United States Government Accountability Office

Report to Congressional Committees

September 2015

CAPITOL POWER PLANT

Architect of the Capitol Should Update Its Long-term Energy Plan before Committing to Major Energy Projects

Accessible Version

GAO-15-436

September 2015

CAPITOL POWER PLANT

Architect of the Capitol Should Update Its Long-term Energy Plan before Committing to Major Energy Projects

GAO Highlights

Highlights of GAO-15-436, a report to congressional committees

Why GAO Did This Study

AOC's CPP heats and cools 25 buildings in the complex, including the Capitol and House and Senate office buildings. CPP does not have the infrastructure to distribute electricity to the buildings it serves. CPP buys fossil fuels (mostly natural gas) to run boilers that make steam and buys electricity to run chillers that make chilled water. CPP distributes the steam and chilled water for heating and cooling using a network of tunnels. AOC seeks to install a 'cogeneration' system that would produce steam and electricity.

The House of Representatives report accompanying the Legislative Branch Appropriations Bill, 2014 included a provision for GAO to analyze potential cost savings at CPP. GAO analyzed (1) measures AOC implemented since 2008 to manage the energy-related costs of the complex and opportunities, if any, to further manage these costs, and (2) how AOC decided to procure a cogeneration system and the extent to which AOC followed leading capital-planning practices. GAO analyzed AOC budgets and plans; reviewed federal guidance on capital planning; and interviewed AOC staff and other stakeholders, including other heating and cooling plant operators.

What GAO Recommends

AOC should (1) update its long-term energy plan while following key leading practices, including considering a full range of measures to further manage costs, before committing to major energy projects at CPP, and (2) seek independent review of its plan. AOC disagreed with GAO's recommendations; GAO continues to believe they are valid, as discussed further in this report.

View GAO-15-436. For more information, contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov or Lori Rectanus at (202) 512-2834 or rectanusl@gao.gov.

What GAO Found

The Architect of the Capitol (AOC) implemented many measures since 2008 to manage the energy-related costs of the Capitol Complex (the complex) and has opportunities to further manage these costs. AOC updated some of the Capitol Power Plant's (CPP's) production and distribution systems to reduce energy use and increase efficiency. AOC also implemented measures to reduce energy consumption in the complex, such as conservation projects improving lighting and air-handling systems that yielded monetary savings. AOC has opportunities to implement other conservation measures in the complex. For example, energy audits by contractors identified additional opportunities to implement similar measures or other upgrades to lighting, mechanical, and plumbing systems to achieve additional energy and monetary savings. However, AOC officials said they have not implemented these measures but intend to act as resources become available.

AOC decided to procure a cogeneration system to produce electricity and steam based on a 2009 long-term plan and subsequent partial updates but did not follow key leading federal capital-planning practices. In 2009, AOC issued a long-term energy plan that stated it should pursue cogeneration to meet future steam demand and provide a new source of electricity for its chillers, enabling the agency to decrease electricity purchases. Partial updates to the plan in 2014 sought to justify the choice of a cogeneration system. However, AOC's planning did not follow key leading capital-planning practices developed by GAO and the Office of Management and Budget (OMB). First, though called for by leading federal planning practices, AOC has not fully updated the 2009 long-term plan, although changes in key planning assumptions, such as on fuel prices and the complex's demand for energy, have occurred. Instead, AOC intends to make a decision on implementing an $85 million cogeneration system before updating its long-term plan later in fiscal year 2015. Second, the 2014 partial updates to its 2009 plan that AOC has used to justify the project did not include complete information on the need or problem that the project would address. Third, the 2014 updates did not identify a full range of options for cost-effectively meeting projected future needs, including non-capital measures such as conservation. Fourth, the updates did not have valid sensitivity or uncertainty analyses to test key assumptions about whether the system would achieve sufficient savings over time—from decreased electricity purchases—to justify its costs. Related to this, AOC officials said that since upfront appropriations would likely not be available to procure the system, they had decided to use a third party to finance the project, thereby increasing its costs. These officials also said they relied on federal guidance for analyzing and financing energy projects. However, such guidance does not substitute for first completing an up-to-date capital plan. Finally, GAO's prior work has recommended using independent panels of experts to review complex projects such as a cogeneration system, but AOC has not engaged such a panel to review its 2014 updates to its long-term plan. AOC officials said they were unaware of some of these practices and that they needed to sign a contract quickly to avoid the risk of losing construction and air quality permits. Without updating its long-term energy plan and obtaining independent review, AOC may pursue a project that does not cost-effectively meet its needs.

Contents

Tables

Figures

Abbreviations

AOC	Architect of the Capitol
the complex	Capitol Complex
CPP	Capitol Power Plant
DOE	Department of Energy
ECM	Energy Conservation Measure
EISA	Energy Independence and Security Act of 2007
EPAct	Energy Policy Act of 2005
ESPC	Energy Savings Performance Contract
GSA	General Services Administration
HVAC	heating, ventilation, and air conditioning
NRC	National Research Council
NECPA	National Energy Conservation Policy Act
NIST	National Institute of Standards and Technology
NREL	National Renewable Energy Laboratory
OMB	Office of Management and Budget
PURPA	Public Utility Regulatory Policies Act of 1978
RPR	Refrigeration Plant Revitalization
UESC	utility energy services contract

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

September 3, 2015

Congressional Committees

The Architect of the Capitol (AOC) operates the Capitol Power Plant (CPP) that provides heating and cooling to the U.S. Capitol and 24 surrounding buildings, often referred to as the Capitol Complex (the complex). CPP is a "district energy system" that produces steam and chilled water at a central plant for distribution via tunnels to the complex. The plant has not produced electricity since 1952 and does not have the infrastructure to produce or distribute electricity—either for use in the plant itself or in the buildings in the complex.[1] AOC purchases fossil fuels (primarily natural gas) for use in CPP's seven boilers, and purchases electricity to run the plant's eight chillers.[2] The cost of operating the plant totaled about $63 million in fiscal year 2014.[3]

For more than a decade, the Congress has expressed interest in reducing the costs of heating and cooling the buildings served by CPP, and AOC currently has multiple capital projects under way that could significantly affect those costs. For example, AOC has undertaken major building renovations in the complex that could affect future demand for steam and chilled water, such as the renovation of the Cannon House Office Building. In addition, AOC has initiated a planning effort for procuring a cogeneration system that would generate steam and electricity, in part, to address a projected gap in steam-generating capacity.[4] A number of federal leading practices exist to guide such planning efforts.

[1]CPP has an emergency electricity generator capable of providing 1.5 megawatts of power to its steam generating equipment (a megawatt is a unit of energy equal to one-million watts of power, and one megawatt provides enough electricity to power about 750 homes). An AOC planning document stated the generator was not designed to run for long, continuous periods of time and could not be relied upon for an extended power outage.

[2]AOC purchases natural gas and electricity under a contract through the General Services Administration and purchases coal and fuel oil using the Defense Energy Support Center.

[3]Total AOC obligations for operating CPP are expressed in fiscal 2015 dollars.

[4]Cogeneration involves the simultaneous production of electricity and heat from a single fuel source.

The House Report accompanying the Legislative Branch Appropriations Bill, 2014 included a provision for GAO to examine potential cost savings associated with privatizing CPP.[5] GAO last reported on AOC's management of CPP in 2008.[6] Based on discussions with the House and Senate Appropriations Committees, this report contains information on: (1) measures AOC implemented since 2008 to manage the energy-related costs of the buildings served by CPP and opportunities, if any, to further manage these costs, and (2) how AOC decided to procure a cogeneration system and the extent to which AOC followed leading capital-planning practices.[7]

To identify measures AOC has implemented to manage heating and cooling costs since 2008, we examined AOC and CPP appropriations, obligations, and expenditures data; reviewed relevant reports; and interviewed AOC and CPP officials. We assessed the reliability of these data and found them sufficiently reliable for our purposes. To identify measures AOC could consider implementing to further manage the costs of heating and cooling the buildings served by CPP, we reviewed AOC reports and other documents. We also interviewed a nongeneralizable sample of eight operators of other district energy systems—representing both public and private entities—to learn about measures they have implemented to manage costs as well as the benefits and costs of those measures.[8] We identified these operators based on, among other things, literature research; interviews with CPP staff and managers of other district energy systems; and selected operators of district energy systems with similarities to CPP, such as those located in climates similar to

[5]H. R. Rep. No. 113-173, at 19 (2013).

[6]GAO, *Economic and Other Implications of Switching from Coal to Natural Gas at the Capitol Power Plant and at Electricity-Generating Units Nationwide*, GAO-08-601R (Washington, D.C.: May 1, 2008).

[7]Given the considerable challenges associated with privatizing CPP's operations, we agreed to focus more generally on cost-savings opportunities. CPP contracts with private sector organizations for, among other things, some operations and maintenance, energy savings upgrades, and planning and analysis. We have noted these activities throughout this report.

[8]District energy systems vary but generally involve production of electricity, steam, or chilled water at central plants for distribution to nearby buildings via tunnels. Buildings then use this energy for purposes such as cooling, heating, and electrical power. Such systems decrease the need for individual buildings to generate their own energy on site or purchase it from utilities.

Washington, D.C. The information collected during these interviews cannot be generalized to all district heating or cooling systems. However, because of their characteristics, the select operators provide useful insights on a range of issues relevant to AOC's management of CPP. To review the extent to which AOC has followed leading practices when planning to meet future steam demands, we reviewed past planning documents and recent updates—AOC's 2009 strategic long-term energy plan and two sets of 2014 AOC planning documents, among others. To identify key leading capital-planning practices we identified and reviewed four sources of relevant federal guidance on capital planning: GAO's *Executive Guide: Leading Practices in Capital Decision-Making*, GAO's *Cost Estimating and Assessment Guide*, the Office of Management and Budget's (OMB) *Capital Programming Guide, Supplement to OMB Circular A-11*, and the National Institute of Standards and Technology's (NIST) *Life-Cycle Costing Manual for the Federal Energy Management Program*.[9] We also interviewed senior AOC officials and CPP managers.

We conducted our work from December 2013 to September 2015, in accordance with all sections of GAO's Quality Assurance Framework relevant to our objectives. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and to discuss any limitations in our work. We believe that the information and data obtained, and the analysis conducted, provide a reasonable basis for the findings and conclusions in this report. Appendix I provides a more detailed description of our scope and methodology.

