Final Report

Green the Capitol Initiative

Submitted to

Speaker Nancy Pelosi
Majority Leader Steny H. Hoyer

by

Daniel P. Beard
Chief Administrative Officer

June 21, 2007

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Executive Summary

Report to the Speaker and Majority Leader

Introduction

On March 1, 2007, the Speaker and the Majority Leader directed the Chief Administrative Officer of the House to develop a "Green the Capitol Initiative" that would demonstrate leadership to the nation by providing an environmentally responsible and healthy working environment for employees.

Global warming and climate change are serious issues. Scientists agree that the introduction of carbon into the atmosphere is causing climate change. Efforts to reduce carbon emissions need to begin immediately. Such changes will have a positive impact on the environment and the economy.

This report on the "Green the Capitol Initiative" meets the directives set out in your letter. "We cannot ask the American people to address global warming and climate change issues," you noted, "without first carefully examining ways to reduce our own energy consumption and develop sustainable workplace practices." This report, and its recommendations, will enable the House to be a leader in sustainable operations.

Environmental responsibility is our duty to future generations. Now is the time to act to reduce our energy consumption as well as our energy dependence. To accomplish this, we will change the way we do business. A sustainable House Capitol complex will recognize the full environmental impact of our decisions on energy and water consumption, materials use and the quality of our workplace. By taking these steps, we not only reduce the impact of House operations on the environment, but also provide leadership by example.

Goals & Strategies

This report recommends that the House adopt three goals for future operations:

1. Operate the House in a carbon-neutral manner by the end of the 110th Congress
2. Reduce the carbon footprint of the House by cutting energy consumption by 50% in 10 years
3. Make House operations a model of sustainability

To achieve the goals outlined above, a wide variety of strategies will need to be implemented. For each goal below, a summary of implementing strategies is provided. These strategies provide the roadmap to reducing the carbon footprint of the House while operating in an environmentally sustainable manner.

Goal #1: Operate the House in a carbon-neutral manner by the end of the 110th Congress (December, 2008)

Climate change and global warming are serious issues. Scientists agree that the introduction of carbon dioxide (CO_2) and other greenhouse gases into the atmosphere has serious effects. There are immediate steps the House can take to provide leadership to address global warming. The House can make the

operations of the House carbon-neutral, so that its net carbon dioxide equivalent (CO_2-e) emissions become zero.

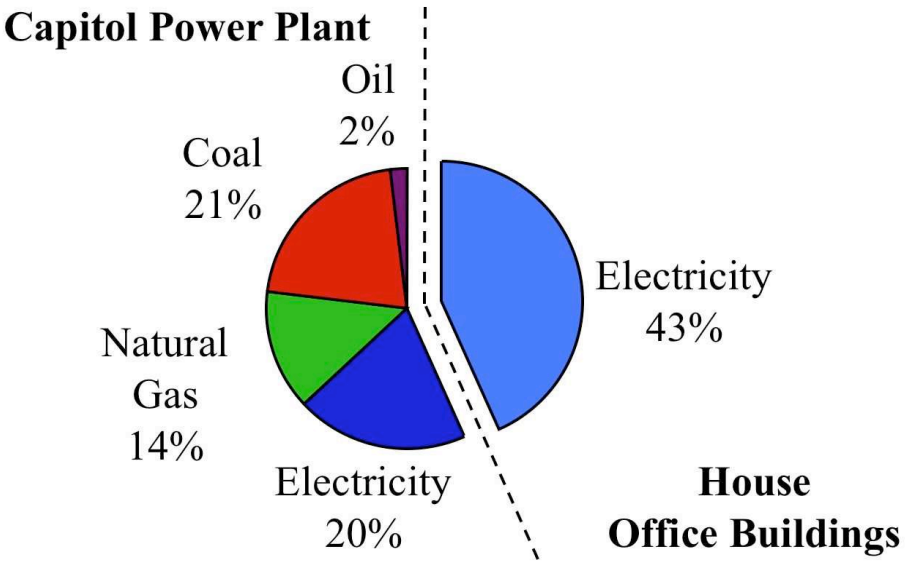

Figure ES-1. Total 2006 Carbon Dioxide-Equivalent Emissions for House Buildings

Using data developed by the Government Accountability Office, and reviewed by Lawrence Berkeley National Laboratory, it is estimated that the operation of the House complex was responsible for approximately 91,000 tons[1] of CO_2-e emissions in fiscal year 2006. This value is equivalent to the annual CO_2-e emissions of 17,200 cars.[2] Figure ES-1 shows the sources for the CO_2-e emissions for the House buildings by fuel type. Electricity is purchased from the local utility and provided directly to the buildings. Heating and cooling for the buildings is provided by the Capitol Power Plant (CPP), located on site. The CPP no longer produces electricity.

Three strategies are recommended to achieve carbon neutrality for the House buildings:

1. Purchase electricity generated from renewable sources
2. Switch from using coal, oil, and natural gas at the CPP to natural gas only
3. Purchase offsets for the remaining carbon emissions

[1] Tons = English short tons (1 ton = 2000 pounds).

[2] Estimates were derived using coefficients for CO_2-e emissions from the GAO April 2007 report and conversion factors for equivalent number of cars from the U.S. EPA (www.fueleconomy.gov).

Strategy #1: Purchase Renewable Power for Electricity Use

Electricity use is the largest source of CO_2-e emissions from House operations. To achieve the goal of making operations carbon-neutral the Chief Administrative Officer (CAO) and the Architect of the Capitol (AOC) have negotiated with our energy service provider to purchase 100% of the electricity needs, approximately 103,000 megawatt-hours per year, from renewable sources beginning October 1, 2007. The cost of electric power generated from renewable sources is an additional $520,000 and that amount has been included in the Fiscal Year 2008 Legislative Branch Appropriations bill. By implementing this recommendation the House will eliminate 57,000 tons of the total CO_2-e emissions annually or the equivalent of removing 11,000 cars from the road.

Strategy #2: Operate the CPP with Natural Gas

The second strategy is to reduce the CO_2-e emissions from the coal burned at the CPP to meet the needs of the House of Representatives. It is recommended that the CPP use natural gas instead of coal to meet the needs of the House. By taking this action, CO_2-e emissions from the CPP can be lowered by 30% from the 2006 level, which is the equivalent of taking 1,900 cars off the road each year. Because the boilers already have dual-fuel capabilities, they can be switched to natural gas and can use alternate fuel, either coal or oil, as emergency back-up. The total cost to implement this recommendation in Fiscal Year 2008 is $2.75 million. Money to purchase the natural gas is included in the Legislative Branch Appropriations bill.

Strategy #3: Purchase Carbon Offsets on the Chicago Climate Exchange

Even by using electricity from renewable sources and switching the generation of steam to natural gas, the House will still need to offset 24,000 tons of carbon emissions to achieve the goal of carbon-neutral operations. Therefore, it is recommended that all our remaining carbon emissions be offset by purchasing from the Chicago Climate Exchange carbon financial instrument contracts or carbon credits specifically for projects in the United States. These carbon financial instruments will be permanently retired so that the carbon credits cannot be used again. The Chicago Climate Exchange has been notified of the House's intent to initiate this action. The cost of offsetting 24,000 tons of greenhouse gases is estimated to be approximately $95,000. Money is available in CAO's Fiscal Year 2008 budget to make these purchases. The CAO will purchase CO_2-e offsets equal to House-attributable emissions on an annual basis.

Goal #2: Reduce the carbon footprint of the House by cutting energy consumption by 50% in 10 years

While the House can achieve carbon neutrality by the end of the 110th Congress, the long-term goal should be to lower our carbon emissions, or the "carbon footprint," by reducing energy consumption. Cost-effective investments in energy efficiency will pay for themselves and reduce the House's annual operating costs. The goal of reducing the House's energy use by 50% over the next 10 years should be adopted. The specific strategies identified in the following pages outline the steps needed to achieve this goal. After careful examination of the current carbon emission and energy use of the House and analyzing the recommendations contained in this report, it is feasible for the House to achieve the 50% energy reduction goal. In carrying out this goal, every opportunity will be taken to purchase American-made, energy-efficient technologies.

Before detailing each of those recommendations and outlining its effects, it is important to provide the following background on the energy use and carbon footprint of House operations.

Figure ES-2 estimates where energy was used during 2006 in the House office buildings, based on data from AOC and additional analyses. To reduce total House energy use by 50% over the next ten years, energy use will have to be reduced five percentage points per year. This is more than twice the Energy Policy Act (EPAct) of 2005 requirement of 2% reductions in energy use per year for federal buildings.

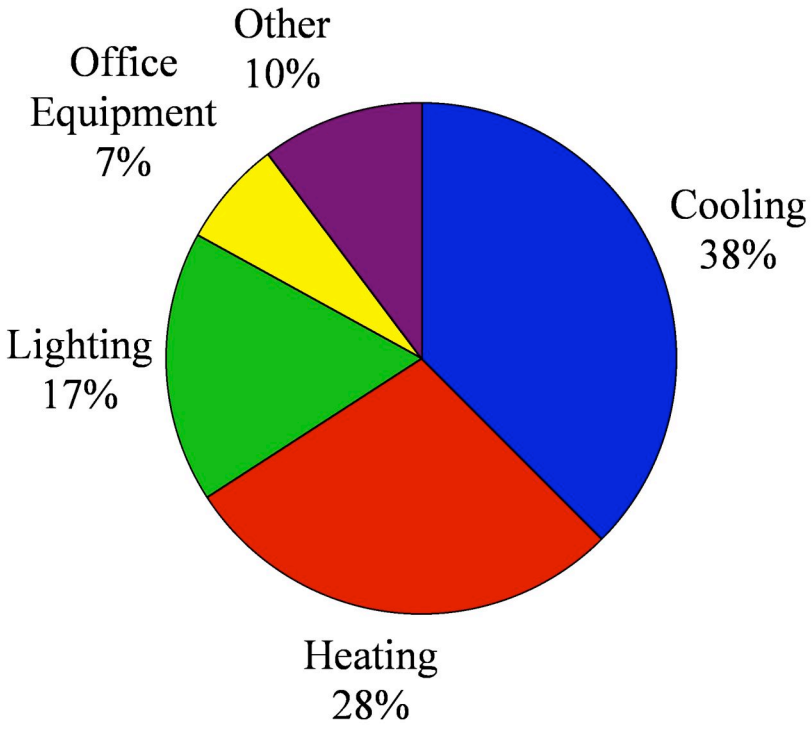

Figure ES-2. Total Energy Use for House Buildings by End Use.

The largest use of energy in the House buildings is for cooling (38%) followed by heating (28%), lighting (17%), office equipment (7%), and miscellaneous other uses (10%), such as ventilation fans, elevators, and other equipment and appliances.

Figure ES-3 shows how the proposed goal for cutting energy use by 50% by 2017 will be achieved. The reductions mandated under the 2005 Energy Policy Act are indicated by the blue dotted line. The proposed strategy more than doubles those savings.

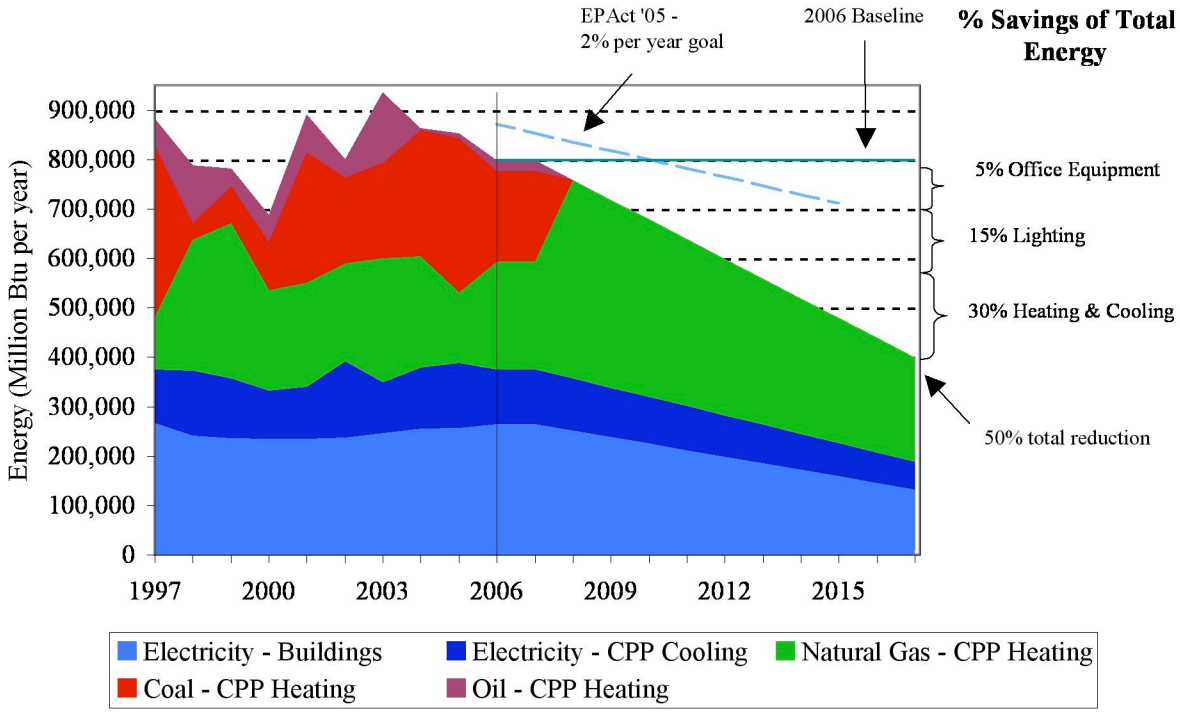

Figure ES-3. Energy reduction scenario for the House attributable consumption due to improved efficiency measures

To achieve the 50% goal, the House will have to employ an optimal mix of life-cycle cost-effective investments in energy efficiency. Figure ES-4 shows how the increased costs necessary to achieve the carbon-neutral strategy will be repaid through energy savings actions.

