidents have planted trees on the grounds during their terms of office. The oldest of the existing trees was planted by President Jackson. There are also tennis courts, a swimming pool, a running track, and maintenance facilities, all screened from public view.

The Old Executive Office Building (OEOB) is the former home of the departments of War, Navy, and State. Begun in 1871 and completed in 1888, it is the largest granite building in the world. Built during a period of great concern about fires, the building is predominantly stone, with cast iron architectural detailing, both inside and out. The doors, window frames, handrails, and office floors were the only wooden components in the original construction. The building has two large internal courtyards and was originally designed to use daylighting and passive cooling.

Energy and Environmental Audits

In June and July of 1993, the Inter-Governmental-Agency Team conducted comprehensive audits of the energy and environmental performance of the White House complex. The energy audit team, led by the Department of Energy, included Lawrence Berkeley Laboratory, the National Renewable Energy Laboratory, and Rocky Mountain Institute (serving both as a technical advisor and as the American Institute of Architects' liaison). The environmental audit team, led by the Environmental Protection Agency, included the General Services Administration, the District of Columbia's regulatory office, and the Institute for Environmental Auditing. The audit process conducted detailed reviews of records and billing, research on building histories, and investigation of site conditions.

The energy audit team gathered sufficient information on current energy and water use to assess the opportunities for efficient use of these resources. The audit team determined the different types of energy supplying the complex collected billing information, interviewed facilities management staff, and inspected the site. The audit analysis and recommendations focused on readily-achievable, cost-effective, innovative techniques that could be transferred from the White House to other buildings. The energy audit studied the main types of energy end-use, including the building shell or "envelope:" the walls, roof, windows, and doors, that buffer the interior living and working areas from outside weather conditions; lighting; plug load, or all items that are plugged into the electrical system, from office equipment to refrigerators; and heating, ventilating and cooling (HVAC). Energy use in the kitchens was addressed separately. The energy team also studied the efficient use of water resources. The opportunities for reducing energy loads, including improving the building envelope, were addressed before assessing the mechanical system requirements or other means of meeting these energy loads. This was done because increased lighting efficiency and smaller plug loads would allow the building to use smaller more cost effective HVAC systems, and would increase the potential for cost-effective use of solar and renewable.

An historic document discovered during the audit process detailed how the OEOB had been constructed with an intricate passive cooling system. The structure included air channels through the granite mass of the building. Fresh air came from the channels through slots under the windows, and then moved through the rooms and into the corridors. At each corner of the building there are open

stairwells topped by stained glass domes. Hot air would rise to the top of the stairwells and be exhausted through vents in the domes. Since 1888 the system has been slowly undone and almost entirely disabled. The current cooling system consists of 782 window air conditioners, 100 package units and 3 chillers.

Since the OEOB has been in continuous operation for over 100 years, it contains a fair amount of architectural debris. For example probably less then 10% of the electrical wires in the building are active. There's been a joke among the people working on this project that revenues from mining the abandoned copper wires could probably finance much of the project.

The in-depth audit conducted by the EPA examined the overall environmental performance of the White House complex. The audit examined the complex's compliance with various federal and local environmental acts and regulations. These include Resource Recovery Act (RICRA), Fungicide, Insecticide, and Rodenticide Act (FIFRA), and an alphabet soup of other regulations. In the past federal buildings have been exempt from these regulations, and through this project the White House will be brought into compliance. The issues identified in the complex were relatively minor - volatile organic compounds (VOCs) from a paint shop, small chlorofluorocarbon (CFC) leaks from an old chiller, and some dust escaping from an immense paper shredder.

Opportunities for pollution prevention were also investigated. Materials flows, waste streams, and purchasing patterns were studied, and procedures for conducting White House events were analyzed. A review of the management systems examined the decision making process and chains of command. The audit also recommended several areas for potential retrofits.

Reports detailing the results of both audits was turned over to the White House complex's facilities staff. The audit information was also used in the subsequent Feasibility Study.

