The Capitol Power Plant: Background and Greening Options

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Summary

The Capitol Power Plant and its impact on congressional operations are often misunderstood. Although it was originally constructed as an electric power plant, the Capitol Power Plant has not generated electric power for over 50 years. Rather, the facility is used to produce steam and chilled water for heating and cooling of Capitol complex buildings. Because it is a significant source of atmospheric emissions, some Members of Congress are concerned about the operation of the facility and its impact on the environment.

In March 2007, the House leadership asked the Chief Administrative Officer (CAO) and his Senate counterparts to undertake a "Green the Capitol" initiative to reduce the Capitol complex's environmental footprint. As a result of this request, the CAO issued a report in June 2007 which recommended, among other strategies, operating the Capitol Power Plant with natural gas and optimizing operations to reduce energy consumption at the plant. On February 26, 2009, House Speaker Nancy Pelosi and Senate Majority Leader Harry Reid sent a letter to the Architect of the Capitol calling for the facility to be converted to run exclusively on natural gas for all of its steam production. The Architect of the Capitol took immediate action to maximize the use of natural gas and on May 1, 2009, the Speaker and the Majority Leader of the Senate announced that the Capitol Power Plant will no longer burn coal, unless backup capacity is needed.

There are also proposals to further Capitol Power Plant efficiency by outsourcing plant management or converting the plant to a combined heat and power (CHP) facility. Each of these options has distinct costs, environmental benefits, implementation requirements, and risks—not all of which have been thoroughly explored. It appears unlikely that outsourcing of the plant's operations could provide environmental benefits of the same magnitude as converting the plant to 100% natural gas or biomass, although such an action could provide incremental environmental benefits. When both steam production and power generation are considered, the overall environmental benefits of a CHP plant could be large.

Measures taken to date at the Capitol Power Plant have already resulted in significant environmental benefits, but there are operational and plant conversion options which may reduce the plant's environmental impacts even further. These options may be costly, however, both in terms of fuel expenses and capital requirements—and may involve price and operational risk. Consequently, careful comparison of all the options for this aspect of "Greening the Capitol" may be required to ensure that the most cost-effective and environmentally beneficial investments are made while ensuring the continued supply of utility services to the Capitol.

Contents

Introduction 1
Background and History 1
Operations 4
- Steam and Chilled Water Production 4
- Boilers 4
- Fuel Consumption 5
- Appropriations 6
- Current Projects 7
- Future Projects 8

Options for "Greening" the Capitol Power Plant 9
- Converting Boiler Fuel to 100% Natural Gas or Biomass 9
- Outsourcing Capitol Power Plant Management 11
- Combined Heat and Power (CHP) Conversion 12

Conclusion 14

Tables

Table 1. Average and Peak Capitol Power Plant Loads for Steam and Chilled Water 4
Table 2. Capitol Power Plant Boilers 5
Table 3. Fuel Consumption for 2007 and 2008 5
Table 4. Capitol Complex Utilities Budget FY2008 and FY2009 7
Table A-1. Facilities Supplied with Steam by the Capitol Power Plant 15

Appendixes

Appendix. Facilities Supplied by the Capitol Power Plant 15

Contacts

Author Contact Information 16
Acknowledgments 16

Introduction

The Capitol Power Plant and its impact on congressional operations are often misunderstood. Although it was originally constructed as an electric power plant, the Capitol Power Plant has not generated electric power for over 50 years. Rather, the facility is used to produce steam and chilled water for heating and cooling of Capitol complex buildings. As a heating and refrigeration plant, the Capitol Power Plant remains a large consumer of energy and a significant source of atmospheric emissions in the District of Columbia. Consequently, some Members of Congress are concerned about the operation of the facility and its impact on the environment. Recent demonstrations by environmental groups have drawn national media attention to emissions from the plant.[1]

In March 2007, the Speaker of the House, the Majority Leader, and the chair of the Committee on House Administration asked the Chief Administrative Officer (CAO) and his Senate counterparts to "undertake a 'Green the Capitol' initiative to ensure that the House institutes the most up-to-date industry and government standards for green building and green operating procedures." As a result of this request, the CAO issued a report in June 2007 which recommended, among other strategies, operating the Capitol Power Plant with natural gas and optimizing operations to reduce energy consumption at the plant.[2]

This report discusses the creation of the power plant, its operations, and the Architect of the Capitol's projects related to energy use at the plant. The report discusses energy efficiency and fuel-switching issues at the plant and potential administrative and operational options in light of the CAO's recommendations.[3]

Background and History

Located four blocks from the Capitol building, the Capitol Power Plant provides steam and chilled water to 24 Capitol Hill facilities. The plant site consists of a main plant (built in 1909), the east refrigeration plant (built in 1938), an operations building (built in 1978), the west refrigeration plant (built in 1978 and expanded in 2007), and a coal yard (transferred from the General Services Administration in 1987).[4] The plant contains seven boilers which burn either

[1] For example see, Nicole Gaudiano, "Thousands Gather In D.C. Cold For Rally About Global Warming," *USA Today*, March 2, 2009; Emily Yehle, "Protesters Claim Big Win Over Coal," *Roll Call*, March 3, 2009, p. 3; Dina Cappiello, "Capitol power plant dims clean energy hopes," *The Washington Post*, http://www.washingtonpost.com/wp-dyn/content/article/2009/03/01/AR2009030100454.html; and Brian Westley, "Thousands rally for legislation on climate change," *The Washington Post*, March 2, 2009 http://www.washingtonpost.com/wp-dyn/content/article/2009/03/02/AR2009030200447.html.

[2] U.S. Congress, House Chief Administrative Officer, *Green the Capitol Initiative Final Report*, 110th Cong., 1st sess. http://speaker.gov/pdf/GTCI621full2.pdf, accessed March 3, 2009, pp. 2-14.

[3] For further analysis of power plant management and operations see CRS Report RL34746, *Power Plants: Characteristics and Costs*, by Stan Mark Kaplan, CRS Report RL33875, *Electric Transmission: Approaches for Energizing a Sagging Industry*, by Amy Abel, and CRS Report RL34621, *Capturing CO2 from Coal-Fired Power Plants: Challenges for a Comprehensive Strategy*, by Larry Parker, Deborah D. Stine, and Peter Folger.