Background

AOC manages and operates CPP to support the agency's strategic goals and objectives, including stewardship of Capitol facilities and conservation of resources. AOC must also comply with relevant laws and regulations, including environmental-protection and energy-reduction

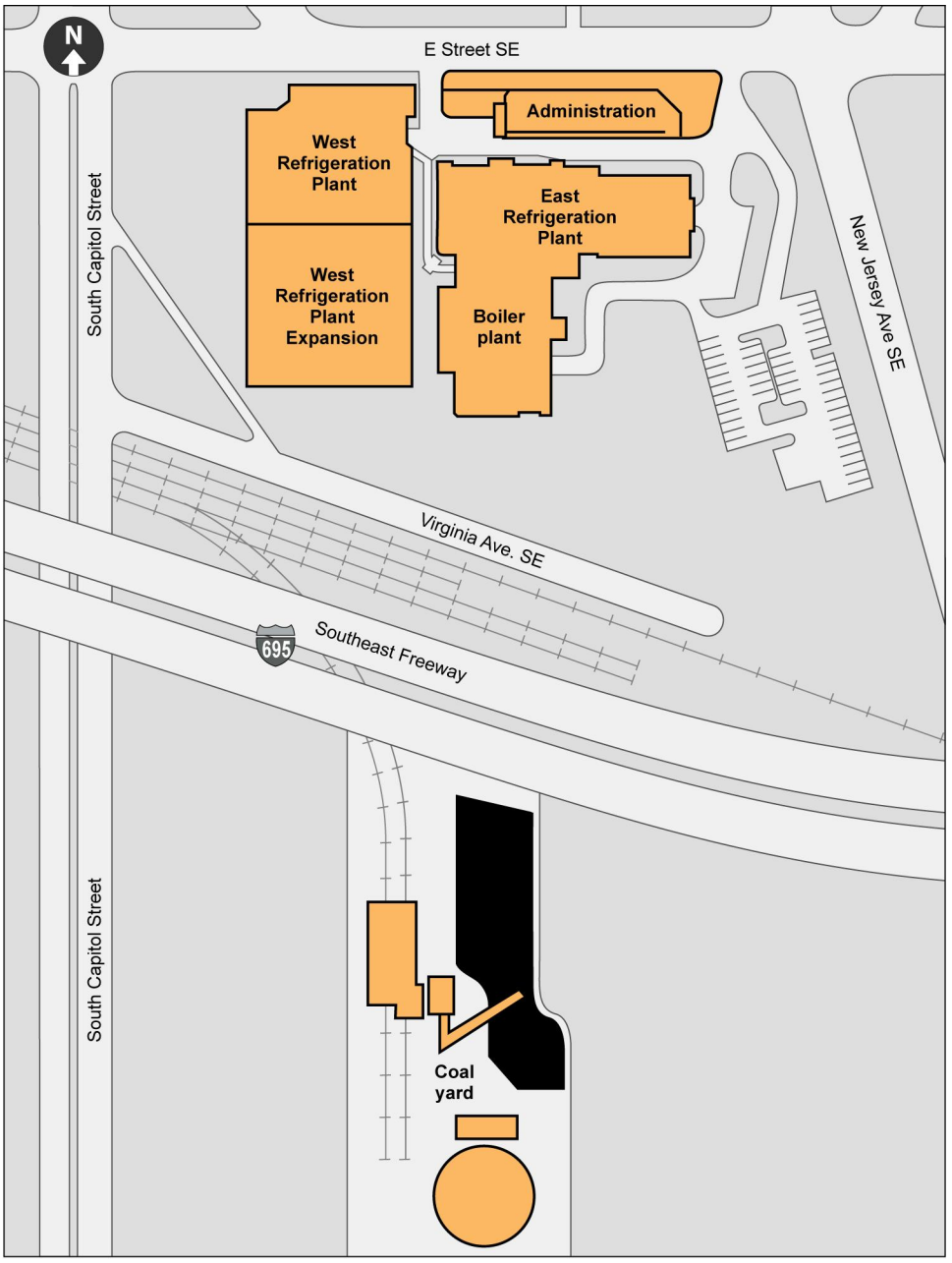
[9]GAO, *Executive Guide: Leading Practices in Capital Decision-Making*, GAO/AIMD-99-32 (Washington, D.C.: Dec. 1, 1998). GAO, *GAO Cost Estimating and Assessment Guide*, GAO-09-3SP (Washington, D.C.: Mar. 2, 2009). Office of Management and Budget (OMB), *Capital Programming Guide, Supplement to OMB Circular A-11* (Washington, D.C.: July 2014). National Institute of Standards and Technology, *Life-Cycle Costing Manual for the Federal Energy Management Program*, NIST Handbook 135 (Washington, D.C.: February 1996).

requirements.[10] CPP consists of six main facilities: an administration building, a boiler plant, the West Refrigeration Plant, the West Refrigeration Plant Expansion, the East Refrigeration Plant, and a coal yard at a secondary site (see fig. 1).[11]

[10]Both the District of Columbia Department of the Environment and the U.S. Environmental Protection Agency (EPA) play regulatory roles with respect to CPP's air emissions under the Clean Air Act. (Clean Air Act Amendments of 1970, Pub. L. No. 91-604, 84 Stat. 1676 (1970) (codified as amended at 42 U.S.C. §§ 7401-7671q) (commonly referred to as the Clean Air Act).

[11]CPP no longer uses the East Refrigeration Plant, in which AOC plans to house the proposed cogeneration system. In its technical comments to our draft report, AOC stated that a Turbine Building is separate from the East Refrigeration Plant.

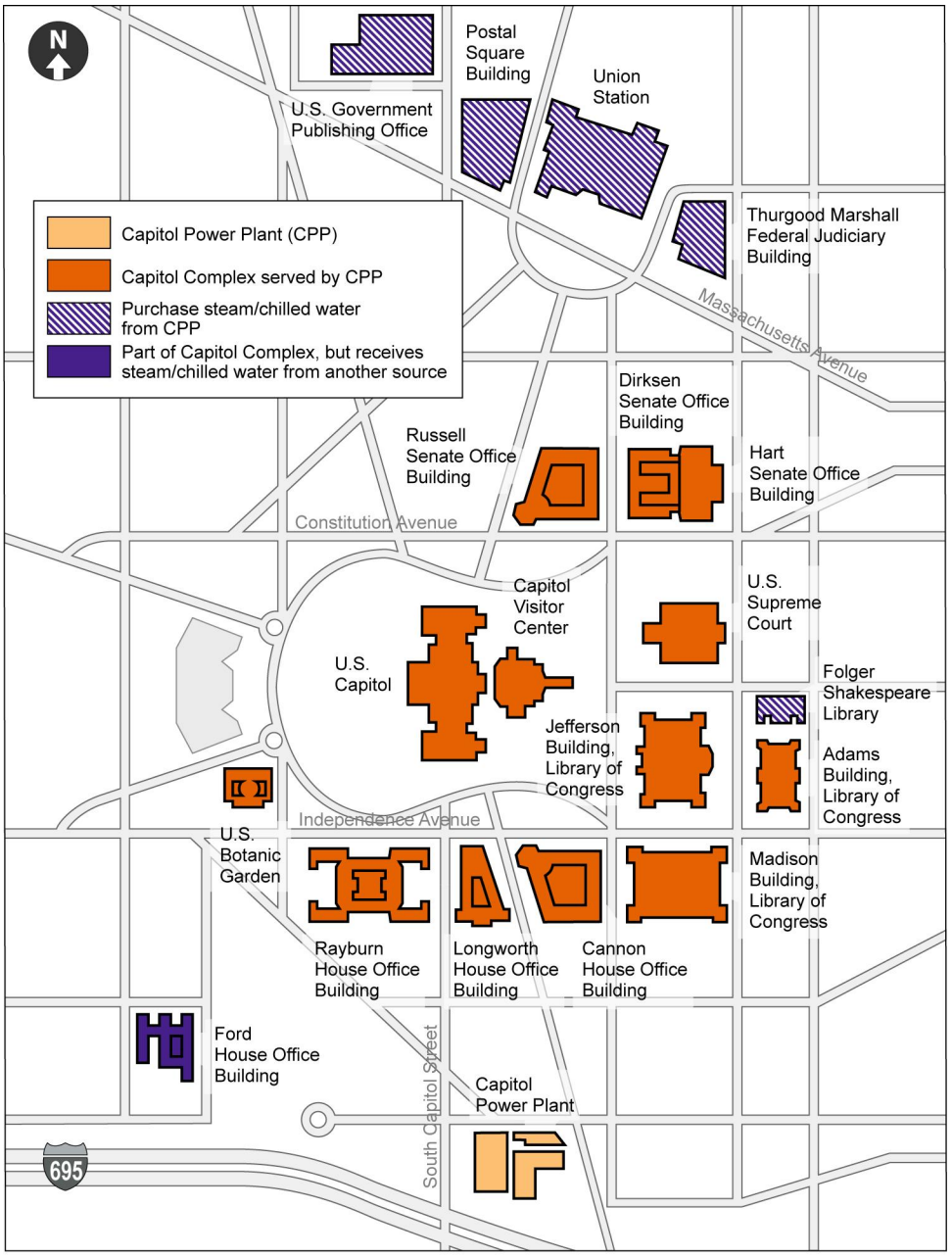
Figure 1: Primary Capitol Power Plant Facilities



Source: GAO. | GAO-15-436

CPP serves 25 buildings comprising about 17-million square feet, including the U.S. Capitol building, House and Senate office buildings, the Supreme Court, and five buildings not under AOC's management, including Union Station and the Government Publishing Office. Figure 2 identifies the primary Capitol Complex facilities served by CPP.

Figure 2: Primary Capitol Complex Facilities Served by the Capitol Power Plant



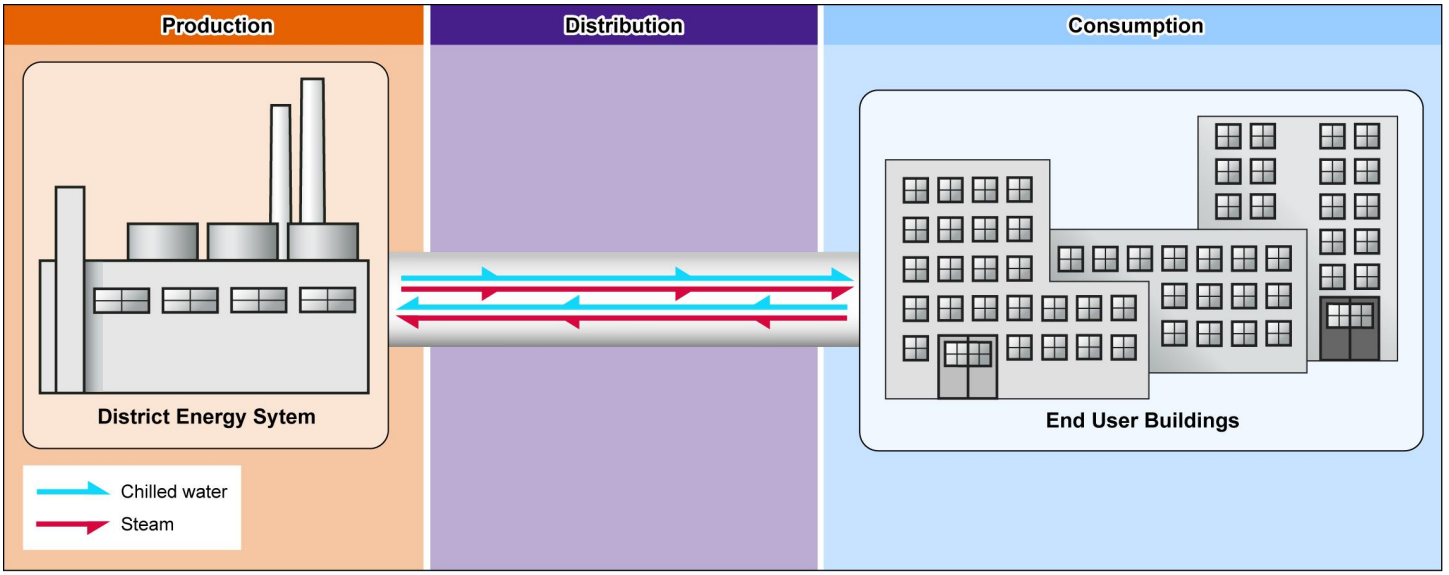
Source: GAO. | GAO-15-436

Note: The Capitol Power Plant serves additional facilities, including parking garages and the page dormitory.