AIA Feasibility Study

One of the most unique aspects of the Greening the White House was the Feasibility Study, sponsored by the American Institute of Architects. In particular, its process for encouraging interaction among design professionals and holistic design has significantly contributed to the success of the project. In July 1993, a comprehensive study of energy and environmental measures for the White House complex was organized by the American Institute of Architects, and was partially funded by the Corporate Conservation Council of the National Wildlife Federation. Over ninety participants came together for this weekend Feasibility Study in Washington, D.C. What emerged from this gathering was a model design process and a report of the experts' recommendations that will lead to an integrated effort to improve the White House's efficiency, performance, and environmental responsiveness.

The participants in the Feasibility Study were all recognized experts within their respective fields, and included architects, engineers, designers, landscape architects, materials consultants, water experts, and representatives from utilities and from the White House operations and maintenance staff. The participants were selected because they could contribute a unique approach to the study. They were charged to look outside their own fields of expertise and to examine everything about the project with an eye towards possible interactions and interdisciplinary solutions. Each of these experts was assigned to one of thirteen teams to address the challenges and opportunities presented by the White House. The topic areas included: building envelope and glazings, lighting, plug loads/equipment, heating and cooling, materials/finishes/fixtures/furnishings, indoor air quality, water, grounds/landscaping, operations/maintenance, procurement, materials/recycling, and cultural change/human factors, and organizational integration.

Teams were directed to work closely with other teams where the problems or solutions identified by one would affect another. The teams were grouped into five main categories: energy, building ecology, water and landscaping, materials streams, and managerial and cultural factors. Further interaction among these groupings was encouraged by several individuals who "floated" from team to team. As the three day workshop gathered steam, the individual participants all quickly realized the value of understanding the issues evolving in other groups, and how the recommendations their teams made affected all the other teams. The entire group met periodically to convey findings among all the participants.

Following the weekend, a Feasibility Study report was turned over to the Office of Environmental Policy. This report contains recommendations for:

- Improving the performance of the White House and Old Executive Office building
- Capturing energy and resource efficiency opportunities
- Improving the building ecology, and
- Improving the relationship to the outdoor environment.

The recommendations had to emphasize cost-effectiveness and produce the best performance using "state-of-the-shelf" technologies (those that are commercially available and readily attainable, or already being sold off distributor's shelves).

The recommendations for improving energy efficiency focus on the building envelope's thermal performance, lighting design, plug loads, space heating, and space cooling systems. As an example of the scope of recommendations the report concluded that, improvements in glazing technologies may provide opportunities to improve the envelope's thermal performance, while new lighting technologies can provide superior lighting levels while using much less energy. Office equipment and appliances on the market today have the potential to reduce plug loads without reducing the level of service. Considering efficiency technologies to address the heat gain from windows, lighting, and then plug loads leads to opportunities to downsize cooling capacity. In addition, improvements in the design and sizing of mechanical systems can increase human comfort and productivity while reducing energy use and adverse environmental impacts.

Recommendations for improving the building ecology address materials issues and indoor air quality. The recommendations emphasize using sustainable and environmentally preferable products, materials and techniques, and providing for a healthy indoor environment for the White House. Recommendations for water use and landscaping focus on the interaction between the buildings and the site. The recommendations recognize the value of efficiency and of cascading, multiple uses for water. They propose restoring a native landscape characteristic of the region.

The recommendations addressing behavioral issues target procurement, operations and maintenance. The recommendations include making changes in the procurement processes, evolving operation and maintenance procedures, and reducing materials streams into and out of the building complex. One theme that emerged from the Feasibility Study was the issue of the changing *use* of the buildings *over time*, and how that use affects the use of resources like water, energy, materials and air. Another theme was the recognition of the critical importance human behavior will play in establishing change. Understanding the importance of both themes can support technological improvements that will simultaneously provide for a high quality of life for building users and a reduction in environmental impact.