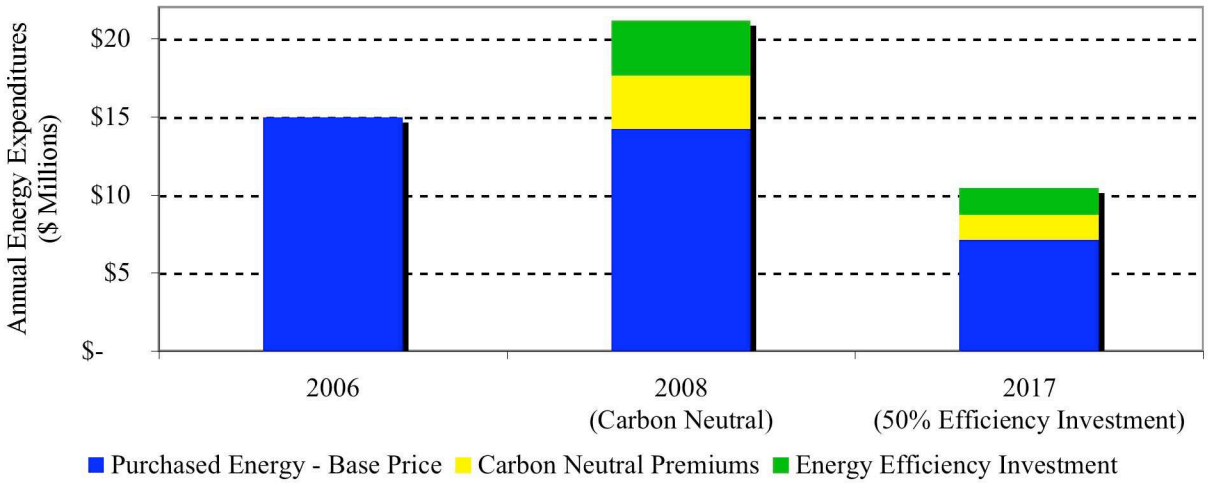

Figure ES-4. Total carbon-neutral scenario costs

Figure ES-4 shows that over a 10-year period, the reduced demand for energy from the cost-effective energy retrofits pays for the increased premium for electricity produced by renewable sources, the costs of switching to natural gas, and the purchase of carbon offsets. These estimates do not include the savings from eliminating fly ash disposal from burning coal, as well as from other direct and indirect environmental benefits.

Investments in energy efficiency should not be delayed if appropriated funds are not available. Congress in Energy Policy Act of 2005 recognized the value of alternative financing mechanisms as a means to leverage private-sector funds to make improvements in public-sector operations. Through alternative financing mechanisms private parties provide funding for energy efficiency projects and they are repaid by the savings. The use of such alternative financing mechanisms where appropriate to move projects forward is a sound approach to help reach the energy efficiency goals.

Two sets of specific actions should be taken: (1) reducing energy consumption in House office buildings and (2) reducing energy consumption at the CPP. This initiative will maximize the use of American products and services.

(1) Recommendations for House office building operations:

- Use metering, commissioning, and tracking to improve operating efficiency and management
- Install/upgrade steam meters for all House buildings
  - Install/upgrade chilled water meters for all House buildings

  - Optimize major steam and chilled water systems for energy efficiency during different seasons
  - Use utility tracking to monitor energy use during various times of day to identify energy savings opportunities
- Install energy efficient lighting
  - Retrofit ceiling lamps, fixtures, and controls to increase energy efficiency
  - Evaluate motion-activated lighting in offices, service corridors, tunnels, and parking areas to reduce energy use
  - Replace desk lamps with energy-efficient bulbs
  - Conduct high-efficiency ceiling lighting pilot program
  - Evaluate exterior building lighting to reduce energy use
- Adopt new technologies and optimal operating practices for electronics and office equipment
  - Change computer operations to allow staff to centrally power-down equipment when unused for significant periods such as nights and weekends
  - Maximize power management efforts present in existing electronic equipment through periodic audits and employee education
  - Develop a preferred list of Energy Star-qualified office electronics
  - Devise strategies to consolidate equipment
- Update heating, ventilation, and air conditioning equipment and practices
  - Retrofit motors, fan drives, pumps, and valves with energy-efficient models.
  - Modify CAV equipment and controls so that air-handling systems operate as VAV systems
  - Seal air distribution ducts to minimize air leakage
  - Optimize fan schedules to avoid unnecessary equipment operation
- Make computer rooms and servers more energy efficient
  - Improve operational control of data center auxiliary cooling and power systems
  - Consolidate servers distributed throughout House buildings into dedicated server rooms
  - Consolidate many lightly-used servers into fully-utilized server systems
  - Adjust air distribution in computer rooms for thermal optimization
- Evaluate food service practices, elevator and vending machine energy efficiency, hot water use, laundry and dry cleaning services, fitness center operations, and other House services for energy savings opportunities
  - Inventory current equipment and schedules to identify energy savings opportunities
  - Install new energy-efficient equipment and operating strategies emphasizing products made in America

(2) The CPP is the largest single source of carbon emissions on the Capitol Hill. As noted earlier, switching to natural gas will reduce the CO_2-e emissions of the CPP by 30%. The plant's

operation has also been controversial because of visual and health concerns among Capitol Hill residents. It is important for Congress to take a leadership role in modernizing and updating this facility. It is recommended that the committees of jurisdiction be instructed to review the plant's operation, and develop appropriation guidance, including legislation if necessary, to make the plant a model of efficient operations and sustainability. This legislation should be passed by the end of the 110th Congress.

Making changes to the CPP will take many years to plan, finance, and implement. During this interim period, the following actions should be taken to optimize operations of the CPP to maximize energy efficiency and reduce energy consumption:

- Improve steam production efficiency
  - Evaluate reducing boiler steam pressure output from 200 PSI to 150 PSI
  - Implement best practices for operations and maintenance
  - Monitor energy efficiency performance
- Improve chilled water production efficiency
  - Implement best practices for operations and maintenance
  - Retrofit motors with premium efficient motors
  - Evaluate retrofit potential of variable-speed drives on pump motors
  - Monitor energy efficiency performance
  - Evaluate new efficient chillers for West Refrigeration Plant
- Improve steam and chilled water distribution systems
  - Improve maintenance of steam traps, increasing steam system distribution efficiency
  - Determine need for new insulation of all distribution lines to reduce heating and cooling losses
  - Adjust steam delivery pressures where practicable to follow heat load requirements in Capitol buildings

Goal #3: Make House operations a model of sustainability

In addition to improving the way the House consumes energy, the House should provide an environmentally sustainable and healthy working environment for employees. The House has the opportunity to lead by example by making its business operations a model of sustainability. In order to achieve this goal, every attempt will be made to purchase American-made environmentally sustainable products.

Strategy #1: Direct the CAO to Oversee Implementation of "Green the Capitol Initiative"

The Office of the CAO should be charged with responsibility to oversee implementation of the "Green the Capitol Initiative" for the House of Representatives. This includes working with the AOC and other offices to improve the sustainability of the day-to-day operations of the House office buildings including maintenance, finance, transportation, childcare, and food service.

Strategy #2: Develop a House Sustainability Plan

In June 2007, the CAO convened a meeting with three sustainability leaders from major universities that are championing sustainability. Representatives from Harvard, Yale, and the University of California provided briefings on their goals, operations, and successes. A key component of their success has been a sustainability plan that provides focus and direction to reform efforts. It is recommended the CAO develop and implement a House Sustainability Plan as a dynamic document intended to provide a roadmap for major steps toward sustainability over the next 20 years and to identify timetables for specific actions.

The CAO and the AOC should be directed to take the following specific actions under the Sustainability Plan:

- Improve indoor water use efficiency
  - Install additional water meters
  - Analyze water consumption and quality patterns
  - Install low flow water fixtures
- Adopt sustainable practices for site and landscape
  - Implement conservation measures for irrigation
  - Improve storm water control to reduce runoff
  - Decrease pesticide use to improve runoff water quality
  - Expand tree canopy
- Improve employee access to transit options and reduce transportation energy use
  - Demonstrate a commitment to alternate fuels through installation of an E-85 ethanol fueling station
  - Replace the current House motor vehicle fleet with efficient, hybrid, or alternative fuel vehicles
  - Establish an employee transit coordinator position
  - Centralize the House transit benefit program and increase the benefit level
  - Implement a Bike to Work program
  - Implement a car sharing program
- Implement sustainable practices in the House's food service system
  - Purchase serviceware products recommended through the U.S. EPA Environmentally Preferable Purchasing Program
  - Establish goals for supply of locally and organically produced food
- Reduce environmental impact of materials through purchase of locally or regionally produced products, and standardize where possible to reduce inventory and procurement costs
  - Specify low-VOC paints, furniture, carpet, and other furnishings emphasizing products made in America
  - Specify office furnishing containing recycled content, bio-based products, or certified wood, emphasizing products made in America

- Purchase office electronics certified through the Electronic Product Environmental Assessment Tool (EPEAT)
- Procure 100% recycled and 30% post-consumer content paper and recommend measures to reduce paper consumption
- Divert 50% of the building occupant waste stream through improved recycling program
- Purchase cleaning supplies that meet the requirements of Green Seal Standard for Industrial and Institutional Cleaners, Standard GS-37; and for floor products, Standard GS-40

Strategy #3: Leadership, Education, and Outreach

The CAO should pursue networking and outreach with the Senate, universities, businesses, local and state governments, and others to remain current on sustainability practices and CO_2-e emission reduction opportunities. The networking can showcase the House's leadership role and facilitate the exchange of ideas and information on environmentally sustainable issues. This activity could include hosting green summits on sustainability. The CAO should also work with the AOC to make sustainability a mission-critical element of the AOC's business practices.

Recommendations for specific actions include:

- Prepare a checklist for sustainable office operations for use by Members of Congress and other Capitol Hill offices
- The House should take a leadership role in networking with the Senate, universities, businesses, and local and state governments including hosting green summits
- Hold a green expo for House offices to demonstrate the latest in green products or services available from commercial vendors
- Work with the AOC to make sustainability a mission-critical element
- Provide energy efficiency and sustainability materials for Capitol Hill visitors

Strategy #4: Develop Mechanisms for Evaluating Success and Reporting Progress

The CAO should track benchmarks for energy consumption and CO_2-e emissions monthly and prepare annual reports documenting progress on the complementary goals of carbon neutrality and sustainable operations. Energy and CO_2-e emissions data will be made available on a website, both as an educational tool and to provide feedback to House staff.

Conclusion

This report provides a roadmap for carbon neutrality, energy efficiency, and operating in an environmentally sustainable fashion. It demonstrates that the House can operate in a carbon neutral manner now and begin to implement energy efficiency measures today. The report provides the way forward to cutting the House's energy use by 50% in 10 years. It shows how the House can do business in an environmentally sustainable manner. Implementing these goals is a good investment for the American taxpayer, the environment, and our children's future.

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Key Terms

Carbon dioxide: Carbon dioxide is a chemical compound composed of one carbon atom and two oxygen atoms. It is often referred to by its chemical formula CO_2. It is present in the Earth's atmosphere at a concentration of approximately 0.04% and is an important greenhouse gas. The unit that is used in this report is short tons of carbon dioxide-equivalents or CO_2-e.

Carbon footprint: The net amount of CO_2-e generated by an institution, business, household, individual, or other entity from all of its activities, usually estimated during a certain period such as a year.

Carbon-neutral: An adjective describing buildings or operations that produce no net contribution to carbon dioxide-equivalent emissions.

Carbon offset: An action that reduces the net carbon dioxide-equivalent emissions of an individual or organization, through investment in emissions reduction action by another individual or organization.

Cogeneration: Cogeneration**,** also called combined heat and power (CHP), is the use of a heat engine or a power station to simultaneously generate both electricity and useful heat.

Global warming: Global warming is the observed increase in the average temperature of the Earth's near-surface air and oceans , and its projected continuation. The cause is an increase in carbon dioxide emissions, primarily from the combustion of carbon (fossil) fuels and other greenhouse gases.

Renewable energy: Renewable energies derived from resources that are regenerative, or for all practical purposes, cannot be depleted. Because of their renewable nature, these energy sources are fundamentally different from finite fossil fuels. They produce fewer greenhouse gases and other pollutants as fossil fuel combustion.

Sustainability: Capable of being continued with minimal long-term effect on the environment. Sustainability relates to the continuity of economic, social, institutional and environmental aspects of society.

Ton of CO_2-e: English short tons (1 ton = 2000 pounds), used in this report for CO_2-e.

Ton of cooling: 1 ton of cooling = 12,000 Btu/hour

Acronyms, Units, and Conversions

AOC	Architect of the Capitol
BOMA	Building Owners and Managers Association International
CAO	Chief Administrative Officer
CAV	Constant air volume
CFL	Compact fluorescent lamp
CPP	Capitol Power Plant
CRAC	Computer-room air conditioner
CRT	Cathode ray tube
DDOT	District Department of Transportation
EPAct	Energy Policy Act (of 1992 or 2005)
EPEAT	Electronic Product Environmental Assessment Tool
FEMP	Federal Energy Management Program
GAO	Government Accountability Office
GPO	Government Printing Office
HOB	House office building
HVAC	Heating, ventilating and air-conditioning
IT	Information technology
LBNL	Lawrence Berkeley National Laboratory
LCD	Liquid crystal display
LED	Light-emitting diode
MACS	Members Allowance Checklist for Sustainability
UPS	Uninterruptible power supplies
VAV	Variable air volume
VOCs	Volatile organic compounds
WMATA	Washington Metropolitan Area Transit Authority
ZEB	Zero energy building
MBtu	Million British thermal unit
MWh	Mega-watt hour (10^6 Watt-hours) (1 MWh = 3.412 MBtu)
PSI	Pound per square inch

Introduction

On March 1, 2007, Speaker Nancy Pelosi and Majority Leader Steny H. Hoyer directed the CAO to develop a series of preliminary recommendations to reduce the environmental effects associated with the operation of the House office building complex. As they noted, "the House of Representatives should demonstrate leadership to the nation by providing an environmentally-responsible and healthy working environment for our employees. In addition, the House complex should be a showcase for sustainability. The House cannot ask the American people to address global warming and climate change issues without first carefully examining ways to reduce our energy consumption and practice sustainable workplace practices."

As a result of this directive, the CAO has undertaken a review of the House operating procedures with respect to energy conservation, sustainability and related matters, and offers the following recommendations to "Green the Capitol."

Several studies have recently been completed, or are currently under way, that characterize the energy use and carbon dioxide equivalent emissions (CO_2-e) of the Capitol area complex. The AOC is preparing an overall Sustainability Plan. The AOC is completing an assessment of the energy retrofits that can be undertaken as part of its overall facilities planning process. The Government Accountability Office (GAO) has issued a report documenting detailed analysis of the energy use and CO_2-e emissions for the Capitol complex and outlined its "carbon footprint." The House Science Committee is proposing demonstration offices to showcase energy-efficient and sustainable practices. Recommendations have been made by Carnegie Mellon University and others on specific measures that can be taken, both as short-term actions and through improved specifications for future retrofits. The Vermont Energy Investment Corporation, a non-profit entity, has offered recommendations to Congressman Peter Welch on the best way to insure carbon-neutral operations for his office in the Longworth Building. Various other energy audits and surveys have been conducted in the past.

Energy management has been on the Capitol's agenda for some years. While the potential for further gains is substantial, notable precedents exist in the House's use of energy-efficient technologies, and operational practices that enhance energy efficiency. Examples of these practices are listed in Appendix B.

This report expands on current practice, drawing on the prior studies, reports, and recommendations, as well as other sources. It presents a framework in which all of these recommendations, and others, can be reviewed and implemented.

Part One: Goals & Strategies

This report contains three goals:

1. Operate the House in a carbon-neutral manner by the end of the 110th Congress
2. Reduce the carbon footprint of the House by cutting energy consumption by 50% in 10 years
3. Make House operations a model of sustainability

To achieve the goals outlined above, a wide variety of strategies will need to be implemented. For each goal below, a summary of implementation strategies is provided. These strategies provide the roadmap to reducing the carbon footprint of the House while operating in an environmentally sustainable manner.