CPP provides steam to 25 buildings and chilled water to 19 buildings. CPP bills non-AOC customers for its costs under arrangements in various statutes.[12]

CPP is a district energy system that generates steam and chilled water for distribution through tunnels and direct buried piping to heat and cool nearby buildings (see fig. 3). Many district energy systems exist throughout the country, often at universities and office parks.

Figure 3: Conceptual Illustration of Capitol Power Plant's District Energy System



Source: GAO. | GAO-15-436

In the absence of the district energy system, AOC would likely have to install a more dispersed system, such as heating and cooling generation equipment in each building. Alternatively, AOC could potentially obtain steam and chilled water from another district energy provider, such as the

[12]Folger Shakespeare Library: Pub. L. No. 83-663, 68 Stat. 800, 803 (1954), Pub. L. No. 95-182, 91 Stat. 1374 (1977); Government Publishing Office and Washington City Post Office: Pub. L. No. 67-263, 42 Stat. 767 (1922); Thurgood Marshall Federal Judiciary Office Building: Pub. L. No. 107-217, 116 Stat. 1062, 1188 (2002) (codified at 40 U.S.C. § 6502); Union Station: Pub. L. No. 107-217, 116 Stat. 1062, 1202 (2002) (codified at 40 U.S.C. § 6909); U.S. Supreme Court: Pub. L. No. 107-217, 116 Stat. 1062, 1180 (2002) (codified as amended at 40 U.S.C. § 6111).

General Services Administration (GSA), to serve some of the buildings in the complex, but could face challenges in doing so.[13]

CPP has seven fossil-fuel fired boilers that primarily burn natural gas to generate steam. The boilers operate primarily on natural gas, but AOC can burn coal in two boilers when additional steam capacity is needed or fuel oil in five boilers if, for example, interruptions occurred in the supply of natural gas (see table 1).

Table 1: Characteristics of CPP's Steam-Generating Equipment (2015)

Boiler number	Installation date	Primary fuel (secondary fuel)	Maximum capacity when operating on natural gas (lbs. of steam per hour)	Maximum capacity (lbs. of steam per hour)
1	1950	Gas/Coal	50,000	140,000 [Note A]
2	1950	Gas/Coal	50,000	140,000 [Note A]
3	1950	Gas/Oil	140,000	140,000
4	1964	Gas/Oil	50,000	50,000
5	1964	Gas/Oil	50,000	50,000
6	1964	Gas/Oil	50,000	50,000
7	1964	Gas/Oil	50,000	50,000
Total			**440,000**	**620,000**

Source: GAO analysis of Architect of the Capitol planning documents and CRS, *The Capitol Power Plant: Background and Greening Options*, R40433 (Washington, DC: June 3, 2010). | GAO-15-436

Note A: Maximum capacity when operating with coal.

As we previously reported, CPP increased its use of natural gas over coal and fuel oil beginning in 2008 as a result of the "Green the Capitol' initiative," which began at the direction of the House of Representatives.[14] CPP has continued this practice for environmental and other reasons.

CPP currently has eight electricity-powered chillers to produce chilled water. AOC officials said CPP has experienced sporadic mechanical and

[13]An AOC planning document stated that connecting the GSA's district energy system in Washington, D.C. to the Capitol Complex would cost about $800 million and require building a mile-long tunnel.

[14]GAO, *Economic and Other Implications of Switching from Coal to Natural Gas at the Capitol Power Plant and at Electricity-Generating Units Nationwide*, GAO-08-601R (Washington, D.C.: May 1, 2008).

electrical problems with its oldest chillers. AOC has a long-term plan to replace its older chillers, referred to as the Refrigeration Plant Revitalization (RPR) project, which calls for the replacement of several existing chillers and the addition of cooling towers over several phases by 2018.[15] Table 2 provides information on CPP's chillers in the West Refrigeration Plant and its West Refrigeration Plant Expansion.

Table 2: Characteristics of Capitol Power Plant's Electric-Powered Chilled-Water-Generating Equipment (2015)

Chiller number [Note A]	Installation date	Peak capacity (tons of refrigeration)	Electricity use (total kilowatts)
1	1978	6,000	4,440
2	1978	6,000	4,440
4	1978	6,000	5,160
5	2014	2,700	1,674
6	2014	2,700	1,674
7	2007	5,400	3,240
8	2007	5,400	3,240
9	2007	5,400	3,240
Total		**39,600**	**27,108**

Source: Architect of the Capitol. | GAO-15-436

Note A: AOC officials stated that as of July 2015, CPP is in the process of installing new chillers numbers 3 and 10, which would bring the total number of operating chillers to ten.

[15]Cooling towers remove heat from condenser water as part of the process of using chillers to create chilled water for the complex.

AOC Has Implemented Many Measures to Manage Energy-Related Costs and Has Opportunities to Further Manage These Costs

Since 2008, AOC has implemented many measures to manage the energy-related costs of the buildings served by CPP. AOC's efforts have reduced the energy needed to cool the buildings in the complex and the energy-related costs of operating CPP have fallen since fiscal year 2011. AOC has additional opportunities to further manage its energy costs.

AOC Has Implemented Many Measures to Manage Energy-Related Costs

Since 2008, AOC has implemented many measures to manage the energy-related costs of the complex.

Measures to Reduce Heating and Cooling Production Costs

To reduce the costs of producing steam, AOC replaced some steam-powered water treatment equipment at CPP with new equipment powered by electricity. Specifically, in fiscal year 2014, AOC replaced two of the pumps feeding the plant's boilers, formerly powered by steam, with new electric pumps. An outside study prepared by a consultant to AOC found that this would reduce in-plant steam use and improve the overall efficiency of the system, resulting in an almost 7 percent decrease in annual fuel costs and a nearly 10 percent improvement in the plant's steam output.

Additionally, AOC officials said they secured better terms in fiscal year 2014 for purchasing natural gas to operate the plant's boilers. Starting in fiscal year 2014, AOC paid $8.36 per thousand cubic feet of natural gas as opposed to the $12.95 the agency paid in fiscal year 2013, a reduction of approximately 35 percent. The contract expires in 2017.

AOC also completed several projects to lower the costs of providing chilled water. AOC officials said that in fiscal year 2012 they began a practice known as "free cooling" at CPP to reduce electricity costs. During winter months, CPP uses outside air, the plant's cooling towers, and heat exchangers to chill water rather than using its electric chillers. A 2013 study of the chilled water system shows that CPP should be able to meet the majority of chilled water demand in winter months using free cooling,

thereby lowering its electricity costs.[16] The study estimated that free cooling would achieve about $307,000 annually in savings through reduced electricity use.[17]

Also, in fiscal year 2014, AOC installed new chillers at CPP. The 2013 chilled-water- system audit concluded CPP could produce chilled water more efficiently if it increased its use of two relatively new and efficient chillers located in the East Refrigeration Plant, where the chillers were underused due to the relatively poor condition of the cooling towers there. AOC initially planned to move the two chillers to the West Refrigeration Plant Expansion. Ultimately, AOC purchased and installed two new chillers of similar capacity and efficiency. Additionally, in fiscal year 2014 AOC started construction to add two new chillers and three cooling towers to the West Refrigeration Plant Expansion as part of the RPR project. AOC budget documents state the new chillers will operate 50 percent more efficiently than the older chillers.

Measures to Better Understand Energy Consumption and Identify Opportunities for Conservation

To better understand energy consumption, AOC installed energy meters at most of the buildings it serves and is installing sub-meters within selected buildings. Energy meters can provide information on the consumption of steam, chilled water, and electricity. According to AOC officials, metering allows the agency to identify changes in energy consumption that could indicate equipment problems, measure progress on energy conservation, assist in identifying future conservation measures, and evaluate energy losses during distribution. Within the last 6 years, AOC installed meters for most of the buildings served by CPP.[18] AOC does not have meters for individual office spaces, but plans to install meters for some energy-intensive spaces, such as kitchens and data centers. According to AOC officials, the agency does not generally track energy use at the occupant level because of the cost and instead

[16]However, peak demand for chilled water occurs in summer months when relatively more building cooling is required.

[17]In technical comments responding to our draft report, AOC stated that it had achieved annual savings exceeding this amount, but we did not assess the validity of this statement.

[18]Prior to installing meters, AOC used models to estimate steam and chilled water needs and potential conservation measures. AOC has used metered data to update its models of building energy use.

encourages energy conservation within offices through education and awareness activities.

Select operators of other district energy systems we interviewed specifically mentioned the installation of energy meters to minimize the costs of operating their systems. Some of these operators said they installed meters at individual buildings served by their systems and are considering installing or have already installed submeters where appropriate.

In addition, between 2008 and 2013, AOC commissioned energy audits of most of the buildings served by CPP. Energy audits involve examining a building's physical features and utility history to identify conservation opportunities. AOC officials told us they engaged an engineering company to complete energy audits of the buildings operated by AOC, including the Supreme Court, and Thurgood Marshall buildings at a cost of $5 million. The audits produced estimates of the implementation cost, maximum energy and cost-savings potential, and pay-off period for energy conservation measures in all of the audited buildings.[19]

For the 16 largest buildings in the complex administered by AOC, these audits recommended several hundred conservation measures that could result in substantial energy savings. Most of the potential savings could stem from upgrades to heating and cooling systems. Three buildings—the Capitol, Madison Building, and Rayburn House Office Building–account for 52 percent of the potential energy savings from measures recommended by the contractor. Over one-third of the potential energy savings from these recommended measures involve the Library of Congress buildings, with the Madison Building—home of one of the Library's largest data centers—accounting for the greatest number of recommendations and the highest potential energy savings. For example, the audits estimated that fully replacing heating, ventilation, and air conditioning (HVAC) control systems in the Madison Building could reduce the building's cooling needs by half, and this project accounted for 18 percent of all potential energy savings from the recommended

[19]Completing many or all of the recommended measures would yield less savings than the sum of each individual measure because the audits estimate energy savings of each individual measure in isolation and the effect of some measures may decline if AOC implements other measures.

measures.[20] The contractor estimated that independently implementing all of its recommended measures could cost $115 million and that each measure would eventually result in dollar savings, with the payoff period varying for the different individual measures. As described below, AOC implemented some measures and intends to implement others as resources allow.

Measures to Reduce Energy Consumption

AOC officials subsequently evaluated the energy audits based on factors such as cost-effectiveness and execution difficulty and approved some measures for implementation. AOC staff and contractors have already implemented some of the measures. For example, AOC staff repaired and optimized some existing HVAC systems.

AOC also hired contractors to improve the energy efficiency of the Capitol and House and Senate office buildings through conservation measures. To finance these measures, AOC repays the contractors from avoided costs. Under Energy Savings Performance Contracts (ESPC), federal agencies enter into contracts—up to 25 years—with a private company in which the company incurs the costs of financing and installing energy efficiency improvements in exchange for a share of any savings resulting from the improvements.[21] Table 3 describes the energy conservation measures installed under these contracts.

[20]Poorly calibrated or functioning HVAC systems can generally use excess energy by heating or cooling spaces excessively or circulating outside air in volumes greater than necessary.