Many technological initiatives intended to improve the energy efficiency and environmental performance of the White House were identified and recommended. Final decisions about the use of new technologies will follow guidelines suggested by the comprehensive design initiatives. The individual technologies will be chosen that can best move the buildings toward efficiency and sustainability.

Some of the recommendations from the Feasibility Study encourage demonstrations of new technologies. Most of the recommended improvements, however, will have little or no impact on the visual appearance of the buildings. The primary, visible change might be improvements in the quality of lighting that will make affected spaces more pleasant and will promote user productivity. In addition, the recommended changes will achieve the greatest long-term value and effectiveness if the people of the White House, from long-term facility maintenance staff to recent political appointees, are involved in the process, are supportive of the implemented changes, and are well-informed about how to use and maintain the new technologies. The report's recommendations should result in an environmentally sustainable White House, one that can significantly decrease resource consumption over the long-term.

Early Actions

A number of early actions to improve energy or environmental performance of the complex have been completed, are in progress, or will soon be implemented in the White House and OEOB. These actions meet one of three requirements: they are easily and quickly done, they have little or no cost to implement, or they are required for regulatory compliance. The categories for these actions include: lighting retrofits, water efficiency measures, installation of energy-efficient appliances, and measures to improve the building's thermal performance. Implementing these early actions has begun. The changes being made are, in general, based on the recommendations of the energy audit, the environmental audit, and the Feasibility Study, and some that are facilities staff initiatives.

As an example, the beautiful old mahogany windows at the OEOB had been frequently painted over the course of 100 years and many were inoperable. Before the Greening the White House Project began those 1700 windows were to be replaced with single-paned glazings. Changing the specification from single-paned glazings to double glazings in the retrofit will significantly increase the thermal performance of the building. The renovated windows will also be operable. Superwindows are being considered for some of the demonstration spaces. This window retrofit and other actions in the integrated design will prepare for eventually putting in a central cooling system to replace the 782 window ac units, 100 package units and 3 chillers now servicing the building.

Another example is the replacement of the refrigerator in the Executive Residence with a "Golden Carrot" refrigerator. The term Golden Carrot refers to the design competition that resulted in the commercial production of super-efficient refrigerators that have been designed to use 25-50% of the energy used by existing models. In addition, they do not use chlorofluorocarbons (CFCs) in the refrigeration cycle or in the foam insulation. The very first Whirlpool Golden Carrot refrigerator, plate number 00001, was installed at the White House in February 1994. Replacing the White House refrigerators is in line with the call by the Administration's Global Climate Change Action Plan to eliminate CFCs and reduce energy use.

Additional early actions already completed include the installation of compact fluorescent in the private residence, the OEOB, and the West Wing, and installation of T-8 lamps and electronic ballasts retrofits.

Demonstration Spaces

Several spaces within the White House and the OEOB were chosen to serve as demonstrations of the possible improvements that would result from a comprehensive energy and environmental retrofit. The designs for the retrofits in these spaces integrate daylighting, efficient systems for lighting and cooling, efficient equipment, improved indoor air quality, the use of environmentally responsive building materials, and in some cases, reemphasizing the original, design intent.

The demonstration spaces allow the recommendations for Greening the White House to be tried and evaluated before full scale implementation in the entire complex begins. The scope of these demonstration spaces will allow the complex's tenants and the public to see what is possible and what the Greening project can accomplish. The improvements in these spaces should also serve to increase interest in the project, and act as a catalyst to begin the important changes possible through the Greening project. The spaces selected include the state bathrooms on the first floor of the executive residence, office suites in the OEOB, and other spaces that allow for comprehensive demonstrations.

Preliminary design work on the demonstration spaces has been completed by a design team coordinated by the American Institute of Architects and Rocky Mountain Institute. Budgeting and scheduling decisions for these spaces are pending.