[4] U.S. Congress, Architect of the Capitol, *2003 Accountability Report*, Washington, DC, 2003, p. 25, http://www.aoc.gov/aoc/cfo/upload/AOC-Financial-Report-2003.pdf; and telephone conversation between the author and Michael Culver, congressional and external relations director, Architect of the Capitol, February 20, 2009.

natural gas, low-sulfur coal, or fuel oil to generate the steam used to heat Capitol complex office buildings.[5] The Capitol Power Plant transports steam and chilled water to the buildings it serves by means of utility tunnels built between 1908 and 1955.[6] A complete list of facilities currently provided with steam by the Capitol Power Plant is in the **Appendix**.

Construction of a power plant for the Capitol complex was authorized in the fiscal year (FY) 1905 Appropriations Act for Sundry Civil Expenses of the Government. The plant was initially designed to provide electricity and heating to the Capitol building, the Congressional Library Building (i.e., the Jefferson building), the House of Representatives office building (i.e., the Cannon building),[7] and any future buildings erected on the Capitol Grounds.[8] In 1911, the power plant was officially named the Capitol Power Plant and the Architect of the Capitol was tasked with facility management.[9]

Between 1909 and 1952, the Capitol Power Plant generated and provided electricity to the Capitol complex buildings.[10] However, the electricity produced by the plant was inconsistent with mid-20th century (and current) electrical standards. On September 29, 1949, Representative William Whittington introduced H.R. 6281 to provide for improvements to the Capitol Power Plant's distribution systems and the buildings served by the power plant.[11] Referred to the Committee on Public Works, the bill provided for changing the type of electricity provided to the Capitol complex and discontinuing the generation of electricity at the Capitol Power Plant following conversion. The bill contained provisions to

> [c]onvert the electrical lighting and power systems and other electrical equipment in all buildings and grounds, including the refrigeration plant, now served by the Capitol Power Plant, from twenty-five cycle and direct current to sixty cycle alternating current.

[5] Testimony of Acting Architect of the Capitol Stephen T. Ayers, in U.S. Congress, Senate Committee on Rules and Administration, *Improving Energy Efficiency, Increasing the Use of Renewable Sources of Energy, and Reducing the Carbon Footprint of the Capitol Complex*, hearing, 110th Cong., 2nd sess., June 18, 2008, p. 8, http://rules.senate.gov/hearings/2008/0618ayers.pdf.

[6] The Capitol Power Plant utility tunnels are separate from pedestrian tunnels that connect the House and Senate office buildings with the U.S. Capitol.

[7] The House of Representatives Office building became known as the Cannon House Office Building. For more information about the Cannon House Office Building and its history see http://www.aoc.gov/cc/cobs/chob.cfm.

[8] P.L. 194, 33 Stat. 479, April 26, 1904. P.L. 194 states "Toward the construction of a building for a heating, lighting, and power plant in connection with the office building for the House of Representatives, the installation of necessary machinery, for labor and material, construction of ducts, heating mains, subways, and traction system connecting the Capitol building, and for all other appliances, and for each and every purpose in connection with all of the foregoing, one hundred and thirty thousand dollars: *Provided*, That said building for heating, lighting, and power plant, when constructed shall be of sufficient size and capacity to furnish the necessary heat, light, and power for the office building of the House of Representatives, the Capitol building, the Congressional Library building, and for such other public buildings which may hereafter be erected on grounds adjacent to the Capitol grounds at the east of the Capitol building and facing the same."

[9] 2 U.S.C. § 2162.

[10] Standard electricity for home, commercial, and industrial use is delivered as alternating current as 60 cycles. Between 1909 and 1952, the Capitol Power Plant "generated 25-cycle alternating current." The Capitol complex buildings were wired for a combination of 25-cycle alternating current and direct current. The 25-cycle alternating current was used to power elevator motors and other machinery and the direct current was used for lighting to prevent flicker in the lights. For information on the generation of electricity prior to 1952, see U.S. Congress, House Committee on Public Works, *Capitol Power Plant*, hearing on H.R. 6281, 81st Cong., 1st sess., October 10, 1949, H.Hrg. 81-9 (Washington: GPO, 1949), pp. 9-10, 22, 43.

[11] Rep. William Whittington, "Public Bills and Resolutions," House debate, *Congressional Record*, vol. 95, part 10 (September 29, 1949), p. 13578.

> Upon completion of such conversion, discontinue generating electrical energy at the Capitol Power Plant and purchase all electrical energy for the buildings and grounds now supplied by the plant; and prior to completion of such conversion, the Architect of the Capitol, with the approval of the House Office Buildings Commission, may purchase such electrical energy as he may deem necessary for such buildings and grounds.[12]

Enacted as P.L. 413, H.R. 6281 provided for reconfiguring the Capitol to use standard electricity, to be purchased from the local utility, and to cease power production at the Capitol Power Plant.[13] Power generation actually ceased in 1952. The Capitol Power Plant continues to burn fuel in boilers to produce steam, and uses purchased electricity to produce chilled water.[14]

The Architect periodically upgrades the Capitol Power Plant to expand or improve its operations. In recent years, the Architect has, among other changes, extended the distribution of steam and chilled water to the Supreme Court building, the Thurgood Marshall Federal Judiciary Building, and to Union Station;[15] expanded the West Refrigeration Plant (2003-2007);[16] increased the capacity of coal burning boilers, repaired gas ducts, and installed blowers and an ash conveying system (2005);[17] completed a new design to provide emergency power and HVAC services to the emergency response center (2006);[18] and installed and upgraded steam meters, updated heating, ventilation, and air-conditioning equipment and practices, and addressed concerns with the