[21]Shared energy savings contracts were first introduced under the Comprehensive Omnibus Budget Reconciliation Act of 1985 (Pub. L. 99-272, 7201, 100 Stat. 82, 142 (1986)) which amended the National Energy Conservation Policy Act (NECPA) (Pub. L. No. 95-619, 92 Stat. 3206 (1978)). The Energy Policy Act of 1992 (Pub. L. No. 102-486, § 155, 106 Stat. 2776 (1992)) further amended NECPA utilizing the phrase “energy savings performance contracts” in authorizing agencies to use energy savings performance contracts as a tool for implementing energy-efficiency improvements. Federal agencies may obligate for such contracts on an annual basis and do not need to obligate amounts for any potential cancellation charges. See 42 U.S.C. § 8287(a)(2)(D).

Table 3: Energy Conservation Measures Installed Under Energy Savings Performance Contracts

Buildings	Energy conservation measures installed by energy service companies	Implementation completed
Capitol Building	• Air handling unit replacement • HVAC systems and controls upgrades • Lighting retrofit and controls • Steam trap maintenance	Nov. 2012
House Office Buildings (Rayburn, Cannon, Longworth, Ford)	• Energy efficient lighting upgrades • HVAC and controls upgrades • Steam trap replacement • Water conservation / fixture upgrades	March 2012
Senate Office Buildings (Hart, Dirksen, Russell)	• HVAC systems and controls upgrades • HVAC testing, adjusting, and balancing • Insulation of steam system components • Lighting retrofit and controls • Transformer upgrades	June 2013

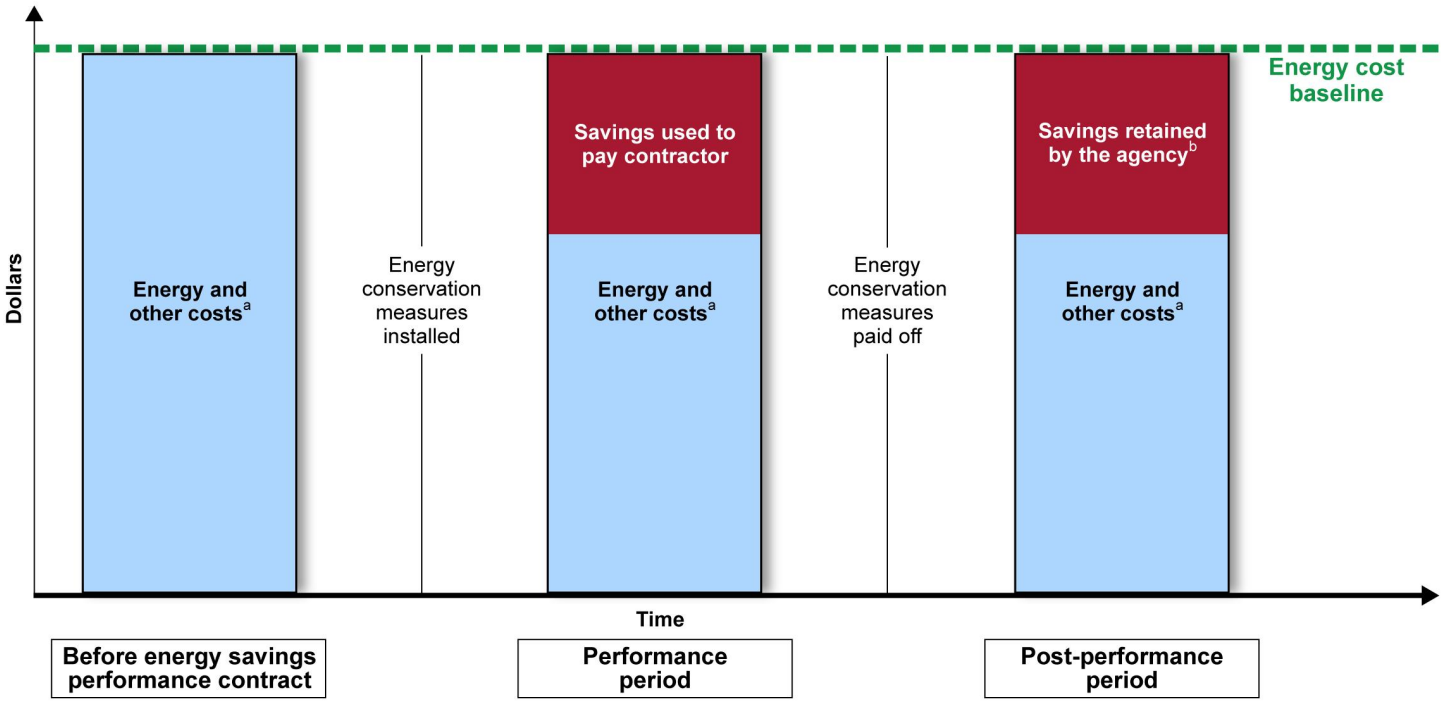
Source: GAO analysis of Architect of the Capitol documents. | GAO-15-436

During the contract term, agencies typically continue to budget and request appropriations for energy-related operations and maintenance based on their baseline energy needs prior to implementation of the improvements. Agencies repay the company for the costs—such as initial construction and installation costs, and the company's borrowing costs and profit—from appropriations using the savings generated by the improvements.[22] The federal statute authorizing federal agencies to enter into ESPCs states that the aggregate annual payments may not exceed the amount the agency would have paid for utilities without an ESPC.[23] At the end of the contract, payments to the company cease and the energy savings may allow agencies to reduce their energy-related expenses. Figure 4 illustrates the potential effect of an ESPC on an agency's cash flows.

[22]In its technical comments, AOC stated that under the ESPCs the energy savings are guaranteed and the agency will only make repayments if savings are measured and verified.

[23]42 U.S.C. § 8287 (a)(2)(B).

Figure 4: Potential Cash Flows from Energy Savings Performance Contracts (ESPC)



Source: GAO, based on review of DOE documents. | GAO-15-436

Note A: Agencies' costs for energy, water, and related expenses for operations, maintenance, and repair and replacement are all generally allowable sources of ESPC cost savings under statute.

Note B: Savings generated after an ESPC's performance period would generally be in the form of lower utility costs. Post-performance period savings are not measured and verified, and agencies do not generally track such savings.

We reported in 2004 that although ESPCs provide an alternative funding mechanism for agencies' energy-efficiency improvements, for the cases we examined at that time, such funding costs more than using upfront appropriations. This is because the federal government can obtain capital at a lower financing rate than private companies.[24] We also reported in June 2005 that vigilance is needed to ensure agencies negotiate the best

[24]GAO, *Capital Financing: Partnerships and Energy Savings Performance Contracts Raise Budgeting and Monitoring Concerns,* GAO-05-55 (Washington, D.C.: Dec. 16, 2004).

possible contract terms and that energy savings achieved will cover agencies' costs.[25]

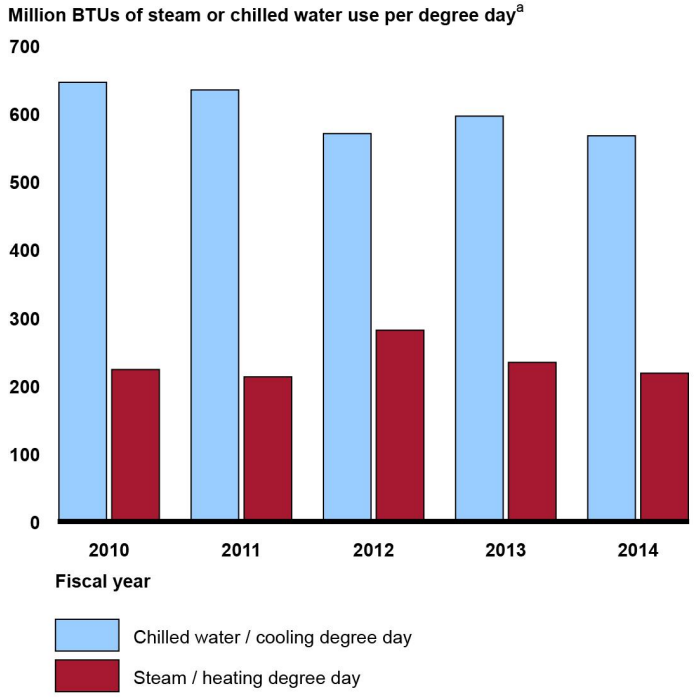
To date, AOC's contractors report that energy and cost savings have exceeded the guaranteed amounts.[26] In fiscal year 2013, they reported total savings of over $9.8 million. AOC made nearly $8 million in payments to the contractors in 2013, resulting in a net savings of approximately $1.7 million. In September 2012, one of AOC's contractors refinanced an ESPC project at a projected savings to the agency of $19.8 million over the term of the project.

For the entire complex, total steam and chilled-water consumption declined between 2010 and 2013, and adjusting the data to account for yearly changes in weather shows reductions in energy use, mostly from greater efficiency in producing chilled water. Because changes in weather affect the need for steam and chilled water, energy managers evaluate energy consumption against a measure of the average need for heating or cooling services. Cooling and heating degree days measure the number of days with outdoor temperatures above or below, respectively, 65 degrees Fahrenheit and the amount above or below that temperature. For example, a cooling degree day value of 10 indicates that the average temperature for the day was 75 degrees. AOC's annual energy consumption of chilled water per cooling degree day fell between fiscal years 2010 and 2013, which shows that consumption of chilled water (i.e., cooling) decreased more than would be expected simply due to lower temperatures. AOC's steam consumption per heating degree day during this period fluctuated. Figure 5 shows AOC's annual steam and chilled-water consumption per heating and cooling degree days.

[25]GAO, *Energy Savings: Performance Contracts Offer Benefits, but Vigilance Is Needed to Protect Government Interests*, GAO-05-340 (Washington, D.C.: June 22, 2005).

[26]AOC receives quarterly reports from its ESPC contractors in addition to annual measurement and verification reports of the energy and cost savings.

Figure 5: Consumption of Steam and Chilled Water by Capitol Complex Facilities (2010–2014)



Source: GAO analysis of energy data provided by the Architect of the Capitol. | GAO-15-436

Note A: One British thermal unit is the heat required to raise the temperature of one pound of water by one degree Fahrenheit. Steam consumption moved from a low of about 205 million BTUs per heating degree day in fiscal year FY2014 to a high of about 270 million BTUs per heating degree day in fiscal year FY2012.

AOC incurs regularly occurring costs as well as capital costs to operate and maintain CPP. AOC's regularly occurring costs to operate CPP, which include, among other things, the fuels and electricity to power the plant's generating equipment and the personnel to operate and maintain them, rose from fiscal year 2009 to fiscal year 2011 and then fell between fiscal years 2012 and 2014.[27] AOC's costs (expressed as total obligations) to operate CPP were about $59 million in fiscal year 2009,

[27]CPP also incurs costs for capital projects to repair, replace, and improve components of CPP. For fiscal 2014, accounting data provided by AOC show that CPP had multi-year appropriation of about $33 million for, among other things, funding for the RPR project.

rose to about $69 million in fiscal year 2011, and then fell to about $63 million by fiscal year 2014 (see table 4).