Long-Term Initiatives

Long-term initiatives focus on goals rather than specific actions. The importance of the long-term initiatives is to ensure that the measures that can move the White House to sustainability become ingrained and permanent. Many of these goals are aimed at directly involving all the players and users within the White House complex in the Greening project and process. Operations, maintenance, and procurement practices are a few areas in which change can occur through increasing environmental awareness. As an example, the use of 1ow-VOC paints was an issue considered by several of the Feasibility Study teams. Recommendations were made to phase-in these paints. This is a short-term action that can be implemented quickly in some areas, although there are historical and special usage concerns. If procurement practices are also changed over the long-term, and the maintenance staff and other personnel are educated about the reasons for using these paints, then the search for sustainable designs may become ingrained.

One of the long-term goals is to educate all of the staff to increase their knowledge about the implications of choices and decision processes. To further the idea of the "participatory process" most of the retrofit work is to be done by facilities staff. This will help in many ways. The facilities staff may come to accept the new environmental standards as normal operating procedure. In addition, they will have the opportunity to learn new techniques, enhance their current skills, and understand new technologies through their direct involvement in the design, installation, and operation of the new systems. This is important since the people who work in the White House complex who are really in the best position to identify and make changes. They are key to the long-term success of the project.

The National Park Service is developing a comprehensive plan to manage and operate the White House complex and the adjacent President's Park over the next 20 years. The plan will consider many of the long-term initiatives addressed by the Feasibility Study, and, when completed, should serve to protect the historic nature of the site while making its operations more sustainable.

Technology Transfer and Outreach

"I want to make the White House a model for other federal agencies, for state and local governments, for business, and for families in their homes. "

President William Clinton, *Earth Day Address,* April 1993

Several steps are being initiated to communicate the results of the Greening the White House Project to the public, and to encourage its replication in federal, state and private buildings. The Inter-Governmental-Agency Team will continue to work with National Park Service staff on mechanisms for telling White House visitors about the implementation of measures. This may include signposts and displays for people to look at while waiting in line to take the White House tour. The Federal Energy Management Program of the Department of Energy is looking at such other sites as San Francisco's Presidio, a military installation recently turned over to the National Park Service, as transfer sites for the process. The AIA is assembling a design tool called, "Workshop in a Box" that can be used to replicate the audit and Feasibility Study for other buildings. A component of this project will be an interactive CD ROM disk now being developed. This disk would allow viewers to "tour" the White House and zoom in on its windows, or lights, water fountains, or any other interesting feature, and to get explanations of the technology geared to the viewer's interest level and education. Communicating the lessons learned from Greening the White House and transferring the information to the public is considered to be crucial to the long-term success of the project.

Conclusion

The White House has, in the past, served as a showcase for events in our country's life. With the Greening the White House, it will once again serve as an important symbol, this time as the showcase of environmental responsibility.

The integrated design process that led to the recommendations for Greening the White House is itself an important tool that can easily be employed in considering how to improve the performance of any facility. Interactive design is fostered by assembling all the relevant players in the design field (architects, lighting designers, mechanical engineers, utilities, interior designers, water efficiency experts, etc.) along with on-site managers and the people responsible for the on-going maintenance for the buildings, at the outset of a project, to discuss and design across boundaries. Having all the experts work together can lead to serendipitous discoveries that are often overlooked in a more conventional and linear design process.

The Greening the White House can potentially decrease the White House's resource consumption by 30% or more. It also strongly supports the current Administration's leadership role in environmental protection. The Greening the White House Project should create an environmentally sustainable, model White House, and a world-class environmental showcase.

References

The Clinton Administration's Global Climate Change Action Plan is available from the Office on Environmental Policy, Room 360, Old Executive Office Building, Washington, D.C.

Federal Energy Management Program of the Department of Energy, Forrestal Building, MC CE-44 1000 Independence Ave., Washington, D.C. Telephone 202-586-5772.

Green Development Services, Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, CO. Telephone 303-927-3851.

The Greening of the White House Phase I Action Plan, March 11, 1994 is available from the Office on Environmental Policy, Room 360, Old Executive Office Building, Washington, D.C.

Information on the Super-Efficient Refrigerator Program (i.e., "Golden Carrot" refrigerators) is available at 1-800-927-3985.