[12] P.L. 413, chapter 760, 63 Stat. 933, October 26, 1949. Hearings in the House Committee on Public Works were held on October 10, 1949, and the committee reported the bill on October 11. The bill passed the House on October 14 and the bill was referred to the Senate Committee on Public Works. The Senate committee reported the bill without amendment on October 17, the Senate passed the bill on October 18, and it was signed by the President on October 19. For more information see, U.S. Congress, House Committee on Public Works, *Capitol Power Plant*, hearing on H.R. 6281, 81st Cong., 1st sess., October 10, 1949, H.Hrg. 81-9 (Washington: GPO, 1949); U.S. Congress, House Committee on Public Works, *Providing for Certain Improvements Relating to the Capitol Power Plant, Its Distribution Systems, and the Buildings and Grounds Served by the Plant, Including Proposed Additions*, report to accompany H.R. 6281, 81st Cong., 1st sess., October 11, 1949, H.Rept. 1402 (Washington: GPO, 1949); "Capitol Power Plant," House debate, *Congressional Record*, vol. 95, part 11 (October 14, 1949), pp. 14617-14620; "House Bills Referred or Placed on Calendar," Senate debate, *Congressional Record*, vol. 95, part 11 (October 15, 1949), p. 14631; U.S. Congress, Senate Committee on Public Works, *Providing for Certain Improvements Relating to the Capitol Power Plant, Its Distribution Systems, and the Buildings and Grounds Served by the Plant, Including Proposed Additions*, report to accompany H.R. 6281, 81st Cong., 1st sess., October 17, 1949, S.Rept. 81-1192 (Washington: GPO, 1949); "Improvements to the Capitol Power Plant," *Congressional Record*, vol. 95, part 11 (October 18, 1949), p. 14891; and "Bills and Joint Resolutions Approved After Sine Die Adjournment," *Congressional Record*, vol. 95, part 11 (October 19, 1949), p. 15102 and P.L. 413, chapter 760, 63 Stat. 933, October 26, 1949.

[13] P.L. 413, chapter 760, 63 Stat. 933, October 26, 1949.

[14] Electricity for the Capitol Complex is purchased from Pepco. U.S. Government Accountability Office, *Feasibility of Outsourcing the Management and Operation of the Capitol Power Plant*, GAO-08-382R, January 31, 2008, p. 4. The Capitol Power Plant is the sole source of steam and chilled water for the Capitol complex.

[15] P.L. 107-217, 116 Stat. 1202, August 21, 2002.

[16] The expansion of the West Refrigeration Plant was designed to "provide 16,200 additional tons of cooling capacity to the U.S. Capitol Complex. The project will also convert the existing chilled water system to a primary/secondary pumping configuration and provide architectural and site improvements to the [Capitol Power Plant] grounds." For additional information see, U.S. Congress, Architect of the Capitol, *2005 Performance and Accountability Report*, Washington, DC, 2005, p. 31, http://www.aoc.gov/aoc/cfo/upload/AOC_Report_Full.pdf.

[17] U.S. Congress, Architect of the Capitol, *2005 Performance and Accountability Report*, Washington, DC, 2005, p. 27, http://www.aoc.gov/aoc/cfo/upload/AOC_Report_Full.pdf.

[18] U.S. Congress, Architect of the Capitol, *2006 Performance and Accountability Report*, Washington, DC, 2006, p. 24, http://www.aoc.gov/aoc/cfo/upload/AOC Performance and Accountability Report, 2006 rev 0415.pdf.

operation of the power plant utility tunnels (2007).[19] Current and future projects for the Capitol Power Plant are discussed later in this report.

Operations

The Architect of the Capitol manages the Capitol Power Plant facilities overall, with day-to-day activities handled by the plant's director and deputy director. These individuals are responsible for all plant operations and maintenance, including managing current and future power plant projects.

Steam and Chilled Water Production

The Capitol Power Plant has the capacity to generate up to 570,000 pounds of steam per hour and 47,300 tons of refrigeration.[20] The power plant generates different volumes of steam and chilled water depending on the season. In the winter, the output of steam is almost double the output in summer. The opposite is true for chilled water. In the summer, the output of chilled water is almost four times more than in the winter. **Table 1** lists the average and peak loads in the winter and summer for steam and chilled water.

Table 1. Average and Peak Capitol Power Plant Loads for Steam and Chilled Water

	Steam (lbs/hr)		Chilled Water (tons)	
	2007	2008	2007	2008
Average Summer Load	100,000	100,000	20,000	20,000
Peak Summer Load	110,000	126,000	28,000	28,000
Average Winter Load	225,000	220,000	7,000	7,500
Peak Winter Load	290,000	307,000	10,000	12,500

Source: U.S. Congress, Architect of the Capitol, "Capitol Power Plant Fact Sheet" (a copy of the fact sheet is available from the author) and based on CRS discussions with Mike Culver, Director of Congressional and External Relations, Architect of the Capitol, February 20, 2009.

Note: Numbers have been rounded to the nearest thousand by the Architect of the Capitol.

Boilers

The Capitol Power Plant operates seven boilers that burn coal, natural gas, or oil to generate steam. **Table 2** lists the Capitol Power Plant boilers operating as of FY2007, their capacity, installation date, the fuel they were originally designed to burn, the date of conversion and modernization, and the current fuel burned.

[19] U.S. Congress, Architect of the Capitol, *2007 Performance and Accountability Report*, Washington, DC, 2007, pp. 20-21, http://www.aoc.gov/aoc/cfo/upload/AOC-2007-PAR_Oct23-2008-2.pdf. [Hereafter, *2007 Performance and Accountability Report*].

[20] U.S. Congress, Architect of the Capitol, "Capitol Power Plant Fact Sheet." A copy is available from the author.

Table 2. Capitol Power Plant Boilers

Boiler	Capacity (lb of steam/hr)	Installation Date	Original Fuel	Fuel Conversion Date	Current Fuel Burned
1	140,000	1950	Coal	2000	Coal/Gas
2	140,000	1950	Coal	2000	Coal/Gas
3	140,000	1950	Coal	1989	Gas/Oil
4	50,000	1964	Oil	2000	Gas/Oil
5	50,000	1964	Oil	2000	Gas/Oil
6	50,000	1964	Oil	2000	Gas/Oil
7	50,000	1964	Oil	2000	Gas/Oil

Source: U.S. Congress, House Committee on Appropriations, *Legislative Branch Appropriations for 2007: Part 2, Fiscal Year 2007 Legislative Branch Appropriations Requests*, 109th Cong., 2nd sess. (Washington: GPO, 2006), p. 775.