Goal #1: Operate the House in a carbon-neutral manner by the end of the 110th Congress

Climate change and global warming are serious issues caused primarily by the introduction of carbon dioxide (CO_2) and other greenhouse gases into the atmosphere.[3] There are immediate steps the House can take to provide leadership to address global warming. The House can make the operations of the House carbon-neutral, so that its net carbon dioxide equivalent (CO_2-e) emissions become zero.

Using data developed by the Government Accountability Office, and reviewed by Lawrence Berkeley National Laboratory, it is estimated that in 2006 the operation of the House complex was responsible for approximately 91,000 tons[4] of CO_2-e emissions in fiscal year 2006. This value is equivalent to the annual CO_2-e emissions of 17,200 cars.[5] Figure 1 shows the sources for the CO_2-e emissions for the House buildings by fuel type.

[3] Greenhouse gas emissions are referred to as carbon dioxide-equivalent emissions (CO_2-e), in short tons.

[4] Tons = English short tons (1 ton = 2000 pounds).

[5] Estimates were derived using coefficients for CO_2-e emissions from the GAO April 2007 report and conversion factors for equivalent number of cars from the U.S. EPA (www.fueleconomy.gov).

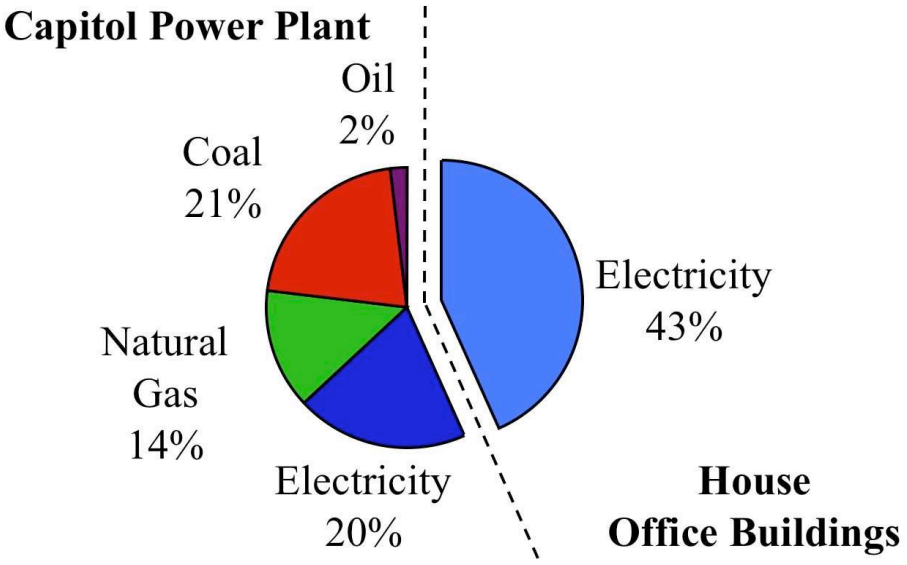

Figure 1. Total 2006 Carbon Dioxide-Equivalent Emissions for House Buildings [Source GAO 2007]

The largest source of CO_2-e emissions for the House buildings is from the electricity purchased by the House and other Legislative Branch agencies. Electricity comprises 63% of CO_2-e emissions and is generated offsite from several sources: coal (53%), nuclear (37%), natural gas (7%), renewables (2%), and fuel oil (1%). Combustion of fossil fuels in the CPP boilers generates steam to heat the buildings and accounts for the remaining 37% of the House CO_2-e emissions. The power plant's boilers are fired using coal (43% of the 2006 boiler output), natural gas (52%), and oil (5%); the relative amounts of fuel used vary widely from year to year.

Figure 2 illustrates that there has been no clear trend in CO_2-e emissions for the past 10 years, with the drop in 1998-2001 for central steam due to fuel switching for the boilers in the CPP. The data[6] in Figure 2 use CO_2-e emissions factors from GAO 2007.

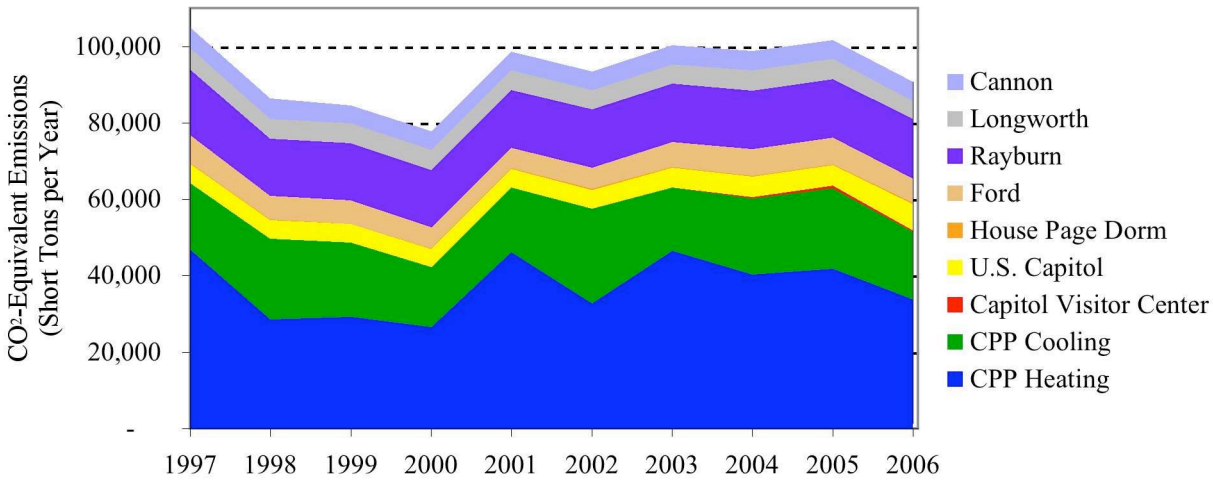

Figure 2. Total Carbon Dioxide-Equivalent Emissions for the House Buildings 1997-2006

[6] Fuel consumption from 2007 to 2017 has been weather-normalized to the long-term average degree-days from 1997 to 2006. Weather normalization means that one year's energy use data is adjusted to reflect what the energy consumption would have been if average weather conditions had occurred instead in the same location over the time period of interest.

Figure 3 shows the CO_2-e emissions by type of energy from the House buildings and the House-attributable portion of the CPP output. This graph illustrates the need for reduction of emissions from electricity use and fuel use addressed by the strategies below. Historically, the use of different percentages of coal, natural gas and oil has varied widely from year to year; for example, in 1998, coal was considerably reduced, and the difference was made up in natural gas and oil.

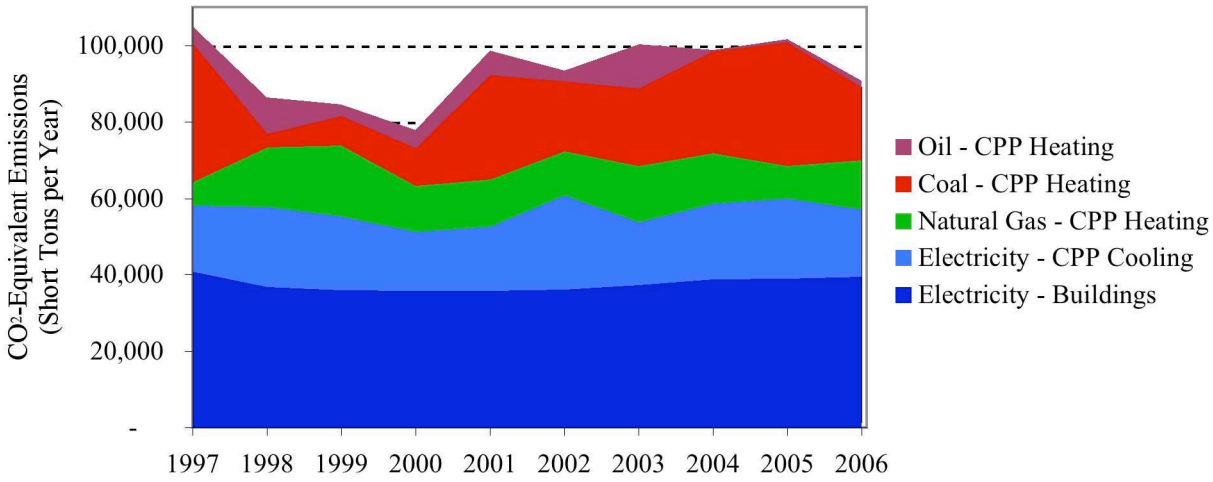

Figure 3. Carbon Dioxide-Equivalent Emissions by Type of Energy

Figure 4 shows proposed strategies for achieving carbon neutrality for the House buildings. As shown by the vertical line, the baseline year is 2006. The first strategy is to offset CO_2-e emissions from electricity use by purchasing electricity generated from renewable sources. The second strategy is to reduce the carbon emissions from the fossil fuel use at the CPP. By switching from coal, oil, and natural gas use to natural gas only, the CO_2-e emissions of the CPP required to meet the House's needs can be lowered 30%. The third strategy is to offset the remaining fossil fuel use by purchasing carbon offsets.

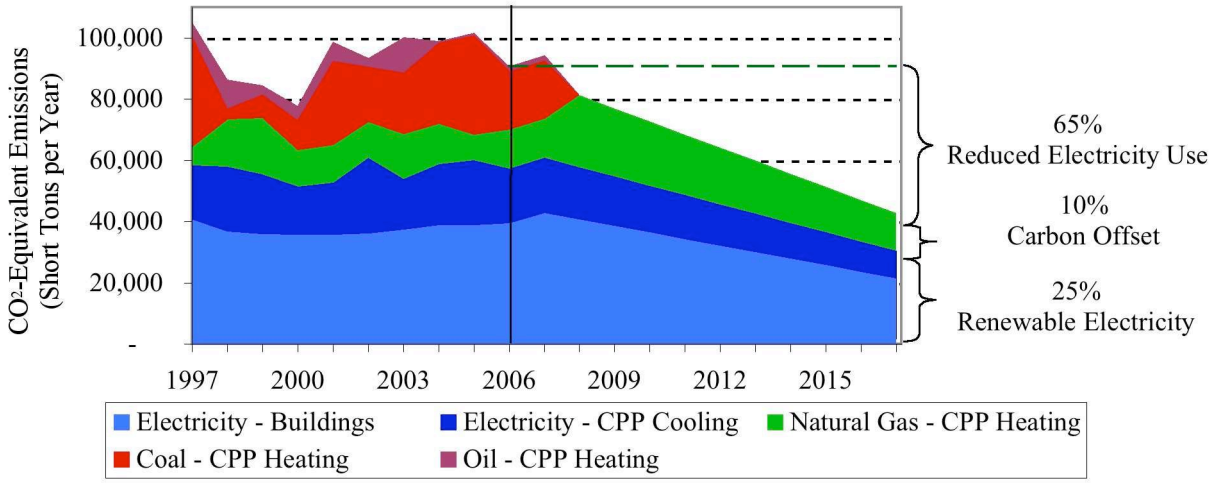

Figure 4. Carbon Dioxide-Equivalent Emissions Reduction Scenario

Strategy #1: Purchase renewable power for electricity use

The purchase of electricity is the largest source of CO_2-e emissions from the operations of the House. To achieve the goal of making House operations carbon-neutral, the CAO and the AOC have negotiated to purchase 100% of the electricity needs, approximately 103,000 megawatt-hours per year, using renewable power starting October 1, 2007. The electricity cost premium to purchase power generated from renewable sources is an additional $520,000 and that amount has been included in the Fiscal Year 2008 Legislative Branch Appropriations bill. This increased cost will be offset over the long run by energy conservation actions. By implementing this recommendation, the House buildings will eliminate 57,000 tons of CO_2-e emissions, or the equivalent of removing 11,000 cars from the road.

Strategy #2: Operate the CPP with Natural Gas

The second strategy is to reduce the CO_2-e emissions from the coal burned at the CPP to meet the needs of the House of Representatives. The CPP should use natural gas instead of coal to meet the needs of the House. By taking this action, CO_2-e emissions from the CPP can be lowered by 30% from their 2006 level. Because the boilers already have dual-fuel capabilities, they can be switched to natural gas and can use their alternate fuel either coal or oil as emergency back-up. The total cost to implement this recommendation in Fiscal Year 2008 is $2.75 million. Money to purchase the natural gas is included in the Legislative Branch Appropriations bill. Implementing this recommendation will eliminate over 10,000 tons of CO_2-e emissions, the equivalent of removing 1,900 cars from the road.

The switch to natural gas will also dramatically reduce other pollutant emissions from the CPP. More than 95% of sulfur oxides (SO_X) and at least 50% of nitrogen oxides (NO_X) and carbon monoxide could be eliminated. Onsite testing and further analysis is needed to determine the actual reductions possible. The CPP already monitors stack emissions, so relevant data may be available or obtained. The cost of removing fly ash from the coal-fired boilers, expected to double or triple in coming years, would be eliminated. The dual-fueled boilers can be switched to natural gas immediately if directed.

Strategy #3: Purchase Carbon Offsets on the Chicago Climate Exchange

Even by using electricity from renewable sources and switching the generation of steam to natural gas, the House will still have to offset 24,000 tons of carbon emissions to achieve the goal of carbon-neutral operations. Therefore, it is recommended that all remaining carbon emissions be offset by purchasing Carbon Financial Instrument (CFI) contracts, or carbon credits, specifically for projects in the United States from the Chicago Climate Exchange. The Carbon Financial Instrument is the financial instrument developed by the Chicago Climate Exchange (CCX) to facilitate price-transparent, cash-transaction emissions trading based upon emissions reductions and emissions offsets by CCX Members and Participant Members. Each CFI sold represents the emission reduction of 100 metric tons of carbon dioxide. CFIs are assigned unique serial numbers that are tracked in the CCX database called a registry. CFIs are traded in similar fashion to traditional commodities such as corn and wheat. These carbon financial instruments will be retired permanently so that the carbon credits cannot be used again. The Chicago Climate Exchange has been notified of the House's intent to initiate this action. The cost of offsetting 24,000 tons of greenhouse gases is estimated to be approximately $95,000. Money is available in CAO's Fiscal Year 2008 budget to make these purchases. The CAO will purchase CO_2-e offsets equal to House-attributable emissions on an annual basis.

Goal #2: Reduce the carbon footprint of the House by cutting energy consumption by 50% in 10 years

While the House can achieve carbon neutrality immediately, the long-term goal is to lower carbon emissions, or the carbon footprint, by improving energy efficiency. Cost-effective investments in energy efficiency will pay for themselves and reduce the House's annual operating costs. The goal of reducing the House's energy use by 50% over the next 10 years should be adopted. The specific strategies identified below outline the steps needed to achieve this goal. After careful examination of the current carbon emission and energy use of the House and analyzing the recommendations contained in this report, it is feasible for the House to achieve the 50% energy reduction goal. In carrying out this goal, every opportunity will be taken to purchase American-made energy efficiency technologies.

Before detailing each of those recommendations and outlining the effects, it is important to provide the following background on the energy use and carbon footprint of House operations.