Table 4: Capitol Power Plant's Operating Obligations, in 2015 Constant Dollars, Fiscal Years 2009–2014

Fiscal year	2009	2010	2011	2012	2013	2014
Facility maintenance	574	1,155	1,689	N/A	N/A	N/A
Jurisdictional activities	243	234	233	221	236	211
Misc.	N/A	N/A	50	N/A	N/A	N/A
Payroll	9,593	10,104	9,962	9,357	9,139	9,329
Plant maintenance	6,723	8,450	6,627	10,342	10,164	9,226
Projects	2,033	1,100	8,130	N/A	N/A	1,551
Safety	173	185	158	161	156	162
Utilities – coal	3,006	0	295	881	N/A	588
Utilities - electricity	14,265	13,564	12,127	10,385	9,457	8,849
Utilities – energy savings Performance contracts	N/A	N/A	1,359	7,913	7,847	8,755
Utilities - fuel oil	78	1,768	508	216	N/A	N/A
Utilities - natural gas	14,929	17,829	17,974	16,206	16,343	14,991
Utilities - other	2,915	2,891	3,361	2,820	2,758	2,253
Utilities - water/sewer	4,475	4,372	6,303	6,865	6,256	6,785
Total	**59,009**	**61,652**	**68,776**	**65,365**	**62,357**	**62,699**

Source: GAO analysis of AOC accounting data. | GAO-15-436

From fiscal year 2009 to fiscal year 2014, fuel and electricity accounted for about 46 percent of the costs to operate CPP (in 2015 dollars). AOC's total obligations on fuel and electricity for CPP rose from about $32 million in fiscal year 2009 to a high of $33 million in fiscal year 2010, before declining in the subsequent years to about $24 million in fiscal year 2014. Changes in a variety of factors can affect CPP's costs, including fuel and electricity costs, staffing levels, maintenance needs, efficiency in using fuels, and consumption patterns. As shown above, costs for individual line items have varied over time.

AOC Has Opportunities to Further Manage Energy-Related Costs

While AOC has implemented some conservation measures, AOC has additional opportunities to manage its energy-related costs. AOC's past energy audits identified several hundred additional measures that could further reduce energy consumption in the complex and related costs and are expected to pay for themselves. Of these, AOC has selected some measures it intends to implement when resources become available (see table 5).

Table 5: Energy Conservation Measures (ECM) Identified by AOC for Future Implementation

Building	No. of ECMs
Cannon House Office Building	3
U.S. Capitol Building	15
Capitol Police Headquarters	4
Capitol Visitor Center	7
U.S. Botanic Garden (Conservatory)	2
Dirksen Senate Office Building	11
Ford House Office Building [Note A]	3
Hart Senate Office Building	10
Madison Building, Library of Congress	11
Adams Building, Library of Congress	7
Longworth House Office Building	1
Rayburn House Office Building	5
Russell Senate Office Building	8
U.S. Supreme Court	3
Jefferson Building, Library of Congress	5
Thurgood Marshall Federal Judiciary Building	16
Total	**111**

Source: GAO analysis of Architect of the Capitol's planning documents. | GAO-15-436

Note A: Ford House Office Building not served by CPP.

These include upgrades to building lighting, plumbing, and mechanical systems throughout the complex. For example, such upgrades could include (1) replacing inefficient light fixtures with modern, more-efficient fixtures with occupancy sensors, (2) replacing older inefficient plumbing fixtures with low-flow fixtures with automatic sensors, or (3) replacing pneumatic air-handling controls with more modern, digital controls. The measures AOC selected with the largest projected energy reductions include upgrades to the Library of Congress buildings. AOC officials said they are considering entering into an ESPC for these buildings that would include improvements to lighting and HVAC systems, and infrastructure upgrades to the data center in the Madison Building.

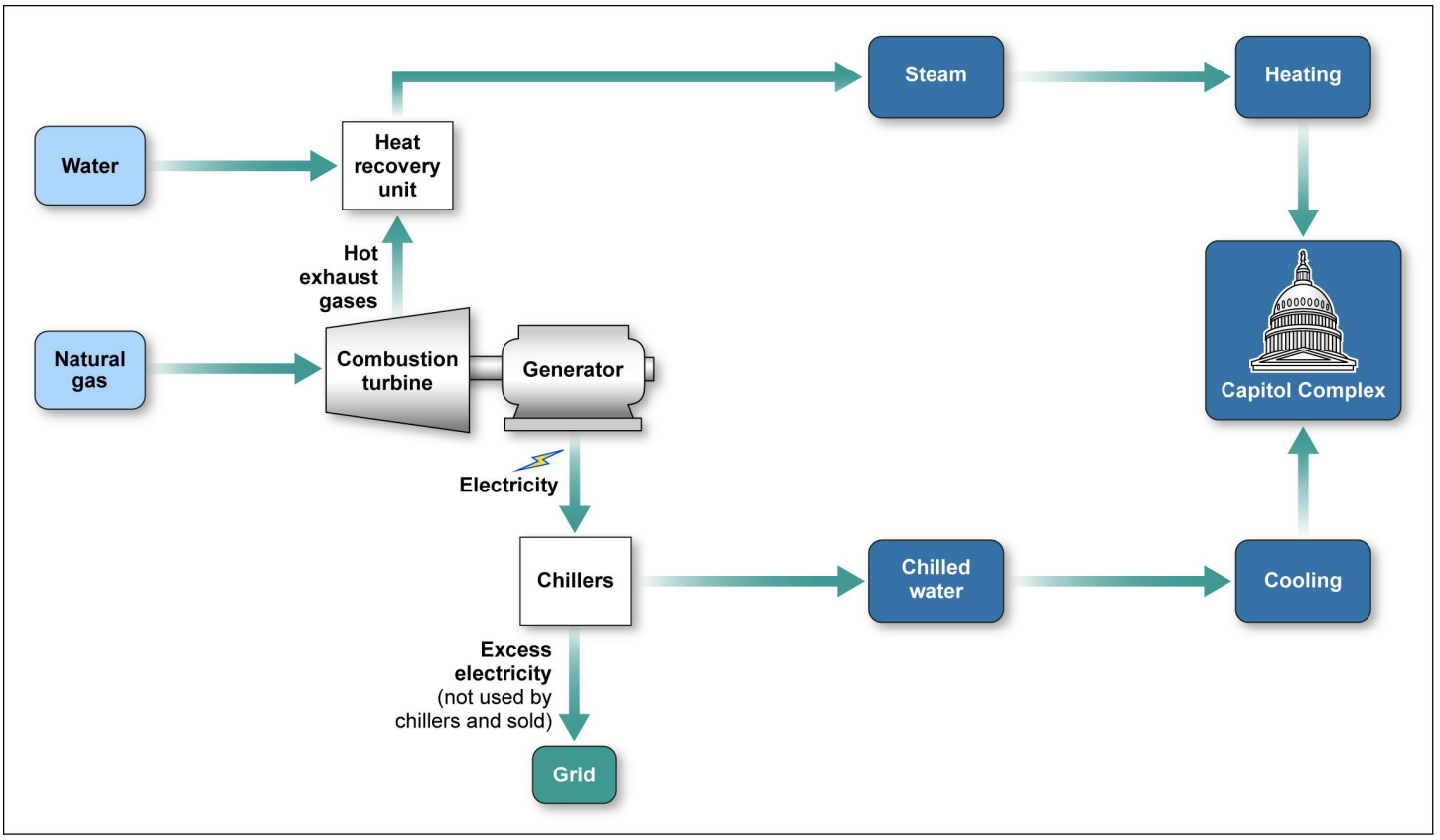
AOC Decided to Pursue a Cogeneration System Based on Partial Updates of Its 2009 Long-term Plan but Did Not Follow Key Leading Federal Capital-Planning Practices

Based on a 2009 long-term plan and subsequent partial updates, AOC decided that it should install a cogeneration system to replace aging boilers, meet future demand for steam, and produce electricity. AOC officials said that since upfront appropriations would not likely be available to procure the cogeneration system, they had decided to finance the project. AOC's iterative planning did not follow key leading practices we identified for federal capital planning. AOC officials said they were unaware of the relevant guidance we cited on leading practices and did not provide documents to support their claims that the agency needed to move quickly to execute a contract for the proposed cogeneration system.

AOC Decided That a Cogeneration System Was Needed Based on a 2009 Long-term Plan and Subsequent Partial Updates

In 2009, AOC issued a long-term energy plan that concluded the agency should install a cogeneration system to replace aging boilers, meet future demand for steam, produce electricity, and serve other agency objectives. AOC continued to justify the need to pursue cogeneration in subsequent partial updates to the plan. Cogeneration, also known as combined heat and power, involves the simultaneous production of electricity and heat from a single fuel source, such as natural gas. AOC has proposed a cogeneration system that would use a natural gas combustion turbine to generate electricity and a recovery unit that would use excess heat from the turbine's exhaust stream to heat water and create steam (see fig. 6).

Figure 6: Proposed Cogeneration System Using a Combustion Turbine



Source: GAO analysis of Architect of the Capitol planning documents. | GAO-15-436

AOC officials stated the cogeneration system, despite initial costs that are significantly higher than other alternatives, will provide needed steam and save money over time by producing electricity to power its chillers—thereby avoiding or decreasing the costs of purchasing electricity. In addition, cogeneration systems can produce excess electricity that can be sold to local utilities, thereby generating income that helps offset the cost of the system.

AOC's 2009 long-term energy plan included a forecast showing that demand for steam would grow and exceed the plant's capacity to

generate steam by fiscal year 2016.[28] To address this projected gap in capacity, the 2009 plan assessed nearly 30 capital alternatives for installing new steam-generating equipment, including natural-gas-powered boilers, a cogeneration system, or nuclear capabilities. The 2009 plan evaluated the capital alternatives using several criteria, including total life cycle costs, initial construction costs, air pollution emissions, energy efficiency, and security.[29,30] AOC's 2009 plan recommended that AOC continue to operate CPP as a district energy system to provide heating, and in that context, the best options based on life cycle costs and environmental impacts would involve a new cogeneration system or the use of synthetic coal.[31] Ultimately, citing concerns about the cost and availability of synthetic coal as well as environmental concerns, the plan recommended that AOC procure a cogeneration system.[32]

Specifically, the 2009 long-term plan recommended that AOC purchase a cogeneration system comprising one 7.5-megawatt cogeneration combustion turbine, which would represent the first of a three-phase plan.[33] The 2009 plan also called for the installation (in two subsequent phases) of five natural gas boilers along with two other combustion turbines—another 7.5-megawatt turbine and a 15-megawatt turbine—and the equipment needed to distribute electricity throughout the complex.

[28]The Architect of the Capitol, *Strategic Long Term Energy Plan: Final Report* (Washington, D.C.: Sept. 30, 2009).

[29]For each considered alternative AOC estimated life cycle costs, which are the expected costs to own and operate each alternative expressed in today's dollars. These include the initial construction costs and the present value of the projected annual operating costs, which include, among other things, costs for operations, maintenance, and fuels.

[30]For energy efficiency, the plan 2009 plan calculated, for each considered alternative, a regional energy efficiency rating, which took into account all the forms of energy used to generate and distribute utilities to the Capitol Complex.

[31]In this instance, synthetic coal would have involved burning a coal substitute derived from wood. The cogeneration alternative included the addition of three combustion turbines and the replacement of five natural gas boilers over several phases, while the synthetic coal alternative included the emissions equipment and storage facilities needed to use synthetic coal as well as the replacement of CPP's seven boilers.

[32]AOC selected the alternative with the lowest estimated net present value of life cycle costs—that is, expressed in current dollars, the costs to install and operate the alternative over its useful life.

[33]A megawatt is unit of energy equal to one-million watts of power. One megawatt provides enough electricity to power about 750 homes.