Upgrading the boilers at the Capitol Power Plant is an ongoing process that will enable the burning of additional natural gas should the House and the Senate direct the Architect to use more natural gas to supply steam to the Capitol complex buildings.[21] In the FY2009 Omnibus Appropriations Act, the Architect received $450,000 to modernize and renovate boilers.[22] The affected boilers provide approximately 35% of the steam generated by the plant.[23]

Fuel Consumption

According to the Government Accountability Office (GAO), during an average year, the Capitol Power Plant has used a fuel mixture of approximately 43% natural gas, 47% coal, and 10% fuel oil to generate steam. More recent data from the AOC indicates decreasing reliance on fuel oil (down to zero consumption in 2008), less use of coal, and increased use of natural gas.[24] **Table 3** lists the quantity (in units) of fuel used by the Capitol Power Plant in 2007 and 2008. In 2008, the Architect also purchased 105,856 MWh of electricity for the Capitol Power Plant.[25]

Table 3. Fuel Consumption for 2007 and 2008

Fuel	2007	2008
Coal (tons)	23,740	18,875

[21] *2007 Performance and Accountability Report*, p.38.

[22] Rep. David Obey, "Explanatory Statement Submitted by Mr. Obey, Chairman of the House Committee on Appropriations, Regarding H.R. 1105, Omnibus Appropriations Act, 2009," *Congressional Record*, daily edition, vol. 155 (February 23, 2009), p. H2396.

[23] Telephone conversation between the author and Mike Culver, congressional and external relations director, Architect of the Capitol, February 20, 2009.

[24] U.S. Government Accountability Office, *Economic and Other Implications of Switching From Coal and Natural Gas at the Capitol Power Plant and at Electricity-Generating Units Nationwide*, GAO-08-601R, May 1, 2008, p. 2. [Hereafter, *Switching from Coal and Natural Gas at the Capitol Power Plant*]; and U.S. Congress, Architect of the Capitol, "Capitol Power Plant Fact Sheet." A copy of the fact sheet is available from the author.

[25] Based on CRS discussions with Mike Culver, Director of Congressional and External Relations, Architect of the Capitol, February 20, 2009.

Fuel	2007	2008
Natural Gas (decatherms)	852,274	975,044
Fuel Oil (gallons)	3,010	0

Source: U.S. Congress, Architect of the Capitol, "Capitol Power Plant Fact Sheet" (a copy of the fact sheet is available from the author) and based on CRS discussions with Mike Culver, Director of Congressional and External Relations, Architect of the Capitol, March 9, 2009.

The increase in the use of natural gas at the Capitol Power Plant in 2008 was a direct result of the "Green the Capitol" initiative in the House of Representatives.[26] The Chief Administrative Officer, at the request of Speaker of the House Nancy Pelosi, ordered the Capitol Power Plant to stop using coal to generate steam for the House of Representatives. The Capitol Power Plant generates and distributes steam to all Capitol complex buildings, however, so it is impossible to separate the steam that goes to the House from the steam that goes to the Senate, the Library of Congress, or any other facilities supplied by the Capitol Power Plant. As part of the "Green the Capitol" initiative studies, the House has estimated that 31% of the Capitol Power Plant steam output can be attributed to House buildings and office space.[27] The 2008 increase in natural gas consumption reflects this proportion. The House has appropriated funds to purchase additional natural gas for the continued generation of steam necessary to operate the heating and cooling system in the House Office Buildings and in the House portion of the Capitol building.[28]

Appropriations

For FY2008, the Capitol Power Plant was projected to spend approximately $67,000,000 on utilities, including natural gas, electricity, coal, and fuel oil, and for FY2009, the Architect requested approximately $68,000,000 in appropriations.[29] Overall, the Capitol Power Plant spent 82% of its appropriations on utilities in FY2008 and is projected to spend 80% of appropriations on utilities in FY2009.[30] **Table 4** lists the disbursements for utilities, for FY2008 and requested appropriations for FY2009.

[26] For more information on green programs in the House and Senate see CRS Report RL34694, *Administering Green Programs in Congress: Issues and Options*, by Jacob R. Straus.

[27] U.S. Congress, Chief Administrative Officer of the House of Representatives, *Preliminary Report Green the Capitol Initiative*, 110th Cong., 1st sess., http://www.speaker/gov/pdf/GTCreport.pdf.

[28] U.S. Congress, Chief Administrative Officer of the House of Representatives, Six Months of Progress: A Report from the Green the Capitol Office, "Checklist," p. 2, http://cao.house.gov/greenthecapitol/progress-report-2007dec.pdf; *Switching from Coal to Natural Gas at the Capitol Power Plant*.

[29] *Legislative Branch Appropriations for 2009: Part 1*, p. 510. A breakdown of Capitol Power Plant appropriations for FY2009 were not included in the Omnibus. Overall, the Capitol Power Plant received $149,042,000 in FY2009, of which $63,570,000 shall remain available until September 30, 2013. These funds are "[f]or all necessary expenses for the maintenance, care and operation of the Capitol Power Plant; lighting, heating, power (including the purchase of electrical energy) and water and sewer services for the Capitol, Senate and House office buildings, Library of Congress buildings, and the grounds about the same, Botanic Garden, Senate garage, and air conditioning refrigeration not supplied from plants in any of such buildings; heating the Government Printing Office and Washington City Post Office, and heating and chilled water for air conditioning for the Supreme Court Building, the Union Station complex, the Thurgood Marshall Federal Judiciary Building and the Folger Shakespeare Library, expenses for which shall be advanced or reimbursed upon request of the Architect of the Capitol and amounts so received shall be deposited into the Treasury to the credit of this appropriation." For more information see, P.L. 111-8, 123 Stat. 524, March 11, 2009.

[30] For FY2008, the Capitol Power Plant had an operating budget of $81,685,000. In addition to utilities, the operating budget includes appropriations for personnel, travel, transportation, contractual services, equipment, supplies, materials, land and structures, and insurance. For FY2009, the Architect requested $85,472,000 to operate the Capitol (continued...)