Characteristics of the House Building Complex

The House buildings represent a diverse mix of office and support spaces, and include historical buildings as well as the new Capitol Visitor Center, currently under construction. The House complex can be viewed as a small campus within the larger Capitol complex.

The House building complex described in this report consists of seven buildings in the Capitol complex, accounting for 6.1 million square feet, roughly 40% of the 15.4 million square feet of the total Capitol complex area (see Table 1, which does not include the CPP).

Table 1. Characteristics of the House Buildings

Building Name	Year Built	2006 Floor Area [square feet]
Cannon House Office Building	1908	888,536
Longworth House Office Building	1933	682,791
Rayburn House Office Building (inc. E & W Underground Garages)	1965	2,971,469
Ford House Office Building	1939	594,730
House Page Dorm	1940	44,986
U.S. Capitol[A]	1793	421,800
Capitol Visitors Center	(under construction)	580,000
TOTAL		**6,122,312**

[A]Only one-half of the Capitol floor area is under House jurisdiction

Energy Consumption for the House Buildings

Energy is supplied to the House buildings from several sources. Electricity is purchased from the local utility and provided directly to the buildings. The buildings are on a district steam and chilled water loop supplied by the CPP, located on site. The CPP does not produce electricity, but purchases electricity to operate the chillers. The boilers of the plant primarily use coal or natural gas to produce steam that is distributed to many of the buildings. Some of the buildings, for example, the Ford House Office Building, have other suppliers of heating and cooling energy.

Table 2 shows total energy consumption in House buildings. The table includes energy consumption, primarily electricity, metered at each House building, electricity used by the CPP to provide chilled water to House buildings, and fuel used by the CPP boilers to provide steam heat to House buildings.

Table 2. 2006 House Buildings Energy Consumption

Building Name	Metered Electricity (MWh)	Electricity (Million Btu)	Total Fuel (Million Btu)	Total Energy (Million Btu)
Cannon HOB	9,126	31,138		31,138
Longworth HOB	8,761	29,893		29,893
Rayburn HOB plus East & West Underground Garages	28,046	95,694		95,694
Ford HOB	11,745	40,074	22,992	63,066
House Page Dorm	393	1,342		1,342
U.S. Capitol	12,709	43,363		43,363
Capitol Visitors Center	431	1,472		1,472
Capitol Power Plant @ 31%	32,199	109,862	433,259	543,121
TOTAL	**103,411**	**352,838**	**456,251**	**809,089**

Source: Architect of the Capitol 2007
HOB = House Office Building

The CPP provides chilled water and steam throughout the Capitol complex, not just to House buildings. Because metered consumption of chilled water and steam is not available for each House building, LBNL had to estimate of the percentage of total CPP output that was attributable to the House buildings. Based on square footage data for buildings served by the CPP, they estimated that 31% of the CPP output is attributable to House buildings. LBNL calculated chilled water and steam energy consumption to the House buildings by applying that 31% factor to total CPP electricity and fuel consumption.

In 2006, the total annual energy use for the House buildings was an estimated 809,100 million Btu (MBtu) expressed as site energy (not source energy).

Figure 5 shows that for the past ten years there is no clear trend in total energy consumption for the House buildings. Central steam predominates, followed by central chilled water from the CPP.

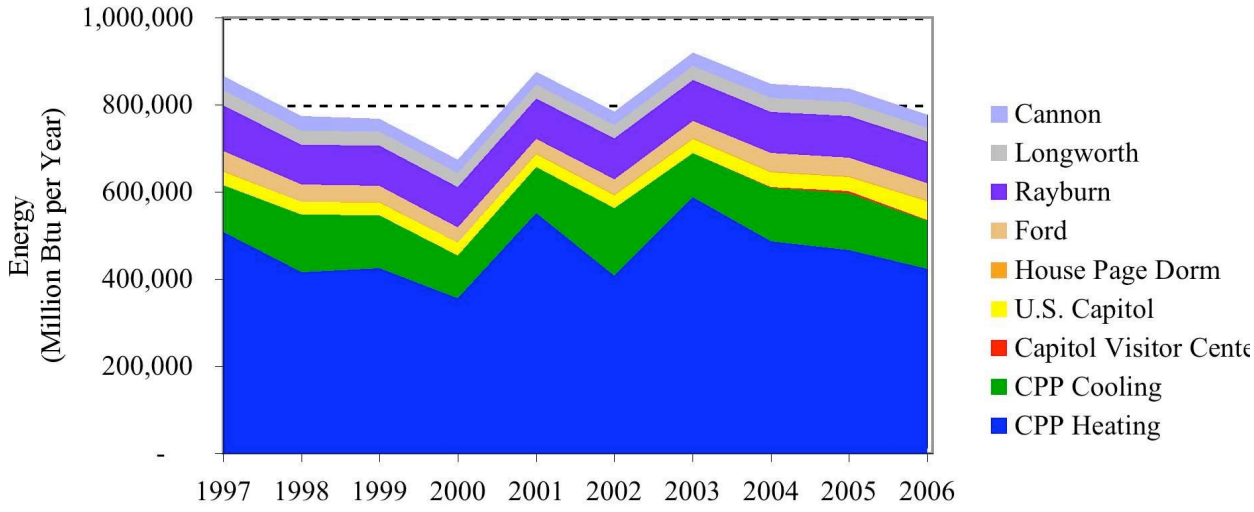

Figure 5. Total Energy Consumption for House Buildings 1997-2006

There are numerous opportunities for investing in cost-effective energy efficiency measures in the House office buildings and at the CPP. Figure 6 shows where energy was used in 2006 in the House office buildings. To reduce total House energy use by 50% over the next ten years, energy use will have to be reduced five percentage points per year. This is more than twice the Energy Policy Act (EPAct) of 2005 requirement of 2% reductions in energy use per year for federal buildings.

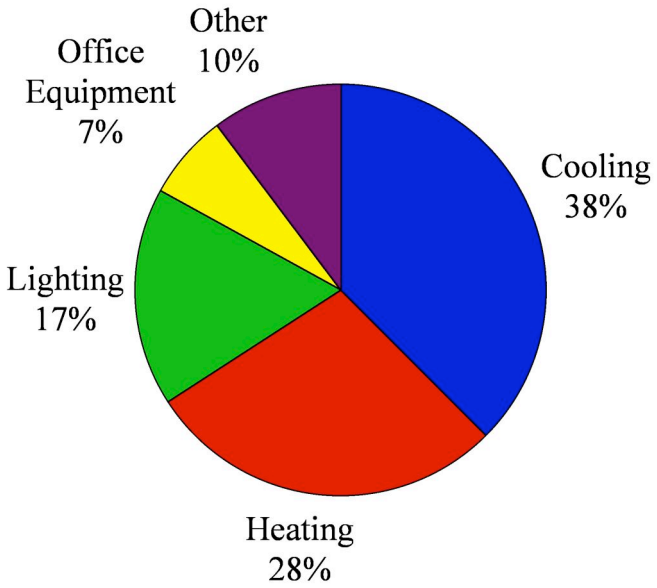

Figure 6. Total Energy Use (site) for House Buildings

The largest use of energy in the House buildings is for cooling (38%), followed by heating (28%), lighting (17%), office equipment (7%), and other uses (10%), such as ventilation fans, elevators, hot water and other equipment and appliances.

The total 2006 annual electricity consumption for the House buildings, including the 31% factor at the CPP for the chilled water, is 103,000 MWh (Table 3). This is roughly the same electricity consumption as that of 8,600 U.S. homes.

Table 3 also shows a 2% increase in electricity consumption by 2006 from the FY03 baseline established by the Energy Policy Act of 2005, with an even greater increase in electricity use in the House buildings. The power consumption at the CPP has been decreasing over the same period.

Table 3. Trend in Electricity Consumption for House Buildings and CPP, 2003-2006

House Buildings Electricity (MWh)					2006 Change from 2003 Baseline	
	FY 03	**FY 04**	**FY 05**	**FY 06**	**MWh**	**%**
Cannon HOB	9,057	9,205	8,890	9,126	69	1%
Longworth HOB	9,173	9,867	9,560	8,761	-412	-4.5%
Rayburn HOB	27,485	27,399	27,774	28,046	561	2%
Ford HOB	11,836	12,749	12,748	11,745	-91	-1%
House Page Dorm	410	439	409	393	-16,	-4%
U.S. Capitol (House only)	9,403	9,663	9,682	12,709	3,306	35%
House Total (kWh)	67,471	70,894	71,665	71,212	3,741	5.5%
Capitol Power Plant @ 31%	34,214			32,199	14,917	-6%
TOTAL HOUSE & CAPITOL POWER PLANT	**101,685**			**103,411**	**29,850**	**1.7%**

Source: Architect of the Capitol 2007

Figure 7 shows the proposed goal for reducing energy use by 50% in ten years. The reductions mandated for federal buildings under the Energy Policy Act of 2005 (EPAct 2005) are indicated by the blue line. Per the EPAct 2005, beginning in 2006, a building must use 2% less per year than its 2003 energy use. The proposed strategy for the House complex nearly doubles those savings.

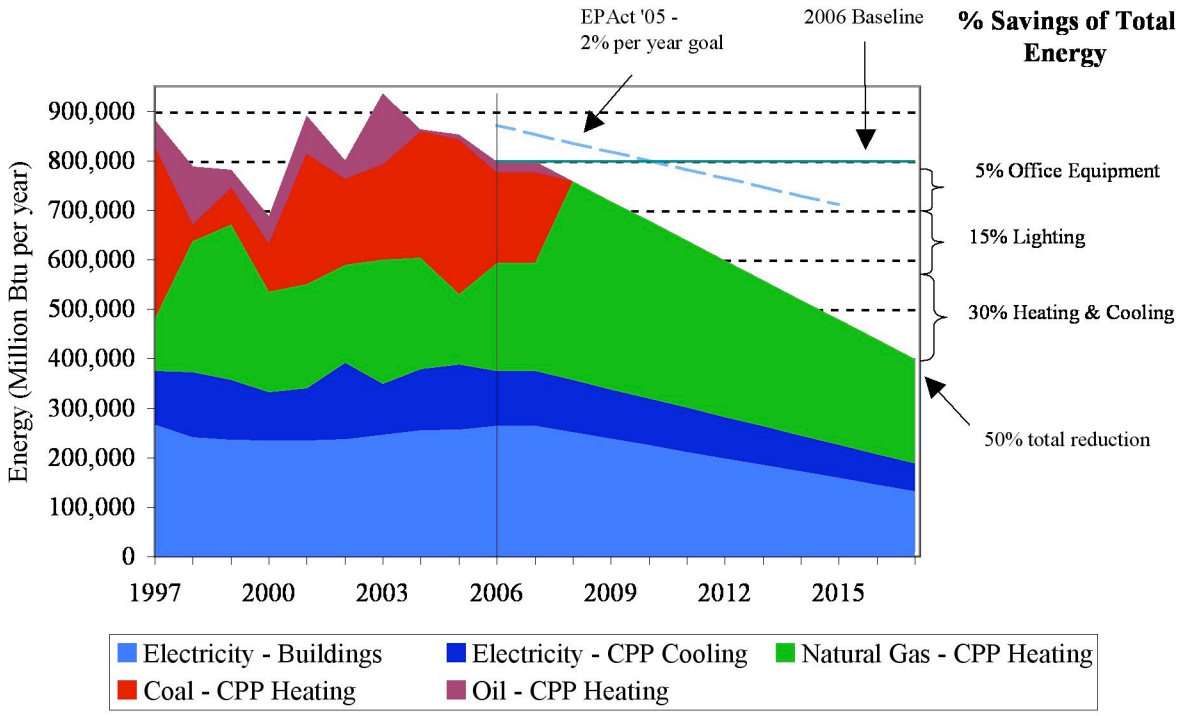

Figure 7. Energy reduction scenario due to improved efficiency measures

Figure 8 shows that the House buildings' energy costs have risen dramatically in recent years, more than doubling in the past 10 years.

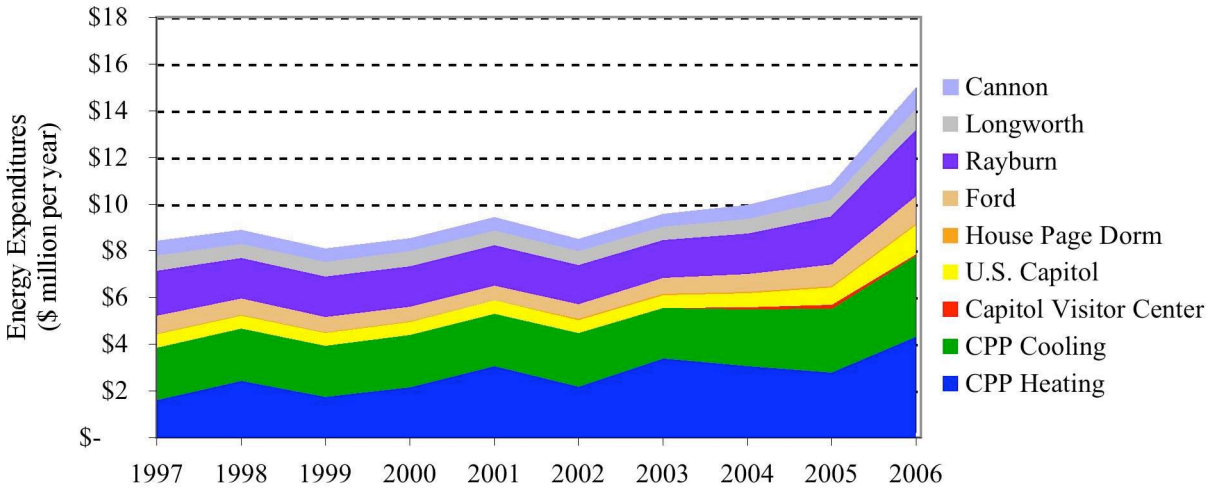

Figure 8. Annual Energy Expenditure for Key End Uses and Buildings

Figure 9 shows the costs, energy consumption and CO_2-e emissions indexed to their 1996 values.

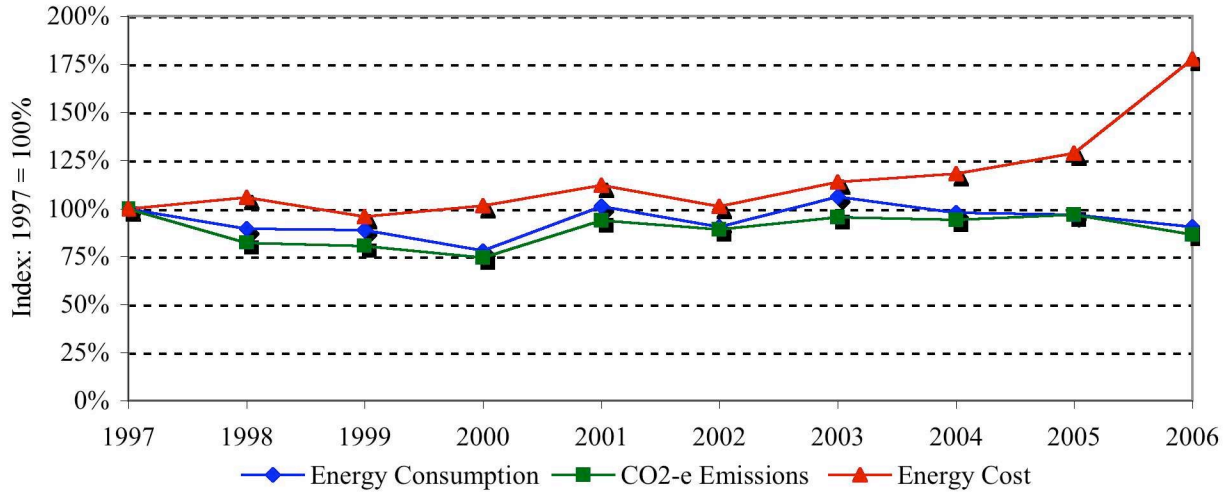

Figure 9. Trends in Costs, Energy, and Emissions

The overall strategy proposed is to pursue an optimal mix of life-cycle cost-effective investments in energy reduction and the most cost-effective ways to reduce CO_2-e emissions.