The 2009 plan assumed the first combustion turbine would serve only CPP, but that the later installation of the additional turbines would enable AOC to distribute electricity throughout the complex and potentially allow for selling excess electricity to the local utility. The estimated construction cost for the project was $120 million over its three phases. AOC officials said that it estimated the construction costs in the 2009 plan through a benchmarking analysis and did not reflect an actual bid from a vendor.[34]

AOC engaged the National Academies' National Research Council (NRC) to review a draft of its 2009 long-term energy plan. In response to AOC's request, the NRC organized an expert panel that identified several shortcomings in the draft plan, including that the energy demand projections were not supported by firm data and did not account for mandates to reduce energy consumption. In the final version of the 2009 plan, AOC states it addressed NRC's concerns and accounted for both increased utility demand from building renovations and reductions in demand due to the energy reduction mandates.

AOC subsequently developed the design of the cogeneration project throughout 2012 and 2013. AOC formally proposed the project during its fiscal year 2012 appropriations hearings. In 2012, AOC also received two consultant-authored reports assessing the feasibility of the system. These reports included an analysis that concluded that the value of a cogeneration system, which AOC officials said represented the first two phases of the 2009 long-term plan, was highly dependent on the price at which AOC could sell the excess electricity generated by the system. Throughout 2013, AOC worked with a vendor to further develop the design of a cogeneration system representing the first two phases of the 2009 plan. In November 2013, AOC officials stated that the project's initial construction-related costs would total roughly $67 million.[35] The vendor ultimately provided a bid in late 2013 that resulted in a total project cost

[34]The 2009 plan stated that AOC should further develop the cost estimates by developing budgetary cost estimates and funding schedule requirements for the plan's recommended projects.

[35]The costs included the design, construction, and construction contingency costs that would be included in a construction contract.

that was $100 million over AOC's estimate.[36] As a result, AOC initiated discussions with another vendor in January 2014.

On two occasions in 2014, during the course of the audit work for this report, AOC provided GAO with draft plans that concluded a cogeneration system was still the preferred means of meeting steam demand. In July 2014, AOC provided GAO with a draft version of a partial update of the 2009 plan prepared by a consultant, titled *Strategic Long Term Energy Plan Update: Draft Final Report*, that concluded new steam-generating capacity was needed to replace two aging boilers and meet projected increased future demand for steam. The draft July 2014 partial update included an updated long-term forecast of demand and, unlike the 2009 plan, did not project a gap in steam capacity occurring in 2016. Instead, the draft recommended that AOC replace the capacity of two aging boilers to decrease CPP's reliance on coal.[37] The draft July 2014 partial update did not, however, describe the expected life of these boilers. Unlike the 2009 document, the draft July 2014 partial update was not comprehensive and reviewed adding new natural gas boilers or eight different configurations of a cogeneration system (which involved combining new gas boilers with the systems). When presenting the draft partial update to GAO in July 2014, AOC officials said that the agency had not accepted the update as final from the consultant and would likely ask the consultant to add information and make changes before doing so. The draft July 2014 update recommended the option with the lowest life cycle costs: that AOC install a natural gas cogeneration system with two 5.7-megawatt turbines, as well as two natural gas boilers providing a total of 190,000 pounds of steam per hour.

The draft July 2014 partial update said the electricity generated by the cogeneration system would only be used within CPP and would not serve the rest of the complex or be sold to a utility; CPP does not have the infrastructure to provide electricity to the complex. Because of the low demand for electricity at CPP during winter months—due to relatively low chiller use—the plant would idle one of the two 5.7-megawatt units during

[36]The bid called for two 7.5-megawatt combustion turbines with a maximum steam capacity of 200,000 pounds per hour, which AOC stated represented phases one and two of its 2009 plan.

[37]The two boilers, installed in 1950, originally burned coal as their primary fuel, but have since been retrofitted and now burn primarily natural gas.

peak winter conditions. In the draft July 2014 partial update, AOC's consultant estimated the initial construction-related costs for the project at $56 million.[38]

Later, in December 2014, AOC provided GAO with a draft plan, along with consultant-generated supporting documents, that assessed a choice between a cogeneration system and a single natural gas-boiler.[39] Unlike the 2009 long-term plan and the consultant's draft July 2014 partial update, the December 2014 draft plan did not include updated long-term forecasts of demand for steam. Instead, the draft plan used one year of demand—calendar year 2013—as the basis for all future years. The December 2014 draft plan stated CPP needed to replace the steam-generating capacity of two of its oldest boilers, citing their age and increasing operations and maintenance costs and recommended that AOC install a natural gas cogeneration system with a single 7.5-megawatt combustion turbine providing a maximum steam capacity of 100,000 pounds per hour. AOC officials stated this would fulfill the first phase of its 2009 long-term energy plan. The December 2014 draft plan stated the electricity generated by the cogeneration system would power CPP's electric chillers and not serve the rest of the complex.

In contrast to the draft July 2014 update, the December 2014 draft plan stated that AOC would sell any excess electricity to the local utility. AOC officials said they expect to use up to 90 percent of the electricity generated by the proposed system to operate the plant's chillers, thereby avoiding paying for the electricity from the local utility and justifying the system's relatively large upfront investment (when compared to other alternatives). The agency plans to sell the excess 10 percent of electricity at rates to be determined by a future agreement with the local utility. AOC officials stated this could involve CPP's becoming a facility qualified to sell electricity to the grid under the Public Utility Regulatory Policies Act (PURPA) of 1978.[40] The officials said they used electricity rates for a qualified facility in the analysis supporting the December 2014 draft plan

[38]In its technical comments to our draft report, AOC stated the costs in the July 2014 partial update represented a benchmarking analysis and did not reflect an actual bid from a vendor.

[39]Both the cogeneration system and the natural gas boiler would be capable of also operating on fuel oil.

[40]Pub. L. No. 95-617, 92 Stat. 3117 (1978).

to use the most conservative approach. AOC officials said they are researching other arrangements for selling the excess electricity that could prove more economically favorable than as a qualified facility under PURPA.

Table 6 summarizes some of the key attributes of the recommended options in AOC's planning since 2009 for meeting future energy needs.

Table 6: Attributes of AOC's Plans for Meeting Future Energy Needs

Attribute noted in Architect of the Capitol plan	2009 *Strategic Long Term Energy Plan: Final Report*	2012-2013 Business Case Reviews and Bid [Note C]	July 2014 *Strategic Long Term Energy Plan Update: Draft Final Report*	December 2014 *Draft: Cogeneration at the Capitol Power Plant: Project Summary*
Scope and purpose of proposed cogeneration systems	One 7.5 MW combustion turbine, followed by 7.5 MW and 15 MW combustion turbines, as well as five natural gas boilers, installed over three phases over 20 years	Two 7.5 MW combustion turbines (representing the first and second phases of the 2009 plan)	Two 5.7 MW combustion turbines and two natural gas boilers, to be installed over 10 years	One 7.5 MW combustion turbine (representing the first phase of the 2009 plan)
Approximate construction cost (millions) [Note A]	$120.3	$117.0	$56.1	$57.0
Third-party financing costs (millions)	n/a	$69.4	$18.7 [Note D]	$24.3
Total project cost (millions) [Note B]	$120.3	$204.9	$74.8	$85.4
Peak steam- generating capacity of combustion turbines	320,000 pph	200,000 pph	124,000 pph	100,000 pph
Peak steam- generating capacity of new natural gas boilers	340,000 pph	n/a	190,000 pph	n/a
Provides power to the Capitol Power Plant	✓	✓	✓	✓
Provides power to Capitol Complex	✓			
Sells Excess Power to Electricity Grid	✓	✓		✓
Long-term steam demand forecasts	✓	Used 2009 forecast	✓	n/a

Source: GAO analysis of Architect of the Capitol's planning documents. | GAO-15-436.

Note A: Approximate construction costs are in nominal dollars.

Note B: In nominal dollars, the sum of approximate construction costs, third-party financing costs over the life of the utility energy services contract (if applicable), and future AOC project management costs if applicable. Excludes funds AOC has obligated to date. These costs do not represent the projects' expected life cycle costs.

Note C: Reflects two business case reviews AOC received in 2012 and a bid received in late 2013.

Note D: The draft July 2014 partial update did not include an estimate of expected financing costs, but AOC officials estimated financing costs would add approximately a third to the estimated construction cost.

AOC officials stated the cost estimates in the December 2014 draft plan reflected two independent cost estimates prepared by consultants and aligned with a bid received in November 2014 from the second vendor, a bid that was closer to the original project budget than the previous bid. AOC informed GAO in December 2014 that the agency desired to execute a contract with the vendor and proceed with construction of the cogeneration system—consisting of one 7.5 MW combustion turbine as described in its December 2014 draft plan. AOC officials said they continued to negotiate the scope of the project, a negotiation that resulted in, among other things, a reduction in the interest rate for financing the project.[41] In March 2015, GAO received updated calculations from AOC reflecting these changes. As of March 2015, AOC had obligated about $16 million on design, preliminary site work, and management of the project.

AOC Officials Said Appropriations Would Not Likely Be Available and Intend to Finance the Cogeneration Project

AOC intends to procure the cogeneration system using a utility energy services contract (UESC)—an agreement, similar to ESPCs described previously, in which, in this case, a utility arranges financing to cover the upfront costs of an energy project that a federal agency then repays over the contract term from energy cost savings achieved by the project. Under the UESC, AOC would pay for financing costs, such as interest payments to the utility, in addition to repaying the initial capital costs of the cogeneration project (i.e., construction and other upfront costs) over the contract period (AOC used an analysis period of two years for construction and up to a 25-year contract period). According to our analysis of AOC's updated data supporting its December 2014 draft plan, the agency would pay about $28 million more in nominal costs under the UESC than if the agency acquired the system using upfront appropriated

[41]In its technical comments, AOC stated that the interest rate for the proposed utility energy services contract is subject to change until the contract is awarded and is a significant driver of the project's expected costs.

funds: $16 million more in initial construction costs, due to additional UESC vendor overhead costs, and $12 million more in financing costs over the life of the contract.[42] Under a typical UESC, repayments to the utility reflect the estimated cost savings from the project's energy efficiency measures. However, under a UESC like AOC has proposed where the utility guarantees performance and not savings, the utility does not guarantee that the project will generate sufficient savings to pay for itself over time.

Acquiring the system using an upfront appropriation would cost less than using a third party to finance the project over the proposed 27-year analysis period. However, AOC officials said that since upfront appropriations would likely not be available to procure the cogeneration system, they had decided to pursue the project using a UESC. Because AOC planned to conduct the project without upfront appropriated funds, AOC officials stated they had not assessed the proposed cogeneration project using the agency's capital-planning prioritization process, by which the agency ranks proposed capital projects and recommends those projects scoring the highest for funding through annual appropriations. As a result, AOC did not analyze the project and its merits relative to other projects using the agency's pre-determined criteria for capital planning. AOC officials stated that the aforementioned ESPC projects did not go through the agency's capital planning prioritization process for the same reason.

AOC intends to use a UESC under an arrangement established by the General Services Administration (GSA) that could help facilitate the transaction but narrows the number of entities AOC can engage to complete the project.[43] Through its UESC arrangement, GSA has established basic contract terms with select utility companies, and agencies using this arrangement contract with one of these providers.

[42]The additional $12 million in financing costs over the life of the proposed contract reflects the difference between the $24 million in financing costs that AOC will owe to the UESC vendor, in nominal dollars, and the federal government's cost of funds, based on April 2015 Treasury note rate of about 2.3 percent. This does not reflect the impact of UESC financing on the project's projected savings relative to a status quo alternative, which AOC estimated when analyzing life cycle costs—which we discuss below.