Table 4. Capitol Complex Utilities Budget FY2008 and FY2009

In Dollars

Items [a]	FY2008 (enacted) [b]	FY2009 (requested)
Natural Gas	16,024,000	17,244,000
Electricity	42,606,000	43,452,000
Coal	5,650,000	6,212,000
Fuel Oil	2,765,000	2,765,000
Steam	1,009,000	1,009,000
Chilled Water	1,065,000	1,325,000
Water and Sewer	2,572,000	4,166,000
Green the Capitol Initiative [c]	3,261,000	0
Postal Square [d]	618,000	618,000
Reimbursement, Steam & Chilled Water [e]	-8,000,000	-8,000,000
Total	$67,570,000	$68,791,000

Source: *Legislative Branch Appropriations for 2009: Part 1*, p. 510.

Note: Numbers have been rounded by the Architect of the Capitol.

a. Items included by the Architect of the Capitol as part of the Utilities Programs Group. This contains funding for utilities for the Capitol complex, including other facilities under the control of the Architect of the Capitol.

b. FY2008 numbers include a rescission by the Architect.

c. FY2008 was the initial pilot year for use of additional natural gas to provide steam, and 100% carbon neutral renewable electric power as part of the Green the Capitol Initiative. For FY2009, additional natural gas and carbon neutral renewable electric power is included within the Architect's estimates.

d. Postal Square numbers include utilities provided directly to Postal Square.

e. Includes money received for providing steam and chilled water to Union Station, Postal Square, the Government Printing Office, and the Folger Shakespeare Library.

Current Projects

Stephen T. Ayers, acting Architect of the Capitol, testified in the 110th Congress about the role of the Capitol Power Plant in ongoing energy efficiency and conservation in the Capitol complex,[31] and Capitol Power Plant operations.[32] At these hearings, the Architect identified goals to improve

(...continued)

Power Plant. See *Legislative Branch Appropriations for 2009: Part 1*, p. 504.

[31] U.S. Congress, House Committee on Transportation and Infrastructure, *Administration Proposals on Climate Change and Energy Independence*, hearings, 110th Cong., 1st sess., May 11 and 16, 2007, H.Hrg. 110-44 (Washington: GPO, 2007); and *Senate Committee on Rules and Administration Hearing*.

[32] For example, see U.S. Congress, House Committee on Appropriations, Legislative Branch Subcommittee, *Architect of the Capitol Budget*, hearing, 110th Cong., 2nd sess., February 13, 2008 (Washington: GPO, 2008), and Testimony of Acting Architect of the Capitol Stephen T. Ayers, in U.S. Congress, Senate Committee on Appropriations, Subcommittee on the Legislative Branch, *Fiscal Year 2009 Appropriations for the Office of the Architect of the Capitol*, hearing, 110th Cong., 2nd sess., April 30, 2008.

energy efficiency and reduce energy consumption for the Capitol Power Plant. These goals include, but are not limited to

- completing the installation of the distributed control system in the boiler plant;
- installing steam and chilled water meters at several buildings around Capitol Hill;
- installing two new main air compressors in the West Refrigeration Plant and two new main air compressors in the boiler plant;
- completing West Refrigeration Plant expansion;
- completing utility distribution system inventory and integrating maintenance management procedures into the computerized work order system; and
- installing new boiler grate system for one of the boilers.[33]

The Architect testified before the Senate Committee on Rules and Administration that taking steps to reduce the power plant's energy consumption through greater efficiency will reduce emissions.[34]

Future Projects

In addition to ongoing projects started before or during the 110th Congress, the Architect is also planning new projects for FY2009 and beyond. Pursuant to the Architect's budget request, there are four major energy-related projects that will either continue or are slated to begin in FY2009. The Omnibus Appropriations Act for 2009 contains appropriations for each of the projects:[35]

- East Refrigeration Plant Chiller Relocation Design (*Requested* and *Omnibus Appropriation*: $1,000,000) – The chillers currently located in the East Refrigeration Plant will be moved to the expanded West Refrigeration Plant. Following chiller relocation, the remaining equipment is scheduled to be demolished.[36]
- West Refrigeration Plant Chiller Replacement (*Requested* and *Omnibus Appropriation*: $1,720,000) – Design for the replacement of four 30-year-old chillers in the West Refrigeration Plant with four new high-efficiency chillers.[37]
- Boiler Modernization and Control Replacement (*Requested* and *Omnibus Appropriation*: $450,000) – Designs to modernize 1950s-era boilers. See "Boilers" below for more information.[38]
- Minor Construction (*Requested* and *Omnibus Appropriation*: $4,000,000) – The Architect has requested additional funds for minor construction. These funds

[33] *2007 Performance and Accountability Report*, p. 39.

[34] *Senate Committee on Rules and Administration Hearing*, p. 7.

[35] Rep. David Obey, "Explanatory Statement Submitted by Mr. Obey, Chairman of the House Committee on Appropriations, Regarding H.R. 1105, Omnibus Appropriations Act, 2009," *Congressional Record*, daily edition, vol. 155 (February 23, 2009), p. H2396. See also, P.L. 111-8, 123 Stat. 524, March 11, 2009.

[36] Ibid., p. 513.

[37] Ibid., p. 514.

[38] Ibid.

> provide "flexibility for unforeseen needs including repair and alteration projects, and related activities in connection with construction and maintenance activities of the facilities under the purview of the Capitol Power Plant."[39] Such activities presumably could be energy-related.

The Architect is also working with the National Academy of Sciences and the Department of Energy's National Energy Technology Laboratory to evaluate options and technologies available for the Capitol Power Plant. The National Academy of Sciences and the Department of Energy are to make recommendations based on criteria including sustainability,[40] energy independence, and security. Following the National Academy and Energy reports, the Architect is to update the strategic master plan for the Capitol Power Plant.[41]

Options for "Greening" the Capitol Power Plant

As discussed above, various efforts are under way or under study to reduce the Capitol complex's environmental footprint.[42] In addition to these efforts, there are proposals to further change the operation of the Capitol Power Plant to reduce costs and increase efficiency: converting to 100% natural gas or biomass operation, outsourcing power plant management, and developing a combined heat and power (CHP) facility.