Figure 10 shows one scenario for reduced costs from pursuing carbon-neutral strategies. In this scenario, the reduced demand for energy from the cost-effective, energy-efficiency retrofits pays for the increased premium for electricity generated by renewables, the costs of switching from coal to natural gas, and the purchased carbon offsets. These estimates do not include the additional savings from avoiding disposal of fly ash from burning coal, as well as other direct and indirect environmental benefits.

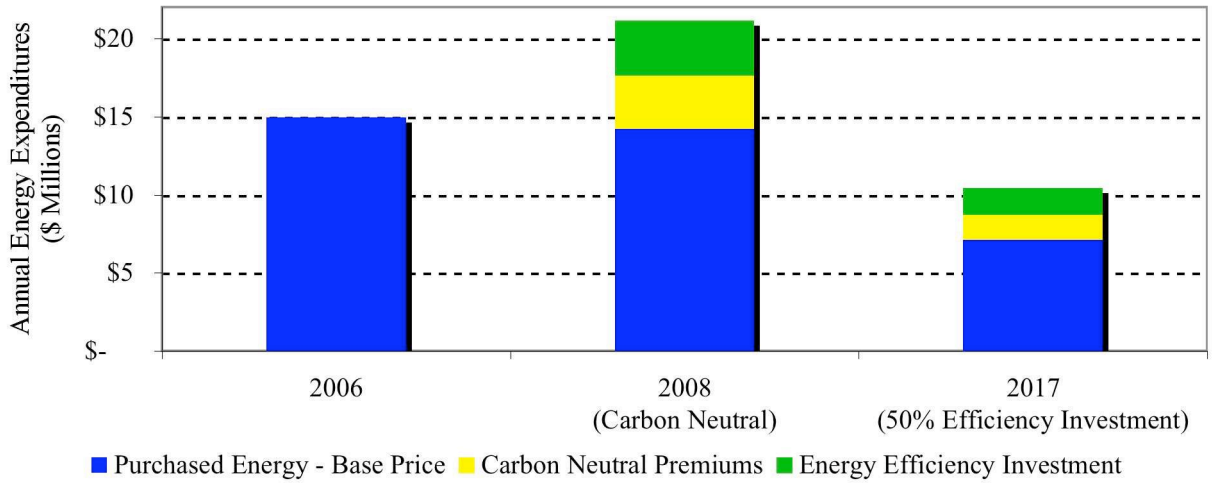

Figure 10. Total carbon-neutral scenario costs

Investments in energy efficiency should not be delayed if appropriated funds are not available. Congress, in the Energy Policy Act of 2005, recognized the value of alternative financing mechanisms as a means to leverage private-sector funds to make improvements in public-sector operations. The use of such alternative financing mechanisms where appropriate to move projects forward is a sound approach to help reach the energy efficiency goals.

Goal #3: Make House operations a model of sustainability

In addition to improving the way the House consumes energy, the House should provide an environmentally sustainable and healthy working environment for employees. The House has the opportunity to lead by example by making its business operations a model of sustainability.

Strategy #1: Direct the CAO to Oversee Implementation of "Green the Capitol Initiative"

It is recommended that the office of the CAO be charged with the responsibility to oversee implementation of the "Green the Capitol Initiative" for the House of Representatives. This includes working with the AOC and other offices to improve the sustainability of the day-to-day operations of the House office buildings, including maintenance, finance, travel, childcare, and food service.

Strategy #2: Develop a House Sustainability Plan

In June 2007, the CAO convened a meeting with three sustainability leaders from major universities that are championing sustainability. Representatives from Harvard, Yale, and the University of California provided briefings on their goals, operations, and successes. A key component of their success has been a sustainability plan to give focus and direction to reform efforts. It is recommended that the CAO be charged with responsibility to develop and implement a House Sustainability Plan as a dynamic document intended to provide a roadmap for major steps toward sustainability over the next 20 years and which will identify timetables for specific actions.

Strategy #3: Pursue Networking, Outreach, and Coordination

The CAO should work to pursue networking, outreach, and coordination with several groups, including the Senate, to undertake activities on sustainability and CO_2-e emissions reduction. The CAO should work with the AOC to make sustainability a mission-critical element of their business model. The CAO should undertake outreach efforts, including hosting a series of greening summits, to better understand where the House can improve its effort and inform the public of the House's accomplishments.

Strategy #4: Mechanisms for Evaluating Success and Reporting Progress

The CAO should track benchmarks monthly on energy use and CO_2-e emissions and prepare an annual report documenting progress on the twin goals of carbon neutrality and sustainable operations. Energy and CO_2-e emissions data will be made available on a website, both as an educational tool and as a way to provide feedback to House staff and other interested parties.

Part Two: Detailed Recommendations

Part Two of the report presents the detailed recommendations for each of the goals identified in Part One.

Recommendations for Goal #1

The recommended approaches for achieving Goal #1, *Operate the House in a carbon-neutral manner by the end of the 110th Congress*, have been addressed in Part One as specific strategies.

Recommendations for Goal #2

The recommended strategies for Goal #2, *Reduce the carbon footprint of the House by cutting energy consumption by 50% in 10 years*, are described in two sections:

- Actions to reduce energy consumption in House office buildings
- Actions to reduce energy consumption at the CPP

Actions to Reduce Energy Consumption in House Office Buildings

Three of the strategies towards achieving carbon neutrality – purchasing renewable electricity, fuel switching at CPP, and purchasing carbon offsets – can be implemented quickly. The next step is to make improvements in House energy use. By implementing these improvements through investment in energy-efficient technologies and changes in operating practices, the House can reduce its ongoing cost of operations while maintaining carbon neutrality.

The starting point to improving the energy efficiency of House buildings is to understand where energy is being consumed. This applies throughout the Capitol complex. There are two major areas where investment in energy efficiency technologies can be made: in House buildings themselves, and at the CPP. The following three sections illustrate these actions.

Metering, Commissioning, and Tracking

Understanding how much energy is being used and where it is being consumed is critical to effective energy management. Meters for all energy flows (electricity, natural gas, steam, chilled water, condensate return) should be installed throughout the Capitol complex. This data must then be regularly collected, widely circulated, and effectively used.

House Buildings and Meters

Reliable and up-to-date energy consumption information is vital to efficiently operate the Capitol buildings. It is also important to track progress in achieving the emissions goals.

It is therefore recommended that the calibration of present meters and loads served by them is verified. Additional steam and chilled water meters should be installed and maintained in House buildings where necessary to understand the system's performance. It is recommended that real-time tracking be developed to determine whether or not benchmarks for load shapes, schedules, and other energy efficiency measures are being achieved. Finally, House staff, building managers, and CPP staff should be provided with real-time information with easy-to-understand graphics on building energy use and CO_2-e emissions.

This proposed emissions-information display system can also serve as a model for other government and commercial buildings.

Benchmarking and Commissioning

The place to begin saving energy and improving the work environment is with a comprehensive review of energy use patterns and the condition of existing energy-using equipment and control systems. Lawrence Berkeley National Lab's preliminary review of energy consumption data and trends has identified buildings in the House complex that are twice as energy-intensive as others, with significant cooling energy use in winter, and uncharacteristically high energy use during low-occupancy days and hours. These findings indicate large opportunities for reducing energy use and CO_2-e emissions by commissioning the House's buildings.

Tuning up the House's buildings is a process known as "commissioning." Commissioning has been shown to yield, on average, 15% energy savings often in less than a year. Retro-commissioning means commissioning an existing building rather than a new building. Periodic retro-commissioning is recommended to ensure that benchmarks for energy and CO_2-e emissions savings continue to be met. Commissioning requires no capital investment, and by helping reduce baseline energy use, it minimizes the cost and maximizes the energy savings from subsequent equipment retrofits. Commissioning is also the primary way to identify and resolve non-energy problems, such as poor comfort conditions, and provide additional benefits to staff. Preliminary walk-throughs conducted during the preparation of this report identified many commissioning opportunities in the House complex that would yield significant energy savings at low cost.

Specific recommendations for metering, commissioning, and tracking:

- Verify calibration of present meters and loads
- Install steam meters and chilled water meters
- Develop utility tracking screens of benchmarked load shapes, schedules, etc.
- Provide Congressional staff, building managers, and CPP staff with real-time information
- Commission (retro-commission) major systems

Lighting

It is recommended that all the overhead lighting in the House buildings be updated with modern, energy-efficient lighting components. These fixtures should be refitted with high-performance electronic ballasts and lamps. This measure will reduce the lighting loads in the House suites and meeting rooms from 2.5 watts per square foot to under 1 watt per square foot while improving lighting quality. This action will reduce the energy and carbon footprint from the House buildings' lighting by more than 50% – the equivalent of eliminating over 7,130 tons of CO_2-e emissions or taking 1,340 cars off the road. Motion sensors and daylight controls will be installed where practical and periodically reviewed for wider application as technologies mature and prices drop.

There are many tunnels and service corridors connecting the Capitol buildings that are lit continuously even though they are very sparsely used at night. Newly-available, two-level or bi-level fluorescent lighting provides a low light level during unoccupied hours and brings the light level to full intensity when anyone enters the tunnel or corridor. By using occupancy sensors to dim lighting of service areas to a low-energy state when unoccupied, the lighting energy consumption will be greatly reduced without reducing security. It is also recommended that the AOC investigate the feasibility of two-step lighting for the parking garages in the House complex.

Table lamps and floor-standing lamps are common in the House buildings and most use inefficient light bulbs. Incandescent bulbs in 2000 desk lamps in the House office buildings were replaced with modern compact fluorescent lamps (CFLs) on Earth Day (April 22, 2007). By the date of this report, June 21, 2007, these CFLs *have already paid for themselves* in lower electricity charges. By completing the conversion of the remaining 10,000 table and floor lamps in the House office complex to CFLs by 2008, the House will save $245,000 in electric power costs every year. Every new Energy Star CFL will use only a fourth of the electricity and last 8 to 10 times longer than the incandescent lamp it replaced. Replacing 12,000 CFLs in the House complex is the equivalent to removing 255 cars from the road.

The goal should be to refit *all* the incandescent sockets in the House complex including the many specialty applications (such as 3-way bulbs, small chandelier lamps, and dimmable lamps) that have inhibited previous high-efficiency lamp replacement programs. Because there are now inexpensive high-efficiency lamps available for these applications, it is recommend that AOC maintain a robust inventory of these efficient lamps.

It is recommended that energy efficiency be promoted among the 7,000 staff of the House by making high-efficiency lamps available at cost in the House Office Supply Store. If all staff members installed just one high-efficiency lamp in their home to replace a standard incandescent bulb used 3 hours/day, it would have the cumulative effect of removing 150 cars from the road.

Given the anticipated increase in high-efficiency lamp usage, the AOC should be directed to expand their lamp disposal program to include the proper collection of used high-efficiency lamps.

Exterior building lighting needs to be evaluated to identify energy-efficiency opportunities. This evaluation needs to balance energy savings, security, and the public visibility of building lighting with the potential energy savings.

Specific recommendations for lighting:

- Replace the inefficient overhead lighting with high-performance fluorescent lighting and improved controls
- Install motion-activated "two-level" lighting in service corridors, tunnels and parking areas
- Upgrade all desk lamps and floor-standing lamps with high-efficiency lamps
- Make high-efficiency lamps available at cost in the House office supply store.
- Direct AOC to collect high-efficiency lamps as part of its lamp disposal program
- Evaluate exterior building lighting

Office Equipment and Other Electronics

Office equipment and other electronics are responsible for roughly 20% of total electricity use in the Capitol buildings. Desktop computers, displays, printers, and copiers consume the majority of this electricity, so the focus should be on these devices. A combination of improved operating practices and new, efficient equipment could reduce electricity use of office equipment and electronics by 50%.

Recommendations for reducing energy use, ranked roughly in order of potential energy savings, are described next. Making changes in computer operations, back-ups, upgrades, and maintenance, will allow staff to safely power-down computers and related equipment during nights and weekends. All energy-saving features on equipment, such as sleep modes, should be enabled. Staff should be advised on ways to effectively consolidate printer and copier operations within offices. Replacing all CRT televisions with LCD models, possibly through bulk purchase, will save energy with the added benefit of increasing ergonomic comfort. Finally, only equipment complying with Energy Star specifications should be purchased.

In addition to providing electricity and CO_2-e emissions savings, these measures have the important side benefits of space efficiencies, improved thermal characteristics and acoustic comfort in offices. Other efficiency measures for more specific opportunities will be described elsewhere.

Specific recommendations for office equipment and other electronics:

- Change computer operations to allow staff to centrally power-down equipment when unused for significant periods such as nights and weekends
- Maximize power management efforts present in existing electronic equipment through periodic audits and employee education
- Develop a preferred list of Energy Star-qualified office electronics
- Devise strategies to consolidate equipment

Heating, Ventilating and Air Conditioning (HVAC)

Together, the CPP and Capitol complex buildings form a typical district heating and cooling system. This system consists of three main components: a "power" plant,[7] a distribution system and multiple buildings with various end uses. Figure 10 illustrates the connections between a generic plant and a generic space heating and cooling system in a building, along with some of the important energy and water flows.