[43]While 42 U.S.C. § 8256 provides executive branch agencies, but not legislative branch agencies such as AOC, the authority to enter into UESCs, under 40 U.S.C. § 113(d), GSA services are to be made available to AOC upon request.

GSA has contracts with two providers in the Washington, D.C., area. While the selection of a UESC vendor is limited to two vendors, AOC officials said that this will not preclude competition as the selected UESC vendor will obtain competitive bids from subcontractors for the construction of the cogeneration system.

Based on independent estimates and in alignment with the bid received in November 2014, AOC's latest data show that a cogeneration system consisting of a 7.5 MW combustion turbine and funded by a UESC would have a total project cost of about $85 million. This includes about $57 million in initial construction-related costs (including contingency funds), another $4 million in agency project management costs, and about $24 million in financing costs.[44]

AOC's data show the project's life cycle costs as lower than other alternatives, such as a natural gas boiler procured using upfront appropriations. These data also show that the cogeneration system procured using a UESC, AOC's intended course of action, would result in savings, when compared to a status quo option, of about $7.3 million over 27 years (in today's dollars) due to the savings achieved by producing its own electricity for the plant.[45] AOC's data show that the project would repay the UESC vendor in full for the capital and financing costs in 21 years (after the completion of construction and once payments had begun). By comparison, AOC's data show that a cogeneration system procured with upfront appropriations would achieve savings in today's dollars of $21.4 million over the analysis period when compared to the status quo option. Further, AOC's data show a natural gas boiler procured with upfront appropriations for $9.3 million would achieve savings of about $2.7 million over the analysis period when compared to the status quo option.

AOC's calculations on life cycle costs did not reflect the nearly $16 million in funds already obligated for the project. AOC officials said they relied on the National Institute of Standards and Technology (NIST) handbook on life cycle costing for federal energy management programs. AOC officials

[44]The total project cost excludes the nearly $16 million AOC has already obligated for the project.

[45]AOC's analysis covers 27 years, which includes 2 years of construction and up to a 25-year UESC contract period.

noted the handbook instructs federal agencies to not include sunk costs when estimating a project's life cycle costs.[46] Our analysis of AOC's data suggest that the agency could have procured a natural gas boiler providing the same amount of steam for less than the $16 million the agency has already obligated for the cogeneration project. AOC's data show a cost of about $9.3 million for procuring such a boiler. AOC officials said they would have had to also obligate funds to prepare the plant for a new boiler, but they did not identify the amount of funds this would have required.

AOC Did Not Follow Key Leading Federal Capital-Planning Practices

Key leading capital-planning practices and other federal guidance we identified state that agencies should, among other things, (1) update their plans in response to changes in their operating environment; (2) fully assess their needs and identify performance gaps; (3) assess a wide range of potential approaches—including non-capital approaches—for meeting those needs; (4) conduct valid sensitivity and uncertainty analyses to identify and quantify the riskiest cost drivers of proposed projects; and (5) engage independent experts when tackling complex issues.[47] However, AOC's planning that led the agency to pursue a cogeneration system did not follow these key leading practices.

AOC Did Not Update Its Long-term Plan in Response to Changes in Key Assumptions

Leading organizations generally revise their decision-making process in response to a perception of changing needs or a changing environment. However, AOC did not update its 2009 long-term energy plan until late 2014, did so only partially, and has continued to use the 2009 plan to justify its decision to procure a cogeneration system. In the meantime, major changes have occurred in key assumptions affecting AOC's plans, such as the price of natural gas and the complex's demand for steam and chilled water. For example, in part due to increased supplies resulting from the boom in domestic shale gas extraction, prices for natural gas for commercial customers fell by about 20 percent between 2009 and 2012 (when AOC formally proposed the cogeneration project). Furthermore, since publishing its 2009 long-term plan, AOC completed energy audits of its buildings and implemented several energy conservation measures in the complex and reduced the complex's demand for steam and chilled water.

[46]NIST handbook 135.

[47]GAO/AIMD-99-32, GAO-09-3SP, OMB *Capital Programming Guide*, and NIST handbook 135.

Despite these changes, AOC officials stated they did not believe it was necessary to fully update its 2009 long-term plan to implement the cogeneration system, which they consider to be a single energy conservation measure that addresses a need to replace aging boilers. The officials stated they updated the factors that changed since 2009 that could affect the choice between cogeneration and a natural gas boiler. AOC officials also told us they recognized the importance of fully updating the agency's long-term energy plan and stated they plan to do so later in fiscal year 2015 after they have made a decision on implementing the proposed cogeneration system. However, by not fully updating its 2009 long-term plan, AOC has continued to pursue a cogeneration system without up-to-date information on a variety of factors, such as the changes in the natural gas markets and the realized impacts of AOC's demand reduction efforts, that could change the relative merits of the full range of alternatives available to AOC for meeting its long-term needs.

Select operators of other district energy system we spoke with stated they regularly conduct planning efforts to identify the needs of their systems, and alternatives to address them. For example, one operator said that although it prepares a strategic plan every 5 years, the operator also updates demand forecasts and conducts other planning as part of its annual budgeting process.

AOC Did Not Fully Assess Needs or Describe a Performance Gap It Intends to Address with Cogeneration

AOC did not fully assess its long-term steam needs or identify the performance gap the cogeneration project would address. Leading practices and federal guidance, including the Office of Management and Budget's (OMB's) *Supplement to OMB Circular A-11* and GAO's *Leading Practices in Capital Decision-Making*, state that agencies should comprehensively assess what they need to meet their goals and objectives, identify any gaps between current and needed capabilities (i.e., performance gaps), and explain how a capital project helps the agency address those gaps and meet its goals. However, AOC's December 2014 draft plan—which the agency has used to justify the current cogeneration project—has not comprehensively assessed the agency's needs or identified potential performance gaps. Without fully assessing its needs, the agency risks committing to a project that does not fully meet its long-term needs and thereby does not provide the agency with the most efficient use of its funds.

Specifically, AOC's December 2014 draft plan did not forecast the future demand for CPP's heating and cooling services and instead assumed 2013 levels of demand would continue over the 27-year contract for the cogeneration system.[48] The agency's 2009 long-term plan included long-term forecasts of steam and chilled water demand showing that future demand for steam would exceed current capabilities. However, the forecast for the 2009 long-term plan is outdated as it does not reflect the realized effects of AOC's demand management efforts. AOC included long-term forecasts of steam and chilled water demand in its draft July 2014 partial update, but AOC did not finalize it. In addition, the demand forecasts in the 2009 long-term plan and its draft July 2014 partial update may have overstated future needs as they did not fully consider the impact of AOC's completed and ongoing energy conservation measures and only included factors that would increase overall demand for steam.

AOC's 2009 long-term plan and draft July 2014 partial update assumed demand for steam and chilled water would increase due to future building renovations that would either increase the amount of building space served by CPP or increase the amount of outside air it heats or cools and circulates through buildings. In the 2009 long-term plan, AOC assumed energy reduction efforts would offset these increases. As described above, AOC's chilled water use has fallen since that time and its steam use has fluctuated. The draft July 2014 partial update specifically states that it did not consider reductions in energy use.

The absence of steam demand forecasts in the December 2014 draft plan (1) disregards prior forecasts that are either outdated or were not finalized, (2) ignores the possibility of future changes in demand, and (3) raises questions about the purpose and sizing of the proposed cogeneration system and how it will meet future needs. In explaining why it did not forecast long-term demand for the CPP's services, AOC officials said new steam-generating capacity was needed—regardless of potential changes in the long-term demand for steam—to decrease the plant's reliance on two of its older boilers at the end of their service life. AOC's December 2014 draft plan stated that doing so would thereby allow AOC to avoid the increased maintenance costs associated with operating the

[48]AOC officials stated, per the analysis supporting its December 2014 draft plan, that the cogeneration system will achieve net savings sufficient to pay off the principal and financing costs of the UESC contract 21 years after construction is completed—four years prior to expiration of the 27-year contract.

boilers infrequently. AOC officials stated that the December 2014 draft plan was intended to compare installing one natural gas boiler with installing one cogeneration system and re-validate the 2009 long-term plan's recommendation, rather than re-evaluate all long-term technical options for meeting steam demand—thereby making it inappropriate to include a long-term forecast of demand. Furthermore, the AOC officials stated that expected future demand that reflects reductions due to AOC's conservation measures would not reduce demand to anywhere near the point where a boiler replacement is not needed. However, AOC's December 2014 draft plan that it is using to justify the need and scope of the cogeneration project does not include any such forecasts to support these statements.

AOC officials stated the two coal boilers needing replacement are nearly 60 years old and are showing signs of wear.[49] The officials stated the boilers still operate but are unreliable and suffer frequent breakdowns requiring emergency repairs. However, AOC has not provided documents that support these statements. AOC estimated that renovating the boilers, including the addition of currently lacking air-pollution controls, could cost up to $10 million per boiler. However, reports on the condition of the boilers provided by AOC, as well as the agency's aforementioned planning documents, did not estimate the expected remaining life of the boilers—thereby not assessing whether a performance gap exists and making it unclear how the cogeneration system will meet any long-term needs.

Furthermore, AOC's December 2014 draft plan did not make clear to what extent the proposed system would help AOC avoid the increased maintenance costs associated with continued operation and maintenance of the two older boilers which can operate on coal. AOC officials said in February 2015 that once it had installed the cogeneration system, CPP would keep at least one of the two boilers in reserve to meet peak steam demand. The officials added that the cogeneration system would allow

[49]AOC officials said the signs of wear include bag house corrosion, antique control systems, boiler tube leaks, flame scanner failures, ductwork leaks, and coal scale failures.

CPP to operate these older boilers on natural gas instead of coal.[50] However, later in its technical comments, AOC noted that CPP would maintain only one of the older boilers for occasional use (decommissioning the other once the cogeneration system is operational). Therefore, AOC will continue to incur maintenance costs associated with continued use of at least one of the two older boilers.

AOC's December 2014 draft plan stated the proposed cogeneration system would enhance the agency's ability to meet its environmental objectives but stated the system is not needed to meet current EPA emissions standards for hazardous air pollutants.[51] The plan stated CPP can meet promulgated rules limiting emissions of hazardous air pollutants (HAP) from industrial, commercial, and institutional boilers without installing the cogeneration system.[52]

Although the cogeneration system would likely increase emissions of certain air pollutants from CPP due to the increased use of natural gas, AOC's draft plan estimated the system would result in lower regional emissions overall. The electricity generated by the cogeneration system using natural gas would result in relatively fewer emissions than the equivalent amount of electricity purchased from the local utility, which delivers electricity produced predominantly from coal. The December 2014 draft plan states a cogeneration system would result in 14 fewer metric tons of regional HAPs annually, or 18 percent less than a new natural gas boiler providing the same amount of steam. AOC's draft plan estimates that the cogeneration system will result in lower regional greenhouse gas emissions, although federal regulations for limiting such emissions have not yet taken effect. AOC's December 2014 draft plan

[50]The proposed cogeneration system could provide a maximum steam-generating capacity of 100,000 pounds per hour, which is equivalent to the combined maximum steam-generating capacity of the two older boilers—when operating on natural gas—AOC intends to replace. Currently, CPP cannot meet peak demand when operating the two boilers on natural gas, thereby requiring AOC to occasionally operate the two boilers using coal—which increases the output of the boilers—to provide the extra needed steam.

[51]In its technical comments, AOC stated continued significant investments in the older boilers could trigger additional emissions requirements that would necessitate installing costly emissions controls.