Converting Boiler Fuel to 100% Natural Gas or Biomass

The Capitol Power Plant currently burns natural gas, coal, and fuel oil for the generation of steam. As discussed earlier, the House Chief Administrative Officer's (CAO) 2007 report recommended operating the Capitol Power Plant solely with natural gas. Switching from coal to natural gas is seen as environmentally desirable because natural gas produces approximately half the carbon dioxide emissions of coal for the same energy output, among other reasons.[43] In his testimony before the House Committee on Transportation and Infrastructure, the CAO stated,

> I think it is important to add to this debate, though, that if we switch to 100 percent natural gas, we would certainly have a significantly reduced environmental footprint and carbon footprint. Right now, the Congress is the proud owner and operator of a facility that is the second largest point source pollution in the District of Columbia. And so, I think there is a significant environmental benefit associated with moving to 100 percent gas.[44]

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[39] Ibid., p. 515.

[40] Sustainability criteria include economic analysis, environmental impact, efficiency, and energy consumption.

[41] Telephone conversation between the author and Mike Culver, congressional and external relations director, Architect of the Capitol, February 20, 2009.

[42] For more information on greening program in Congress, see CRS Report RL34694, *Administering Green Programs in Congress: Issues and Options*, by Jacob R. Straus and CRS Report RL34617, *Recycling Programs in Congress: Legislative Development and Architect of the Capitol Administration*, by Jacob R. Straus.

[43] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, UK, 2007, p. 264.

[44] U.S. Congress, House Committee on Transportation and Infrastructure, *Administration Proposals on Climate Change and Energy Independence*, 110th Cong., 1st sess., May 11 and 16, 2007, H.Hrg. 110-44 (Washington: GPO, 2007), p. 45.

In May 2008, the Government Accountability Office (GAO) completed a study of the implications of switching from coal to natural gas at the Capitol Power Plant. GAO reported that to complete the "Green the Capitol" goal of using only natural gas to supply steam to the House (but not necessarily all buildings served by the plant) would require a 38% increase in the use of natural gas relative to its baseline level between 2001 and 2007 and could cost from $1.0 to $1.8 million in FY2008.[45] In June 2008, the GAO Director of Construction and Facilities Management testified before the Senate Rules and Administration Committee that

> [I]t costs about 4 times as much to burn natural gas at the Capitol Power Plant as it does for coal based on the amount of energy that you get out of the two energy sources.... Earlier this year, we estimated that switching from coal to natural gas costs about $139 per ton of carbon dioxide saved.[46]

Natural gas prices are volatile, however, and have fallen from around $11.00/MMBtu in May 2008 to around $4.50/MMBtu in February 2009, so the cost of additional natural gas for the Capital Power Plant in the future could be substantially lower than the GAO estimates.[47]

During a 2008 Senate Committee on Rules and Administration hearing, the Architect estimated that further increasing gas burn (presumably up to 100%) would require "a significant investment in equipment upgrades to the tune of about $6 or $7 million,"[48] because the plant was near its maximum capacity to burn natural gas with its current equipment. Because of this substantial capital requirement, it was not clear to GAO that such an upgrade would be the most cost-effective means of reducing carbon dioxide and other pollutant emissions from the Capitol complex.[49] GAO stated that "fuel switching would impose a recurring additional fuel cost on [the] AOC and may prove less cost effective than implementing projects that decrease the demand for energy."[50]

On February 26, 2009, House Speaker Nancy Pelosi and Senate Majority Leader Harry Reid sent a letter to the Architect of the Capitol (AOC) calling for the facility to be converted to run exclusively on natural gas for all of its steam production.[51] On April 24, 2009, the Architect responded by ordering "the seasonal conversion to natural gas two months earlier than normal"

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[45] *Switching from Coal to Natural Gas at the Capitol Power Plant*, p. 6.

[46] U.S. Congress, Senate Committee on Rules and Administration, *Increasing the Use of Renewable Sources of Energy, and Reducing the Carbon Footprint of the Capitol Complex*, hearing, 110th Cong., 2nd sess. June 18, 2008, pp. 5-6 http://rules.senate.gov/hearings/2008/0618transcript.pdf. [Hereafter, *Senate Committee on Rules and Administration Hearing.*]

[47] Oilnergy.com, "NYMEX Henry-Hub Natural Gas - 12 Previous Months," March 3, 2009, http://www.oilnergy.com/1gnymex.htm#year.

[48] *Senate Committee on Rules and Administration Hearing*, pp. 13-14.

[49] "The Capitol Power Plant operates under the Title V permitting program established under the Environmental Protection Agency's (EPA's) 1990 Clean Air Act Amendments." For more information see, U.S. Congress, Office of the Architect of the Capitol, "Facts About the Capitol Power Plant," press release, February 20, 2009, p. 1, http://www.aoc.gov/aoc/press-room/loader.cfm?csModule=security/getfile&pageid=57651.

[50] *Senate Committee on Rules and Administration Hearing*, pp. 13-14.

[51] Letter from Representative Nancy Pelosi, Speaker of the House and Senator Harry Reid, Majority Leader to Stephen T. Ayers, Acting Architect of the Capitol, February 26, 2009, http://www.speaker.gov/blog/?p=1711. Sen. Tom Udall also introduced an amendment (S.Amdt. 639) to the Omnibus Appropriations Act of 2009 to "ensure that any electricity generated by or otherwise used by the Capitol Power Plant is not derived from coal." For the text of the amendment, see Sen. Tom Udall, "Text of Amendments," *Congressional Record*, daily edition, vol. 155 (March 3, 2009), p. S2721.

and upgrading equipment to "enable the CPP to meet the steam requirements for the Capitol complex using only natural gas...."[52] On May 1, 2009, Speaker Pelosi and Majority Leader Reid announced that "[m]oving forward, the Architect of [the] Capitol will use only natural gas for generating steam, and resort to coal only as a backup fuel source."[53]

Some in Congress have suggested that the Capitol Power Plant could reduce its emissions even further by converting to a renewable (biomass) fuel. For example, in a statement on the House floor, Representative Jay Inslee stated that carbon emissions could be achieved

> [s]witching from coal, first, to natural gas in our power plant, which reduces carbon dioxide something like 20 to 30 percent. We're then taking a look at the possibility of going to a totally renewable fuel of wood pellets [from trees] grown in New Hampshire and some other places which would go to essentially zero CO_2 on a net basis.[54]