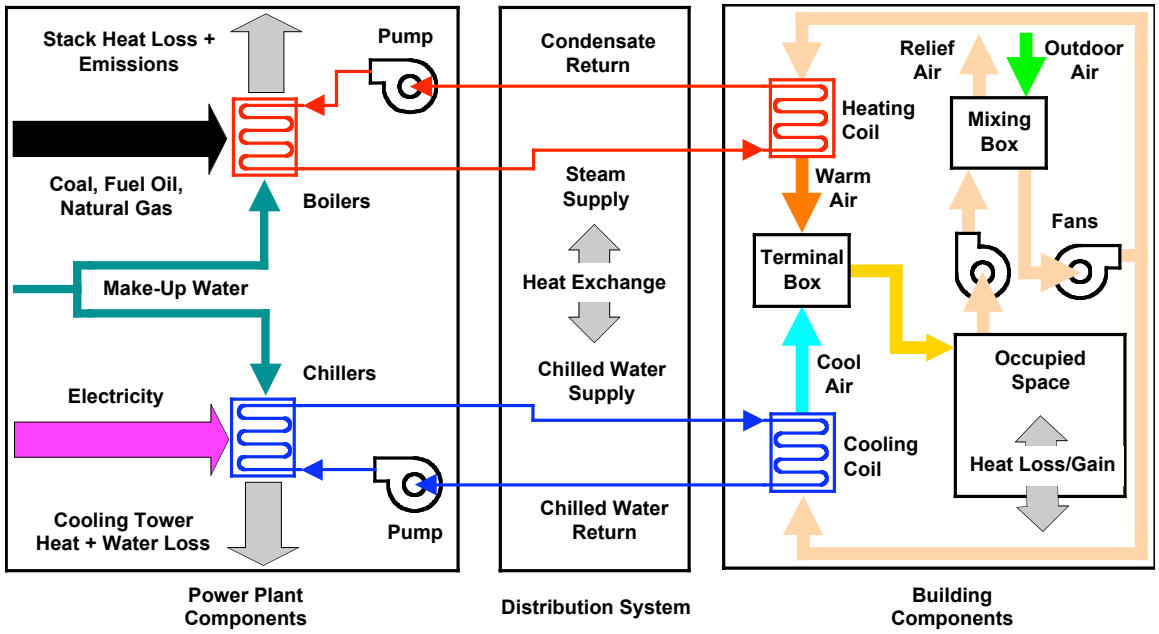

Figure 10: District Heating and Cooling System Schematic

It is essential to recognize that the effects of the power plant, distribution system, and building inefficiencies are multiplicative. For example, to heat a conditioned space, if 40% of the steam and chilled water energy supplied to the buildings is wasted before it reaches the conditioned spaces, 15% of the energy supplied to the distribution system pipes is wasted before it reaches the buildings, and 25% of the energy supplied to the plant is wasted before it reaches the distribution system, then the net efficiency, fuel to end use, is reduced to only about 38%. This means that about 62% of the energy supplied to the plant is ultimately wasted, or conversely, the plant must supply about 2.6 times more energy than the building end uses require. It also means that actions to reduce CPP energy use should include improvements to the HVAC and distribution systems.

Consultants who have carried out energy audits of the Rayburn House Office Building and the Capitol Building have recommended several improvements to increase HVAC energy efficiency,

[7] Although the CPP was originally equipped with steam turbines, it has not generated electricity since the early 1950s.

such as replacing faulty equipment and using motors and pumps that are more efficient. However, the recommendations have not included two major opportunities that are available at relatively low cost: reducing duct leakage, and improving the operation of constant-speed fans that circulate hot and cool air.

Electricity used by fans to circulate hot and cool air in large commercial buildings is typically 30 to 50% of the total HVAC site energy use. Recent field data indicate that duct leakage can result in fan energy increases of 25 to 35%. It is possible to almost eliminate this energy waste by sealing the ducts using aerosol-based sealants or a similar technology. New wireless-based sensor and control technology has recently become available to enable constant air volume (CAV) air-handling systems to operate as variable air volume (VAV) systems. This will help reduce fan speeds and energy use, as well as reduce unnecessary heating and cooling. To use this wireless technology, fan drives need to be upgraded, but there is no need to replace other air distribution components. Potential energy savings from duct leakage sealing and improving fan operation could be as much as 30 to 50% of supply fan energy consumption, plus about 30 to 40% of the other heating, cooling, and HVAC auxiliary equipment energy consumption.

It is recommended that duct leakage tests and an analysis of available fan speed control technologies be conducted to better assess the potential energy savings. It is also recommended that fan schedules be optimized to avoid unnecessary equipment operation, further reducing energy use.

Ventilation air is supplied to each House building by its HVAC system, by building leakage, and in some cases, by open windows. Large reductions, (greater than 50%), in ventilation-related energy use may be possible if ventilation rates can be reduced without harming health and reducing work performance. It is recommended that detailed analyses be conducted and supplemented by onsite testing to select appropriate ventilation rates and technologies. It is also recommended that long-term monitoring be conducted to verify acceptable or superior indoor air quality. Specific efforts should include improving existing equipment and installing new equipment as needed to: a) measure and control ventilation rates such as measurement systems for HVAC outdoor airflows, demand-controlled ventilation systems for spaces with highly variable occupancy; b) calibrate and maintain ventilation economizer controls; c) re-circulate return air for 100% outdoor air systems where possible; d) recover ventilation heat that would be otherwise discharged outdoors; and e) implement improved particle filtration and add gas-phase air cleaning. Related efforts should include providing guidance to building operators and occupants about indoor pollutant source control to reduce the amount of ventilation needed.

Specific recommendations for heating, ventilation, and air conditioning (HVAC):

- Retrofit motors, fan drives, pumps, and valves with energy-efficient models
- Modify CAV equipment and controls so that air-handling systems operate as VAV systems
- Seal air distribution ducts to minimize air leakage
- Optimize fan schedules to avoid unnecessary equipment operation

Information Technology Equipment and Data Centers

Computer servers, network equipment and storage devices are collectively known as information technology (IT) equipment. IT equipment consumes a significant amount of electricity itself, but its energy consumption impact is magnified by the cooling that must be provided for the equipment. Opportunities for energy efficiency are similarly divided between improvements to the energy performance of the equipment itself and enhancements to the ways in which the operating environment of the equipment is maintained.

House IT systems are operated two ways: distributed operation, in which IT equipment is dispersed throughout Member and Committee offices in the House office buildings; and centralized operation, in which IT equipment is located in dedicated data center facilities.

Distributed IT equipment energy savings opportunities

Energy savings opportunities in distributed IT equipment operation are available through careful attention to power management and process scheduling. These include: enabling sleep modes to allow equipment to reduce power when not actively providing computational services, powering off equipment when its services are not needed, and scheduling services carefully.

Server consolidation can also provide energy savings. Moving various IT functions to one server instead of spreading those functions across multiple machines can reduce the energy consumption associated with those IT functions while providing equal services. If IT functions are consolidated into centralized operations, the services available from the hardware can often be enhanced.

Beyond operational management, substantial energy savings are available from transitioning distributed IT equipment into a centralized operations model because of the cooling loads associated with the distributed IT equipment. Systems that are sprinkled throughout Member and committee offices require levels of power reliability and space conditioning that are much higher than the requirements for other office operations. For example, House office building ventilation systems do not have the degree of control that can allow air conditioning to be supplied solely to one small space housing a file server. As a result, one cluster of IT equipment in a particular office can often drive the space conditioning supply requirements for a large portion of the building, leading to enormous energy loses in unneeded cooling supplied to that large area. In some cases, offices in the same HVAC zone require heating in their space to override the cooling that is being delivered for the IT equipment.

Centralized data center facilities, by contrast, are designed to deliver focused space conditioning (and other infrastructure services like high-quality, reliable power) to meet the unique needs of IT equipment. Making the transition to a centralized IT equipment model would increase space available in the House office buildings currently used by IT equipment, as well as reduce the noise and the cooling loads on the HVAC systems that are overwhelmed in many areas. This will have the added benefit of improving thermal and acoustical comfort in the office. Consolidation would significantly reduce the number of servers that need to be purchased, housed, powered, cooled, and maintained, with corresponding energy, emissions, and other operating cost savings. Consolidation opportunities could be facilitated by the office moves at each new Congress.

Specific recommendations for distributed IT equipment:

- Specify energy management capability, energy efficiency, and environmentally-benign materials as desired product criteria in new purchases. Where applicable, use the Electronic Performance Environmental Assessment Tool (EPEAT) to guide purchasing decisions
- Enable power management to minimize unnecessary energy consumption
- Consolidate multiple servers into a smaller number of servers with higher utilization
- Consider energy consumption implications of service scheduling and maximize opportunities for IT equipment to be powered down or off
- Wherever possible, shift from distributed IT equipment to a centralized model that can be design-optimized for IT equipment operation

Data center energy savings opportunities

The opportunities for energy savings for servers and data centers are similarly divided into the energy savings potential of the IT equipment itself and the potential for improvement in energy efficiency of the dedicated services supporting the IT equipment, such as space conditioning and reliable power.

Operational improvements include efficiency improvements that require essentially no capital investment. Operating the existing stock of IT equipment with greater detail to power management could result in savings of 20% of existing energy consumption.

Energy efficiency levels achieved by the most efficient existing facilities today go well beyond those operational savings. These facilities build on the enhancements from improved operational maintenance. Specific improvements require more capital investment, planning and engineering. The technologies in this scenario are available today but are not widely used in the Capitol. Potential savings could be 45% of existing energy consumption. It should be noted that in state-of-the-art new data centers, reductions of energy use by approximately 66% are possible.

Improved operational control of computer-room air conditioners (CRACs) and Uninterruptible Power Supplies (UPSs) is recommended. There should be coordinated controls of CRACs in any data center room to eliminate simultaneous humidification and de-humidification. Also, temperature and humidity setpoints that are consistent with the IT equipment manufacturers' recommended range should be used. Finally, CRACs should operate double-conversion UPSs in bypass mode, when this feature is available and the switchover time to battery/inverter operation is consistent with the IT equipment requirements.

An evaluation of current computer rooms and servers needs to be done to develop ways to consolidate distributed servers. Opportunities are likely to include both consolidating the servers to fewer locations as well as consolidating to fewer physical servers, including virtualization.

An evaluation and adjustment of air distribution in computer rooms for thermal optimization should be conducted. In the current data centers, modeling tools are already being used to improve air-flow management. This is critical to effective and efficient data center operation. These tools need to be used to help configure and optimize the centers as modifications are made. Improved air-flow management, including hot aisle/cold aisle isolation, and the elimination of bypasses and leaks in the room and within racks should be pursued.

Finally, power management functions in servers and storage equipment need to be enabled to reduce energy use during light demand.

Specific recommendations for data centers:

- Specify energy management capability, energy efficiency, and environmentally-benign materials as desired product criteria in new purchases. Where applicable, use the Electronic Performance Environmental Assessment Tool (EPEAT) to guide purchasing decisions
- Enable power management functions in servers and storage equipment
- Turn off test and lab equipment when not in use.
- Install sensor-based lighting in server rooms and ensure lights (other than emergency lighting) are turned off during prolonged inactivity periods
- Evaluate current computer rooms and servers and find ways to consolidate distributed servers
- Improve operational control of CRACs and UPSs
- Evaluate and adjust air distribution in computer rooms for thermal optimization. Develop and enforce controls for the introduction of new equipment to maintain optimal equipment thermal performance within the space
- Perform a comprehensive energy efficiency assessment in the existing data centers to identify specific energy reduction opportunities and savings targets
- Institute an ongoing energy management process to continually monitor and improve the energy performance of data centers

Other End Uses

Other end uses where energy efficiency opportunities exist are food service, vending machines, hot water, laundry, dry cleaning, gyms, elevators, escalators, and others. Each of these areas should be evaluated for energy efficiency investments.

Actions to Reduce Energy Consumption at the CPP

The CPP is the largest single source of carbon emissions on Capitol Hill. It is important for Congress to take a leadership role in modernizing and updating this facility. It is recommended that the committees of jurisdiction review the plant's operation, and develop legislation to make the plant a model of efficient operations and sustainability. This legislation should be passed by the end of the 110th Congress.

Making changes to the CPP will take many years to plan, finance, and implement. During this interim period, it is recommended that the following actions be taken to optimize operations of the CPP to maximize energy efficiency and reduce energy consumption.

Boiler Plant

The CPP produces high-pressure steam using seven dual-fuel boilers: two that are fired using coal or natural gas and five that are fired using oil or natural gas. Well-tuned, generic boilers have "fuel-to-steam" efficiencies in the range of 70 to 85% at full load, but the efficiency drops rapidly as less steam is needed. There can be further efficiency losses of 10 to 15% due to soot and scale contamination of the boiler heat transfer surfaces and poor water quality control practices. In combination at full load, as much as 45% of the energy in the fuel could be wasted.

The AOC is already planning to address one of the larger opportunities for energy savings: adding controls so that one or more boilers are operated at or near full load as much as possible. A variety of other energy-saving opportunities exist. These include: using natural gas only to fire the boilers instead of a combination of coal, oil, and natural gas; reducing boiler steam pressure from 200 PSI to 150 PSI reducing fuel usage by about 5%; and assessing opportunities to improve existing operation and maintenance programs such as regular cleaning to minimize boiler contamination, returning more condensate to the CPP, recovering more heat from the stacks to reduce the energy needed to preheat water for the boilers and resetting the steam supply pressure in mild weather to optimize the tradeoff between lowest acceptable steam pressure and piping pressure losses. Boiler performance needs to be monitored to measure the effects of these changes and to fine-tune equipment operation. This information should be available real-time, in an easy-to-use graphical format, for each component and for the overall boiler plant so that the operations staff can monitor and control it as well as flag components in need of maintenance or repair.

Specific recommendations for the boiler plant:

- Switch to using natural gas only
- Evaluate reduction of steam pressure generated by the CPP boilers from 200 PSI to 150 PSI
- Implement best practices for operations and maintenance
- Monitor performance

Chiller Plant

There are a number of strategies that can be implemented at the CPP chiller plant to save energy, money, and CO_2-e emissions. While further study will be needed to more precisely determine the possible savings, there appear to be opportunities for 10 to 20% savings in the electricity used for the overall chiller plant, which is comprised of the chillers, chilled water and condensing water

pumps, cooling towers, water-side economizer heat exchangers, interconnecting piping and valves, and controls.

Implement best practices for operations and maintenance

The CPP chiller plant is undergoing modification, relocation, and modernization of the major equipment and controls, offering new opportunities for energy efficient operation. The plant already appears to have an excellent maintenance program. Specific opportunities for energy efficient plant operation, some of which are already being implemented, include:

- Operate the most efficient available chillers for any given load
- Operate the cooling towers at the best operating point given the tradeoff between tower fan and chiller compressor power
- Continue to explore chilled water temperature reset strategies to deliver the highest acceptable chilled water temperature
- In winter and shoulder months, operate the water-side economizer system in the best combination of series or parallel configuration to obtain "free" cooling, again with fan vs. chiller power in mind
- Investigate the opportunity to reset the chilled water supply pressure to follow the load
- Operate the new chillers' synchronous motors to control the plant power factor

For cooling tower, water-side economizer, and chilled water supply pressure reset optimization, further study and analysis will be needed, and ideally software written, to inform the operators on the most efficient configuration for the combination of load, chilled water temperature, and wet-bulb temperature.

Retrofit motors with premium efficiency motors

It is recommended that a study be performed to assess the opportunity for replacing existing motors with premium efficiency motors. In particular, the older west-plant cooling tower fan motors seem to be optimum candidates.

Evaluate retrofit potential of variable-speed drives on pump motors

The new chilled-water secondary pumps are equipped with variable-speed drives, and there is a planned conversion of the older pumps to two-speed operation; the option to make the latter pumps completely variable should be investigated, as variable speed pumping would fully support parallel operation and pressure reset in the most energy-efficient manner. Also, the condensing water pumps should be studied for variable-speed operation, which would allow further optimization of the condensing side of the plant and the current strategy of throttling flows could be minimized.