Such a conversion would likely involve additional capital costs for new boiler equipment, and would rely on a totally new source of fuel, the costs of which have not been estimated. Therefore, there is insufficient information available this time to further examine the merits of biomass fuel conversion compared to the other Capitol Power Plant fuel alternatives.[55]

Outsourcing Capitol Power Plant Management

Outsourcing plant management and operations to a firm specializing in the running of steam and refrigeration facilities could provide certain advantages to the Capitol Power Plant. Potential benefits may include lower net costs through operating efficiencies and the sale of excess production to other government agencies or the private sector.[56] The Consolidated Appropriations Act of 2005[57] required that the Government Accountability Office (GAO) conduct a feasibility study of Capitol Power Plant management outsourcing:

> (b) Study of contract with a private entity. Not later than 180 days after the date of enactment of this Act, the Comptroller General shall conduct a study and submit to the appropriate congressional committees and the Architect of the Capitol a report that—(1) analyzes the costs, cost effectiveness, benefits, and feasibility of the Architect of the Capitol entering into a contract with a private entity for the management and operation of the Capitol Power Plant; and (2) makes a recommendation on whether the Architect of the Capitol should enter into such a contract.[58]

[52] Letter from Stephen T. Ayres, Acting Architect of the Capitol, to Nancy Pelosi, Speaker of the House of Representatives, April 24, 2009, http://speaker.gov/pdf/AOC42409.pdf.

[53] Speaker of the House Nancy Pelosi and Senate Majority Leader Harry Reid, "Reid, Pelosi: Capitol Power Plant to End Burning of Coal; Only to be Used as Emergency Backup," press release, May 1, 2009, http://speaker.house.gov/newsroom/pressreleases?id=1136.

[54] Rep. Jay Inslee, "Green the Capitol Initiative," *Congressional Record*, daily edition, vol. 153, no. 177(Nov. 15, 2007), p. H14074.

[55] For further analysis of wood biomass and atmospheric emissions, see CRS Report RL31432, *Carbon Sequestration in Forests*, by Ross W. Gorte.

[56] The Architect of the Capitol currently sells excess steam and chilled water to Union Station, the Folger Shakespeare Library, and Postal Square.

[57] P.L. 108-447, 118 Stat. 385, December 8, 2005.

[58] 2 U.S.C. § 2162 note.

Pursuant to the act, GAO conducted a study in 2005 on Capitol Power Plant operations and in 2006 issued recommendations on staffing levels and training to make the power plant operate with increased efficiency and safety.[59] In January 2008, GAO issued another report on the Architect's progress in addressing staffing and plant management concerns raised by the 2006 report.[60] In that report, GAO recommended the Architect take three actions to address previous staffing concerns prior to the consideration of outsourcing:

1. quantify cost savings and efficiencies developed since the passage of P.L. 108-447 in 2004;
2. complete the development of a comprehensive staffing plan and establish procedures and guidelines for future sourcing decisions; and
3. create and pursue a competitive sourcing strategy.[61]

Because the Architect of the Capitol is a legislative branch official, the Capitol Power Plant would not be required to follow the executive branch's guidelines on outsourcing. The Architect, however, could investigate whether the spirit of executive branch regulations could be utilized in making future decisions on contracting for private sector services.[62]

Although outsourcing Capitol Power Plant management and operations could provide additional revenues to Congress, and could also trim its operating budget and personnel costs by utilizing the staffing resources of the management company, the environmental benefits of such an arrangement are unclear. Selling excess steam or refrigeration output to additional customers might well generate new revenues for Congress, but could increase the Capitol Power Plant's fuel consumption and associated emissions. It might also expose Congress to risks associated with long-term energy prices and customer supply contracts. An outsourcing vendor potentially could incorporate new operating practices with an environmental benefit beyond the Architect's current practices and the operational recommendations in the CAO report,[63] but it is not known what these new practices could be. Outsourcing of plant operations could provide worthwhile incremental benefits.[64]

Combined Heat and Power (CHP) Conversion

Another option for improving the environmental posture of the Capitol Power Plant is conversion to a combined heat and power plant (CHP plant, also known as a co-generation facility) fueled by

[59] U.S. Government Accountability Office, *Architect of the Capitol: Addressing Staffing and Training Issues Is Important for Efficient and Safe West Refrigeration Plant Operations*, GAO-06-321R, February 10, 2006.

[60] U.S. Government Accountability Office, *Feasibility of Outsourcing the Management and Operation of the Capitol Power Plant*, GAO-08-382R, January 31, 2008.

[61] Ibid., p. 4.

[62] Office of Management and Budget, *Performance of Commercial Activities*, Circular No. A-76, May 29, 2003. In the executive branch, competitive sourcing and the decision to outsource services and management and programs is guided by the Office of Management and Budget (OMB). OMB Circular A-76 governs whether commercial services should be performed by the public or private sector and how the government makes that determination.

[63] *Green the Capitol Initiative Final Report*, pp. 24-26.

[64] For example, see CRS Report RL34495, *Continuation of Employment Benefits for Senate Restaurant Employees*, by Jacob R. Straus. The House contract with Restaurant Associates specifies environmentally friendly practices to be implemented in the House cafeterias.

natural gas or, potentially, biomass.[65] In 2005, Representative Jim Moran suggested that a CHP installation could be beneficial for Congress in the long term:

> I don't think that we have got a very efficient system going on here, and it could be replaced. We could make a far better use of that real estate.... We can put an electric generation facility in to capture excess heat. The property is valuable, but not the way it is being used now. And it seems to me it is something that we really need to look at very seriously.[66]

CHP plants produce electricity and steam in an integrated process that maximizes the efficiency with which fuel is consumed. Consequently, CHP systems can help mitigate carbon dioxide emissions because they make more efficient use of fossil fuels than the utility power generation they displace. According to a study by the Intergovernmental Panel on Climate Change, "current CHP designs can boost overall conversion efficiencies to over 80%, leading to cost savings ... and hence to significant carbon-emissions reductions per kWh generated."[67] This level of efficiency compares favorably to conventional coal-fired power plants, which typically operate at around 33% efficiency, or advanced coal plant technologies under development, which could improve coal plant efficiency to around 46%.[68] Consequently, a CHP plant might be a lower cost alternative to the current practice of buying electricity for the Capitol complex from Pepco while continuing to produce steam for Capitol complex facilities.[69] Depending upon the type of fuel used for Pepco's electricity, power from a gas-fired CHP plant at the Capitol could result in lower carbon dioxide emissions than current Pepco power supplies. The benefits from a biomass-fired CHP plant would be even greater, by some estimates. When both steam production and power generation are considered, the overall environmental benefits of a CHP plant could be large, by some estimates.