Monitor performance

The key delivery variables of chilled water supply temperature and pressure are paramount in the monitoring of the plant. The metric for efficient supply of temperature and pressure should be overall plant kW per ton of cooling supplied, including all power consumed by chillers, chilled and condensing water pumps, and cooling tower fans. This information should be available real-

time, in an easy-to-use graphical format, for each component and for the overall chiller plant so that the operations staff can monitor and control it, as well as flag components in need of maintenance or repair.

Specific recommendations for the chiller plant:

- Implement best practices for operations and maintenance
- Retrofit motors with premium efficiency motors
- Evaluate retrofit potential of variable-speed drives on pump motors
- Monitor performance
- Evaluate new efficient chillers for West Refrigeration Plant

Distribution System

Two capital-intensive improvements should be considered to improve distribution system performance:

Steam traps are used to remove water from steam lines as well as at the thousands of heat exchangers in the buildings, and are often a critical source of energy inefficiency. Although the AOC has an excellent trap maintenance program in place, many traps cannot be maintained easily, such as in the Longworth building. The problem of maintaining steam traps can be reduced by changing steam distribution to hot water, where feasible. The AOC is already considering such a change in the Longworth building.

The steam and chilled water pipes that connect the CPP to the buildings that it serves are located in an extremely hot environment throughout the year due to heat losses from the steam pipes. Energy losses associated with steam line leakage and inadequate insulation can be in the range of 5 to 20% of the energy entering the steam line. An audit is needed to quantify the savings opportunities from lowering steam temperatures and pressures and improving the pipe insulation.

Specific recommendations for the distribution system:

- Improve maintenance of steam traps, increasing steam system distribution efficiency
- Determine need for new insulation of all distribution lines to reduce heating and cooling losses

CPP Alternatives

One major opportunity that the House should consider further is the conversion of the CPP to be a combined heat and power (CHP) system, also known as a cogeneration system. Such a system would generate electrical power on site, and energy that would normally be wasted in offsite electricity generation (as much as two thirds of the energy input) could be used to produce steam and chilled water for use onsite. A CHP system can save at least 50% of the combined energy that otherwise would be required to separately generate electricity off site plus steam and chilled water onsite. The conversion is capital-intensive and requires further study. A report requested by the AOC for such a system will be available this summer.

Recommendations for Goal #3

The recommended strategies for Goal #3, *Make House operations a model of sustainability*, are described in the following sections:

- Water Management
- Landscape Management
- Transportation and Alternative Fuels
- Food Service
- Procurement, Materials, Recycling, and Cleaning
- Leadership, Education, and Outreach

In order to achieve this goal, every attempt will be made to purchase American-made environmentally sustainable products.

Water Management

Water use needs to be managed in three areas: indoor water consumption, outdoor irrigation use, and stormwater runoff. Irrigation water and runoff are discussed further in the following section on Landscaping. Reducing water usage has a secondary impact on the carbon footprint as it saves energy for water pumping and for wastewater treatment.

According to the AOC, water is the only purchased utility not tracked by the AOC's online Utility Tracking and Management program (AOC 2007). Instead, AOC staff maintains water consumption and billing data separately. Data are available for 67 meters within the Capitol complex. Water consumption for offsite facilities is not included in this information. The 67 meters account for all campus water consumption, including landscape irrigation and CPP cooling tower use. Water is metered by supply volume only. There is no separate metering of sewer volume.

Since FY 2003, water consumption tracked by these meters rose 8.9 percent, from 438 million gallons to 478 million gallons. CPP water consumption was relatively stable during this time, but in FY 2003, much of the Capitol complex irrigation system was shut down while backflow preventers were installed. This condition may have produced an artificially low baseline volume. Increased consumption could also result from aging infrastructure.

A storm water management rain garden was installed in 2004. The rain garden gathers rain water, which the vegetation not only utilizes for growth, but also processes oil and other manmade products cleaning the storm water prior to draining into the sewage system.

In FY 2006, AOC developed a preliminary analysis of improved water metering for the Capitol campus. This includes consideration of separate metering of supply and sewer volume since water that is evaporated from cooling towers or used for landscape irrigation does not incur sewer volume charges. AOC also plans an initial edit of its Design Standards for irrigation systems. In FY 2007, AOC will meet with the District of Columbia Water and Sewer Authority to upgrade water metering to improve the Agency’s ability to trace and address water consumption inefficiencies. AOC also plans to include water usage in the online Utility Tracking and Management program in FY 2007.

Annual water use for landscaping is shown in Table 4.

Table 4. Annual water use for landscaping (gallons per year)

	2003	2004	2005	2006
Total landscaping water consumed, irrigation & fountains (based on meters that are irrigation-only)	77,806,212	105,425,364	57,817,408	91,360,720

Source: AOC 2007

Currently there is considerably less information available on water consumption and costs or wastewater volumes and costs than exists on energy consumption and costs. To reduce water consumption, use water more efficiently, and determine energy savings from reduced water demand, more information is needed about water use and costs related to Capitol facilities. It is recommended that additional meters to track building water use be installed. Tests should also be conducted regularly to determine water quality.

Water-consuming equipment in the House buildings includes faucets and toilets in bathrooms, dishwashers, food steamers, pre-rinse spray valves and icemakers in food service, and clothes washers, dishwashers, showers, tub-spout diverters, faucets, and toilets. Replacing such equipment with high-efficiency products, either low-flow or water-free, will reduce water consumption.

Specific recommendations for water:

- Analyze water consumption
- Analyze water quality
- Install additional water meters
- Evaluate potential for water-efficient fixtures and follow EPA recommended practices
- Install low-flow and water-free fixtures

Landscape Management

Like buildings, outdoor spaces can conserve resources. They can also degrade or wastefully consume resources. Unlike buildings, green outdoor spaces have the capacity to enhance and regenerate natural resources. No environmental audit of a building complex is complete without consideration of the design and care of the grounds. In the best case, well-designed grounds enhance watershed health and biodiversity. In the worst case, grounds support little or no life and send polluted stormwater downstream. There is always room to further strengthen and celebrate natural heritage, and there is no place more appropriate to do so than on the historic landscape of the Capitol grounds. Greening the Capitol grounds can be accomplished incrementally by integrating a number of improvements in design features and maintenance practices:

Stormwater Management

The Capitol complex has the opportunity to provide a relief for excessive stormwater runoff. The Capitol complex is served by District of Columbia's combined sewer system, which

means that excessive stormwater runoff leads to sewage overflows, which is the primary source of pollution in the Anacostia and Potomac Rivers. Stormwater runoff from paved surfaces and lawns can carry pollutants, overwhelm urban infrastructure, erode stream channels, and degrade aquatic habitats.

In addition to green roof technology, porous pavements and rain gardens are strategies that can vastly improve the stormwater performance of the parking lots and other paved areas on the Capitol grounds. A rain garden area can be designed to be periodically saturated with stormwater, providing another layer of protection against excessive runoff. Parking lot runoff tends to be particularly polluted due to automobile fluids carried by stormwater. These strategies, in addition to collecting stormwater, can help filter out contaminants.

Specific recommendations for storm water management:

- Use porous pavements to replace impervious surfaces, increasing infiltration of stormwater into the soil
- Establish rain gardens, stormwater planters, and tree boxes to serve as collection points for stormwater runoff

Irrigation Water Efficiency

The Capitol complex should also encourage sound water resource management. Emphasis should be placed on careful and efficient use of water to meet the needs of the Capitol complex. Water already on site should be used as much as possible. Irrigation needs could also be reduced by using indigenous plants.

Specific recommendations for irrigation water efficiency:

- Replace on-site water use with high efficiency irrigation, including captured rainwater or recycled site water
- Perform a soil/climate analysis to determine appropriate landscape type and design landscape with indigenous plants to reduce or eliminate irrigation requirements

Biodiversity

To the extent compatible with historic landscape preservation, simple landscapes like lawns should be enhanced with other forms of vegetation that more fully achieve the health, richness, and complexity of the natural world. Biodiversity encompasses the potential richness and complexity of plant and animal life supported by microbe-rich soil. A single site's contribution to biodiversity provides pleasure to its users as well as an incremental increase in habitat for desirable species. As this country's population grows and land consumption rises, tended gardens in urban areas can provide increasingly significant supplemental habitat, particularly to plant, bird, and insect species.

Specific recommendation for biodiversity:

- Explore vegetation that could be added to the Capitol grounds that would enhance biodiversity

Expand Tree Canopy Coverage

Trees offer many benefits to counter air pollution, water pollution, stormwater runoff, heat island effect, and other urban environmental ills. Trees sequester carbon and provide a reduction of

carbon in the atmosphere. One ten-year-old tree can sequester 5 to 20 pounds of carbon per year; 100 ten-year-old trees will sequester up to a ton of carbon each year.[8] They act as giant filters as they convey water from their roots through their leaves and cool the air through evapo-transpiration.

Research shows that the leaves of trees are like cups and can hold up to one-tenth of an inch of rainwater – an amount of rainfall that can trigger a discharge in some sewer-sheds.[9] Trees should be planted in parking lots to shade vehicles and pavement on hot days. This also decreases the "heat island effect" associated with excessive temperatures in the city. Trees in parking lots can also mitigate the evaporative emissions from vehicles.[10]

Specific recommendation for expanding tree canopy coverage:

- Strategically plant trees around the Capitol grounds for shade, helping with rainwater and carbon sequestration benefits
- Reconfigure the parking lots to permit intermittent tree planting

Improved Maintenance Practices.

Maintenance of green spaces can generate pollution. Chemical fertilizers and pesticides can pollute air and water and harm biodiversity both on- site and off-site. A wide variety of machinery is used to maintain the extensive lawns and the landscape of the Capitol complex. Opportunities should be examined to reduce or eliminate various machinery used in landscape maintenance. Regular application of compost improves soil and plant health and retains soil moisture. Composting also provides a means for recycling plant clippings and other organic wastes.

Specific recommendation for improved maintenance practices:

- Reduce or eliminate various machinery use in landscape maintenance
- Reduce chemical fertilizer and pesticide application
- Provide for regular compost application emphasizing using plant material generated on site

Transportation and Alternative Fuels

There are 7,000 people employed in various capacities in the House. Each day they make at least two trips – one to get to work and one to get home – for a total of 14,000 trips each day or 70,000 trips each week. In addition, there are thousands of visitors daily to the House office buildings and the Capitol. The majority of these journeys to and from work are made by car. This pattern is similar to the regional norm, but significantly higher than the District of Columbia itself, where fewer than half of residents drive to work.

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[8] U.S. Department of Energy, Energy Information Administration, "Method for Calculating Carbon Sequestration by Trees in Urban and Suburban Settings," 1998.

[9] Casey Trees and Limno-Tech, "The Green Build-Out Model: Quantifying the Stormwater Management Benefits of Trees and Green Roofs in Washington, DC," 2007.

[10] David J. Nowak, USDA Forest Service, "The Effects of Urban Trees on Air Quality."

The impact of transportation on CO_2-e emissions is enormous – estimates vary from one quarter to one third of all CO_2-e emissions nationwide. The potential to reduce the carbon footprint of the House by addressing commuting issues is quite significant.

From a commuter perspective there are significant programs to help reduce the impact of House employee's current commuter trends – Transit Benefit Programs, Bike and Walk to Work Programs, and Telecommuting Programs.

Alternative Fuel Infrastructure and Vehicles

The House maintains its own fleet of vehicles, both cars and trucks. These are predominantly lower-efficiency vehicles, and should be replaced with efficient, hybrid, or alternate fuel vehicles.

An important element of decreasing our environmental foot print is moving towards alternative transportation fuels. The House will show leadership by providing such infrastructure.

Specific recommendations for Alternative fuel infrastructure:

- An E-85 ethanol fueling station should be installed to provide for alternative fuel vehicles

Establish an Employee Transportation Coordinator Position

Changing the travel behavior of House members and staff will require time. To assist in this change process, the creation of a CAO staff position to properly manage the implementation of all commuter related recommendations and other transportation management strategies is recommended. Such an individual would work with regional transportation management agencies such as the Commuter Connections program at the Metropolitan Washington Council of Governments, as well as with the District Department of Transportation to provide valuable services and information to Capitol Hill employees.

Specific recommendations for the Employee Transportation Coordinator:

- Implement programs that would encourage House employees to utilize an alternative commuting method
- Expand information and education programs to support and encourage alternate modes of commuting
- Implement, administer and promote a guaranteed or emergency ride home program
- Collect and analyze data on travel to, from and within the House office buildings and Capitol complex
- Coordinate with House offices, U.S. Capitol Police, the AOC, District Department of Transportation, Washington Metropolitan Area Transit Authority and other agencies
- Develop a comprehensive website and materials on commuting alternatives to encourage Hill employers to choose alternatives to commuting by car

Centralize the Cost of the House Transit Benefit Program and Increase the Benefit Level

Offering transit benefits demonstrates to House employees and the community that the House is an environmental leader and is committed to a sustainable future.

Specific recommendations to centralize the cost of House transit benefits:

- Increase the House Transit Benefit Program limit to $200, once legislation is passed
- Fund the cost of the House Transit Benefit program in a centralized place, in the same manner as other House employee benefits, and at no direct cost to House employing offices
- Implement the WMATA Smart Benefits program for House employees in the Capitol complex. SmartBenefits is a web-based program that lets employers conveniently load the dollar value of an employee's Metrochek transit, Van Pool and Metro station parking benefits directly to an employee's SmarTrip® card
- Implement a guaranteed or emergency ride home program tailored to the House's circumstances and work practices to provide a back-up to those who can and would like to take public transportation to work

Implement a Bike to Work Program

Bicycling is a healthy, quiet, clean, economical, and fun way to get to work. Thousands of Washington area employees bike to work every day. The House currently provides bike racks in a number of their parking lots however, the racks are old and located in non secure areas. The House should adopt the bicycle parking guidelines of the Association of Pedestrian and Bicycle Professionals. Short-term bicycle parking for staff and visitors should use the inverted U design; longer term and secure parking should be provided with lockable cages.

Specific Recommendations to implement a Bike to Work Program:

- Adopt the bicycle parking guidelines of the Association of Pedestrian and Bicycle Professionals
- Improve the parking infrastructure for cyclists
- To the maximum extent feasible, provide showers and changing facilities in each House building. House buildings should provide at least four showers, two rooms, two stalls each, with two of them being accessible to the disabled
- Provide one lockable gym locker for every long-term bicycle parking space provided
- Implement a Guaranteed or Emergency Ride Home Program tailored to the House's circumstances and work practices to provide a back-up to those who can and would like to bicycle to work
- Provide information on bike commuting including a map of bike parking locations, locations of showers and gym, bike maps of the Capitol area, and information on bike education classes
- Review options for a bike-sharing program that would be available for House members and staff
- Coordinate with the AOC and the District Department of Transportation to provide safe bicycling conditions and facilities for bicyclists on the Capitol complex

Improve Telecommuting Capabilities

The use of telecommuting, also known as telework, for House employees should be encouraged. In addition to the reduced CO_2-e emissions, increased telecommuting capabilities ensure the continuity of business operations for the House in the event of an emergency. Additional benefits include enabling House offices to attract and retain a diverse and talented work force, encourage affordable traffic patterns, better address work and family demands, reduce the number of daily commuters, and further the goals of the Clean Air Act.