In June 2008, the Architect discussed the benefits of cogeneration for the Capitol complex as part of his testimony before the Senate Committee on Rules and Administration.

> We believe the most cost-effective thing we can do is to move towards a co-generation system at the Plant whereby we are generating some electricity that we can use for emergency purposes, and when that need is not there, we can sell that electricity back to Pepco, our utility provider. But we have the infrastructure available to create steam now, and using much of that excess steam to help us generate electricity, we think, is the most cost-effective approach at the Capitol Power Plant.... [70]

CHP installations are potentially complex, seeking to balance steam and electricity requirements which are variable and potentially countercyclical. Consequently, it is difficult to estimate the potential size and cost of a CHP plant optimized for the Capitol complex. In the simplified case of supplying 100% of the 105,856 MWh used only by the Capitol Power Plant itself in 2008, and

[65] For background on CHP technology, see Anna Shipley, Anne Hampson, and Bruce Hedman, et al., *Combined Heat and Power: Effective Energy Solutions for a Sustainable Future*, Oak Ridge National Laboratory, ORNL/TM-2008/224, Oak Ridge, TN, December 1, 2008, http://www1.eere.energy.gov/industry/distributedenergy/pdfs/chp_report_12-08.pdf.

[66] U.S. Congress, House Committee on Appropriations, *Legislative Branch Appropriations for 2007: Part 2 Fiscal Year 2007 Legislative Branch Appropriations Requests*, 109th Cong., 2nd sess. (Washington: GPO, 2006), p. 520.

[67] Intergovernmental Panel on Climate Change (IPCC), 2007, p. 284.

[68] Massachusetts Institute of Technology (MIT), *The Future of Coal*, 2007, pp. 115, 124.

[69] *Senate Committee on Rules and Administration Hearing*, p. 14.

[70] *Senate Committee on Rules and Administration Hearing*, p. 14.

assuming a capacity factor of 75%, a Capitol CHP plant would need to be sized at approximately 16 MW of generating capacity. Retrofitting existing boilers with a steam-driven generation turbine could minimize capital costs for a CHP installation. Assuming a boiler retrofit scenario with an approximate cost of $1.1 million per MW (35% of a full CHP project),[71] such an installation would have a capital cost of approximately $17.6 million dollars. A CHP installation sized to serve the electricity needs of other buildings in the Capitol complex could be an order of magnitude larger than 16 MW, with capital costs in the hundreds of millions of dollars. This type of installation, or associated transmission infrastructure, could also be subject to approval by the District of Columbia Public Service Commission, the Federal Energy Regulatory Commission, or other regulatory agencies.

At these high levels of capital cost, Congress could consider turning over the CHP plant development to an independent power company, which could build and operate the plant with private capital, providing electricity and steam to Capitol complex facilities under a long-term sales agreement. Such arrangements are commonplace in the private sector.[72] If Congress wishes to consider CHP as an alternative to the more limited boiler fuel conversion discussed above, the full economic, environmental, technical, and regulatory aspects of a Capitol CHP plant would benefit from further examination.

Conclusion

Measures taken to date at the Capitol Power Plant have already resulted in significant environmental benefits, but there are operational and plant conversion options which may reduce the plant's environmental impacts even further. These options may be costly, however, both in terms of fuel expenses and capital requirements—and may involve price and operational risk. Consequently, careful comparison of all the options for "Greening the Capitol" may be useful to ensure that the most cost-effective and environmentally beneficial investments are made while ensuring the continued supply of utility services to the Capitol.

[71] Energy and Environmental Analysis, *Technology Characterization: Steam Turbines*, Environmental Protection Agency, Combined Heat and Power Partnership, December 2008, pp. 11-12.

[72] See, for example, Iberdrola Renewables, "About the Klamath Cogeneration and Klamath Peaking Plants," Internet page, http://www.iberdrolarenewables.us/klamath.html, March 3, 2009.

Appendix. Facilities Supplied by the Capitol Power Plant

The Capitol Power Plant supplies steam to 24 buildings on or near Capitol Hill. The Architect of the Capitol does not manage Union Station, the Folger Shakespeare Library, or Postal Square. The buildings not managed by the Architect reimburse the Architect for services rendered. **Table A-1** lists the facilities supplied steam by the Capitol Power Plant.

Table A-1. Facilities Supplied with Steam by the Capitol Power Plant

Facility	Buildings
House of Representatives	Cannon House Office Building
	Longworth House Office Building
	Rayburn House Office Building
	House Page Dormitory
	House East Garage
	House West Garage
	501 1st Street, S.E.
Senate	Dirksen Senate Office Building
	Hart Senate Office Building
	Russell Senate Office Building
Congressional Buildings	U.S. Capitol and Capitol Visitors Center
	Capitol Power Plant
	Capitol Police Buildings
	Legislative Garage
	U.S. Botanic Garden
Library of Congress	Adams Building
	Jefferson Building
	Madison Building
U.S. Courts	U.S. Supreme Court
	Thurgood Marshall Judiciary Building
Other Federal Buildings	Government Printing Office
Non-Architect Managed Buildings	Union Station
	Postal Square
	Folger Shakespeare Library

Source: U.S. Government Accountability Office, *Feasibility of Outsourcing the Management and Operation of the Capitol Power Plant*, GAO-08-382R, January 31, 2008, p. 16.

Notes: Union Station, Postal Square, the Government Printing Office, and the Folger Shakespeare Library are not part of the Capitol complex. They are served by the Capitol Power Plant and are billed by the Architect of the Capitol for services provided.

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