Specific Recommendations to improve telecommuting capabilities:

- Review current House telecommuting policies and individual House office practices regarding telecommuting
- Explore the viability and use of telecommuting centers in the Washington Metropolitan area considering costs, locations, availability of spaces, and computer security
- Develop telecommuting pilot programs, in the House, to determine the most effective telework arrangements, tailored to the House's circumstances and work practices
- Expand information and education programs, for House offices, to support and encourage telework as an alternate to commuting

Car Sharing

The CAO should explore the feasibility of offering car-sharing services at the House. There is a segment of the House community that does not own vehicles. Some individuals in this group live within close proximity to the Hill and others split their time between their home states and DC. Having access to a vehicle, on an as-needed basis, would aid them in running errands, reaching medical appointments, shopping, etc. Their primary mode of transportation would remain public transportation but they would have the option of using a car share vehicle when public transportation was not practical for a given errand. The House has an opportunity to address the need for providing a car service and at the same time offer an environmentally-friendly solution using the car sharing model. For some users, car sharing reduces the dependence on automobiles and increases usage of more environmentally-friendly forms of transportation. According to the Department of Transportation, "a single car-sharing vehicle can be used by 6 to 10 households, thus reducing parking and traffic congestion." Car sharing could be limited to personal use as initially described above. However, adopting models currently in use in several cities, the House could use cars for official business during the day and then those same cars could be used by staff after hours to optimize vehicle use.

Specific recommendations for car sharing:

- Explore the feasibility of offering car-sharing services at the House

Food Service

As part of the "Green the Capitol Initiative," the CAO Service Management team will partnered with its food service contractors to integrate environmentally-conscious measures into Capitol campus dining facilities.

It is recommended that other sustainable food service programs, including introducing organic foods into menu rotations, composting of food wastes, using ecologically-safer cleaning supplies, and installing air-curtains on walk-in coolers be investigated. Furthermore, it is the recommendation that all future equipment purchases adhere to Energy Star and/or Federal Energy Management Program (FEMP) energy-efficient guidelines. The AOC has committed, in the upcoming Longworth Food Court kitchen renovation to use Energy Star and/or FEMP equipment.

Finally, it is recommended that the global foodservice industry be monitored for new and innovative ways to bring sustainable dining initiatives to the House. To this end, allying with an established "green" food organization should be explored.

Specific recommendations for food service:

- Purchase locally-grown food products when possible
- Purchase a reasonable predetermined amount of organic food products
- Utilize sustainable "green" cleaning supplies
- Comply and participate with all present and future campus recycling programs
- Place strong emphasis on waste reduction and prepare to document reductions on an annual basis
- Evaluate the feasibility of implementing composting to reduce waste streams
- Use earth-friendly or biodegradable carry-out and catering food containers
- Use paper carry-out food containers that contain high levels of recycled content
- Maximize opportunities to reduce overall packaging required for food, such as using paper wraps rather than traditional bulkier carry-out containers
- Strictly limit wherever possible, plastic or Styrofoam cups, plates, bowls and other carry-out food containers
- Explore the future use of biodegradable flatware
- Use paper napkins made with high levels of post-consumer recycled content
- Educate customers about the advantages of a sustainable food service
- Investigate sustainable food service programs
- Purchase only Energy Star or FEMP-designated products
- Monitor for innovation opportunities and ally with "green" food organizations

Procurement, Materials, Recycling, and Cleaning

Procurement and Materials

It is recommended the House establish best practices for procurement of paper, furniture, paints, carpets, office equipment, etc. The House is a major purchaser of products and services, and should demonstrate leadership by making purchases that promote sustainability.

Various guidelines should be used in the procurement process. Energy Star or FEMP products have been determined by the appropriate federal agencies to be life-cycle cost effective in normal operations and will contribute significantly to reduced consumption of energy. The Electronic Product Environmental Assessment Tool (EPEAT) system helps evaluate, compare and select electronic equipment based on its environmental attributes. EPEAT-certified electronic devices are low in heavy metals and high in recycled plastic content. Purchasing wood products certified by the Sustainable Forests Initiative or the Forest Stewardship Council will make a contribution toward insuring bio-diverse forests for future generations.

Volatile organic compounds (VOCs) are emitted by adhesive, sealants, paints, coating, and carpets. VOCs are major components affecting indoor air quality and they contribute to climate change. Emphasis should be put on purchasing products that emit low quantities of VOCs.

Specific recommendations for procurement:

- Purchase only Energy Star or FEMP-designated products when available
- Purchase only EPEAT-certified office equipment when available
- Purchase only adhesive, sealants, paints, coating, and carpets that emit very low quantities of volatile organic compounds emphasizing made in America products
- Purchase only furnishings that contain recycled products or wood certified as sustainable by the Sustainable Forests Initiative, the Forest Stewardship Council or similar programs

Recycling and Cleaning

The House needs to review current practices and make recommendations for best practices for recycling, green cleaning and custodial practices. These might include training from associations such as BOMA, incentives, best practices for sustainable operations and maintenance.

The House needs to reduce the environmental impact of materials, through purchase of locally or regionally produced products, and standardize where possible to reduce inventory and procurement costs.

The House needs to significantly improve its current recycling program. A goal of recycling 50% of the waste stream is achievable. Other opportunities for recycling such as obsolete office equipment need to be explored. Also the House should increase the purchase of paper products containing high or 100% recycled content.

Many cleaning products contain toxic substances. Switching to green cleaning materials can improve the health of janitorial staff and office workers. Cleaning supplies used in the House should at a minimum meet the requirements of Green Seal Standard for Industrial and Institutional Cleaners, Standard GS-37; and for floor products, Standard GS-40.

Specific recommendations for recycling and cleaning:

- Divert 50% of the building occupant waste stream through an improved recycling program
- Examine other recycling opportunities such as obsolete office equipment
- Procure 100% recycled and 30% post-consumer content paper and recommend measures to reduce paper consumption
- Purchase cleaning supplies that at a minimum meet the requirements of Green Seal Standard for Industrial and Institutional Cleaners

Leadership, Education, and Outreach

The CAO should pursue networking and outreach with the Senate, universities, businesses, local and state governments, and others to remain current on sustainability practices and CO_2-e emission reduction opportunities. The networking can showcase the House's leadership role and facilitate the exchange of ideas and information on environmentally sustainable issues. This activity could include hosting green summits on sustainability. The CAO should also work with the AOC to make sustainability a mission-critical element of the AOC's business practices.

The CAO should initiate education programs for House staff and Member offices on sustainability practices. This activity should include holding green expositions to disseminate information and learn about new green products and services. A checklist could be created for Members and staff to use to reduce energy and implement sustainability practices; for example, using easy-to-access switches for shutting off office equipment or encouraging public transportation. In such a program, staff would be rewarded for additional innovative ideas and for overall performance.

Energy efficiency and sustainability information should also be provided to the visitors of the House. These educational materials should be available in the Capitol Visitors Center and in Member offices.

Specific recommendations for leadership, education and outreach:

- Prepare a checklist for sustainable office operations for use by Members of Congress and other Capitol Hill offices
- The House should take a leadership role in networking with the Senate, universities, businesses, and local and state governments including hosting green summits
- Hold a green expo for House offices to demonstrate the latest in green products or services available from commercial vendors
- Work with the AOC to make sustainability a mission-critical element
- Provide energy efficiency and sustainability materials for Capitol Hill visitors

Develop Mechanisms for Evaluating Success and Reporting Progress

The CAO should track benchmarks for energy consumption and CO_2-e emissions monthly and prepare annual reports documenting progress on the complementary goals of carbon neutrality and sustainable operations. Energy and CO_2-e emissions reports and data will be made available through the Sustainability website, both as an educational tool and to provide feedback to House staff.

Conclusion

This report provides a roadmap for carbon neutrality, energy efficiency, and operating in an environmentally sustainable fashion. It demonstrates that the House can operate in a carbon neutral manner now and begin to implement energy efficiency measures today. The report provides the way forward to cutting the House's energy use by 50% in 10 years. It shows how the House can do business in an environmentally sustainable manner. Implementing these goals is a good investment for the American taxpayer, the environment, and our children's future.

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Appendix A. Recommendations from Green the Capitol Preliminary Report, April 2007

Recommendation 1: Operate the House in a Carbon Neutral Manner.

Climate change and global warming are serious issues caused primarily by the introduction of carbon into the atmosphere. One way the House can begin to address this problem is to work toward undertaking our operations in a carbon neutral manner. This will mean taking steps to reduce the greenhouse gas emissions our complex creates through its operations. Global warming is an international problem, but there are steps we can take to provide leadership for solving these issues locally. The most important step is to adopt a policy of making the operations of the House carbon neutral.

Accordingly, it is recommended the House operate in a carbon neutral manner at the earliest possible date, but no later than the end of the 110th Congress. By implementing this recommendation, we will be eliminating the impact of 91,000 tons of carbon dioxide emissions annually, which is the equivalent of taking 17,200 cars off the road each year.

Recommendation 2: Shift to 100 Percent Renewable Electric Power.

The purchase of electricity is the largest source of carbon dioxide emissions from the operations of the House. In order to achieve our goal of making our operations carbon neutral, my office, working with the Architect 103,000 megawatt-hours per year) from renewable sources at the earliest possible date. The cost of electric power generated from renewable sources can be up to 20% more than power generated from traditional sources. This increase in cost will be offset over the long run by the energy conservation actions I am recommending. By implementing this recommendation, we will eliminate 57,000 tons of the total greenhouse gas emissions annually, or the equivalent of removing 11,000 cars from the roads.

Recommendation 3: Aggressively Improve Energy Efficiency.

There are a series of immediate steps House offices can take to reduce energy use. I recommend we take the following actions:

a. Immediately convert 2,000 desk lamps in the House office buildings to compact fluorescent lamps (CFL). In addition, within six months take the steps necessary to convert the remaining 10,000 desk lamps to CFLs. Replacing 12,000 CFLs is the equivalent to removing 255 cars from the road, and it will yield a $245,000 savings in electric power costs to the House per year.

b. Direct the CAO and Architect of the Capitol to no longer purchase standard incandescent replacement bulbs with funds made available by the House. Standard incandescent bulbs consume four times the energy of compact fluorescents and it is time for the House to eliminate their use.

c. Instruct the Architect to convert the overhead House ceiling lights to high efficiency lighting and controls at the earliest possible date. Such action has the potential to reduce

lighting energy from these sources by as much as 50 percent. This action will eliminate 7,130 tons of greenhouse gas emissions, which is equivalent to 1,340 cars.

d. Promote energy efficiency among the 7,000 staff of the House by making CFLs available at cost in the House office supply store. If all staff members installed just one CFL bulb for their own use, it would have a cumulative effect of removing 150 cars from the road.

e. Direct the Architect to expand their fluorescent lamp disposal program to include the proper collection of used CFLs.

Recommendation 4: Adopt Sustainable Business Practices.

Our office is a major purchaser of products and services, and we should demonstrate leadership by making purchases that promote sustainability. Therefore, I recommend the following actions:

a. Purchase only Energy Star or Federal Energy Management Program-designated products where such designations are available. These products have been determined by the appropriate Federal agencies to be life-cycle cost effective in normal operations and will contribute significantly to reduced consumption of energy.

b. Purchase office equipment that is certified using the Electronic Product Environmental Assessment Tool (EPEAT) system. This system helps evaluate, compare and select electronic equipment based on its environmental attributes. EPEAT certified electronic devices are low in heavy metals and high in recycled plastic content.

c. Give priority to the purchase of climate neutral products that offset the life cycle contribution of greenhouse gas emissions. Specifically, purchase only adhesive, sealants, paints, coating, and carpets that emit very low quantities of volatile organic compounds. Volatile organic compounds are major components affecting indoor air quality and they contribute to climate change.

d. Purchase only furnishings that contain recycled products or wood certified as sustainable by the Sustainable Forests Initiative, the Forest Stewardship Council or similar programs. Implementing this recommendation will make a small contribution toward insuring biodiverse forests for future generations.

e. Direct the Architect to finalize the installation of an Ethanol-85 tank, pump, and related infrastructure for the use of official vehicles within the next six months.

Recommendation 5: Continued Leadership on Sustainability Issues

It is important for Members and staff to continue to provide leadership on climate change and sustainability issues. To assist in maintaining this continuing commitment, I recommend the following actions:

a. Hold a “Green Expo” for House offices to demonstrate the latest in green products or services available to offices from commercial vendors.

b. Establish a sustainability education program for House employees providing guidance on how employees can make a contribution to impacting climate change and sustainability at home and in the work place.

c. Establish a "Green Revolving Fund" where revenues received from various sources will be placed in a revolving fund to be used to undertake energy and water conservation initiatives that offset greenhouse gas emissions.

Recommendation 6: Offset to Insure Carbon Neutral Operations.

It is likely that even by implementing all the recommendations outlined above, the House will not be operating in a carbon neutral manner. As a result, we will have to develop a strategy for offsetting as much as 34,000 tons of greenhouse gas emissions by either: (1) Purchasing offset credits in the domestic market, or (2) Contributing a per ton payment, based on the current domestic market, of carbon dioxide equivalents emitted by the CPP boilers and placing these funds in the Green Revolving Fund to be used to directly mitigate the emissions. Since the domestic offset market is in its infancy and lacks uniform standards, it is important the House carefully screen any offset purchases. Between now and June 30, I will undertake a review of possible investments and determine their acceptability. If an acceptable offset cannot be secured, depositing the offset monies in the Green Revolving Fund would provide us with an acceptable alternative.

Appendix B. Examples of Current Good Practices for House Buildings

Energy Supply

- An existing policy purchases 3% of all electric power with from wind-generated sources
- The Central Power Plant is able to switch among fuels, allowing the option of lower CO_2-e emission operation with no capital investment

Energy-Efficient Technologies

- Select motors have been upgraded to energy-efficient models
- Failed motor starters are replaced with variable-frequency drives, giving them soft-start capability now and maximum flexibility for more sophisticated control modifications later
- The Ford Building has implemented efficient low-e, spectrally-selective windows
- Many light fixtures have been retrofitted to compact fluorescent lamps
- Fluorescent tube lighting with bi-level switching is installed in congressional suites throughout the Rayburn Building
- A water-side economizer in the Central Power Plant can operate in lieu of, or in combination with, the chillers
- Outside-air economizers with differential enthalpy controls are used at some buildings
- In one building, heat is being recovered from the condensed steam and preheats domestic hot water

Efficient Management & Operations

- Energy expenses are tracked and analyzed using "Energy Guru" software
- A computerized energy management control system is used in parts of some buildings
- An existing design guideline calls for direct digital control energy management systems in new buildings and renovations
- Some air-handling equipment is shut down during unoccupied hours; other equipment is set back
- The chilled water temperature is reset upwards at the Central Power Plant in the winter
- A good maintenance program is in place (e.g., replacements of filters and belts, and attention to basic controls functionality)