[52]Hazardous air pollutants, also known as toxic air pollutants, are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects.

stated a cogeneration system would result in about 15,000 fewer metric tons of regional carbon dioxide emissions per year—7 percent less than a new natural gas-powered boiler, an amount that AOC stated is the equivalent of removing nearly 3,200 vehicles from local roadways each year.

Furthermore, the December 2014 draft plan stated meeting the agency's energy reduction goals did not depend on the cogeneration project. In the plan, AOC stated that "due in large part to the results achieved through the ESPCs and other energy reduction activities, AOC will not require cogeneration to meet the EISA or EPAct requirements at this time."[53] However, AOC officials said that if Congress renews EISA or EPAct and additional annual energy reduction goals are set for federal agencies, cogeneration may again become key in future AOC energy reduction efforts.

AOC Did Not Identify and Evaluate a Range of Alternatives for Meeting Heating Needs

AOC's plans have only considered capital options for meeting its heating needs, and its December 2014 draft plan did not evaluate a range of alternatives. Federal leading planning practices state that capital plans should consider a wide range of alternatives for meeting agency needs, including non-capital alternatives, and evaluate them based on established criteria. GAO's *Executive Guide: Leading Practices in Capital Decision-Making* states that managers and decision-makers in successful organizations consider alternatives to investing in new capital projects. Without considering a wide range of options, including non-capital options, AOC may choose a more expensive alternative for meeting its needs.

Specifically, AOC's 2009 plan broadly considered capital alternatives for meeting long-term demand for steam, such as nuclear or geothermal power generation, but did not assess non-capital alternatives for meeting the agency's objectives, such as implementing operational changes or conservation measures to decrease consumption in the buildings served by CPP. GAO's capital decision-making guide calls for managers to consider non-capital approaches among the alternatives for meeting an agency need, but AOC's plan did not explicitly examine such options. As

[53]Energy Independence and Security Act of 2007 (EISA); Energy Policy Act of 2005 (EPAct).

a result, AOC may not have identified the most cost-effective means to heat and cool the complex.

As we noted earlier, AOC's 2014 planning documents assessed a narrower range of capital alternatives—adding a cogeneration system or new natural-gas powered boilers—to meet the demand for steam. AOC's 2014 plans also envision smaller cogeneration systems that represent a significantly reduced scope from the 2009 plan, which recommended the installation of three turbines in phases to provide power to the entire complex. For example, the December 2014 draft plan recommends a single turbine system that provides electricity to CPP and not the complex

The 2014 plans also did not fully take into account AOC's efforts to reduce the demand for steam through conservation measures in the buildings served by CPP–which may include operational changes or smaller capital investments–on future steam demand. As described above, AOC has installed some conservation measures in the Capitol and House and Senate office buildings and has identified many additional measures that it could implement in the future. The July 2014 plan ignores energy savings from these measures, while the December plan used demand data from 2013 without adjustments for measures implemented since then or in the future.

AOC officials stated its latest plan was not meant to fully update the 2009 plan and thereby assess a broad range of alternatives for meeting the agency's needs. AOC officials stated that the 2014 plan was for replacing current equipment and is consistent with implementing the first phase of the 2009 plan. AOC officials stated they did not believe it was necessary to fully update the 2009 plan to implement a single energy conservation measure that replaces aging boilers—the cogeneration system. AOC officials added that they intend in fiscal year 2015 to fully update the 2009 long-term plan, after the agency has made a decision on implementing the proposed cogeneration project.

By only considering a narrow range of alternatives, not accounting for the agency's ongoing efforts to reduce its steam demand, or fully updating the long-term plan before undertaking a costly and risky project, AOC may be selecting a capital alternative that is not scaled to meet the agency's long-term needs and therefore could cost more than necessary.

AOC Did Not Perform Valid Sensitivity or Uncertainty Analyses

AOC did not perform valid sensitivity or uncertainty analyses when assessing the cogeneration system and available alternatives for meeting the agency's long-term demand for steam. The GAO *Cost Estimating Guide* calls for agencies, when considering capital projects, to conduct both sensitivity and uncertainty analyses to identify and quantify the cost drivers that pose the most risk of increasing project costs beyond expectations. Sensitivity analysis shows how changes in a key assumption affect the expected cost of a program or project, while holding all other assumptions constant. Uncertainty analysis captures the cumulative effect of various risks on the expected cost of a project by changing many assumptions at the same time. Such information can inform managers about whether their preferred choice remains superior among a group of alternatives.

In the case of the proposed cogeneration project, the absence of valid sensitivity and uncertainty analyses makes it unclear whether the project will generate sufficient savings to cover its costs under a range of future conditions—raising questions on whether the project is more cost-effective than other alternatives. Furthermore, should AOC's projections about the project's expected savings prove inaccurate, Congress would likely need to appropriate more funds to cover a portion of AOC's costs to own and operate the system—including the financing costs to be paid to the UESC vendor.

Specifically, in its December 2014 draft plan, AOC did not vary a key cost driver when it performed a sensitivity analysis on the expected life cycle costs of the alternatives it considered. When conducting sensitivity analyses, the *Cost Estimating Guide* calls for agencies to vary the key cost drivers of a project's life cycle costs, particularly those that are most likely to change over time. The expected life cycle costs of operating either a cogeneration system or a natural gas boiler depends, in part, on the demand for heating and cooling over time. However, as noted above, AOC did not vary demand for heating and cooling in its December 2014 draft plan and instead assumed 2013 levels throughout the forecast period.

The *Cost Estimating Guide* also states that valid sensitivity analyses vary assumptions about key cost drivers in ways that are well-documented, traceable, and based on historical data or another valid basis. However, neither AOC nor a laboratory it engaged presented rationales for their variations of forecasted natural gas and electricity prices from the expected case. In its December 2014 draft plan, AOC varied its

assumptions by applying a subjective 25 percent change over the 27-year forecast period. The plan provided no rationale for using 25 percent.

In a separate analysis accompanying the December 2014 draft plan, a Department of Energy (DOE) laboratory engaged by AOC presented results of a sensitivity analysis assessing the impact of varying natural gas and electricity prices that varied their initial values.[54] The analysis varied the starting values of both natural gas and electricity prices in a range based on the author's professional judgment rather than empirical evidence. Furthermore, the analysis did not assess the impact of varying natural gas and electricity prices on the alternatives AOC considered. The *Cost Estimating Guide* states sensitivity analyses should test the sensitivity of the ranking of considered alternatives to changes in key assumptions. However, the analysis did not assess the potential impact of varying natural gas and electricity prices on the other considered alternative in AOC's analysis—a natural gas boiler. AOC officials stated the laboratory is an acknowledged expert charged with administration of the federal government's energy management program.

Furthermore, in its December 2014 draft plan AOC relied on DOE forecasts of natural gas and electricity prices in its expected case, but AOC did not use DOE forecasts in its sensitivity analysis. Instead, the agency chose to vary the prices by 25 percent as discussed above. Using AOC's 25 percent adjustment, instead of available DOE forecasts, to vary future natural gas and electricity prices raises questions about whether the project remains superior to other options under a range of possible outcomes.

Specifically, in the Energy Information Agency's *Annual Energy Outlook 2014*, DOE created numerous forecasts of natural gas and electricity prices to represent a range of possible future scenarios.[55] When using several of these DOE forecasts, we found the expected savings of the proposed cogeneration project, when compared to other alternatives, changed significantly. Specifically, in AOC's expected case the project

[54]AOC engaged the Department of Energy's National Renewable Energy Laboratory (NREL) to perform a third-party review of AOC's analysis, which included the sensitivity analysis discussed above.

[55]Department of Energy, U.S. Energy Information Administration, *Annual Energy Outlook 2014* (Washington, D.C.: May 7, 2014).

financed using a UESC saves about $4.6 million more over the 27-year period than a boiler acquired with upfront appropriations.[56] Using a DOE scenario where natural gas is more plentiful and prices are lower than in the expected case, however, the cogeneration project becomes less advantageous—saving $1.9 million more than a boiler. Conversely, using a DOE forecast where natural gas is relatively less available and prices are higher over time, the savings of the cogeneration project increases slightly to $5.0 million more than a boiler.

In addition to a sensitivity analysis, the *Cost Estimating Guide* calls for agencies to perform an uncertainty analysis to capture the cumulative effect of various risks on the expected cost of a project. In an uncertainty analysis, project costs should involve a range of possible costs based on a specified probability, known as a confidence interval. Unlike sensitivity analysis, an uncertainty analysis looks at the effects of changing many assumptions at the same time. This involves, among other things, identifying key project cost drivers, modeling various types of uncertainty associated with the cost drivers, and using a simulation method, known as a Monte Carlo analysis.[57]

AOC performed an uncertainty analysis on the expected initial construction cost of the project, but did not perform a similar analysis for the life cycle costs of the options it considered. AOC developed an uncertainty analysis on the cogeneration project's initial construction cost using a Monte Carlo simulation, and agency officials stated this helped them assess the risks that could cause the initial cost of constructing the cogeneration system to exceed the expected level. AOC officials also stated the analysis allowed them to calculate a confidence interval around the expected initial construction cost and therefore budget an appropriate amount of contingency funds. However, AOC did not present its estimates of the project's savings, derived from its life cycle cost analysis, as a range of possible costs based on a specified probability. Instead, AOC presented a point estimate of the project's life cycle cost without a confidence interval quantifying the degree of uncertainty.

[56]To calculate savings, AOC compared the life cycle costs of considered alternatives with a status quo scenario, discounted to today's dollars using net present value.

[57]Monte Carlo analysis is a commonly used simulation method.

AOC officials said they did not believe an uncertainty analysis was required, based on their understanding of NIST's handbook on life cycle costs that states uncertainty assessment is more complex and time consuming than sensitivity analysis and therefore the decision for doing so depends on an agency's judgement of a variety factors, including the relative size of the project, availability of data, and availability of resources such as time, money, and expertise. However, the estimated life cycle cost of the project is determined, in part, on the forecasted prices for key inputs like natural gas and electricity that have historically been highly variable. Without a credible uncertainty analysis, AOC has not presented information on which cost drivers pose the most risk to the project's life cycle cost.

AOC Did Not Use an Independent Panel to Review a Full Update of a Long-term Energy Plan

In addition to the capital planning guidance we cite above, our prior work recommends that federal agencies use independent panels of experts for conducting comprehensive, objective reviews of complex issues, such as those facing AOC.[58] As mentioned above, AOC engaged the National Academies' National Research Council (NRC) to review a draft of its 2009 long-term energy plan and the final version of the 2009 plan stated that it addressed NRC's recommendations. However, unlike its 2009 plan, AOC has not engaged an independent panel like the NRC to review the subsequent iterations of its planning. AOC officials stated that they did not find it necessary to fully update its long-term plan before executing the contract for the cogeneration system, which the officials stated is a single energy conservation measure intended to replace aging boilers. However, the cogeneration system is relatively complex when compared to available alternatives such as boiler replacement and AOC has obligated about $16 million in design, preliminary site work, and management for the project—an amount that AOC's data suggests could have procured a new natural gas boiler providing the same amount of steam. Using an independent panel to review AOC's planning could have provided more assurance that AOC was positioning itself to cost-effectively meet its long-term energy needs.

[58]GAO, *Aviation Security: Efforts to Validate TSA's Passenger Screening Behavior Detection Program Underway, but Opportunities Exist to Strengthen Validation and Address Operational Challenges*, GAO-10-763 (Washington, D.C.: May 20, 2010).

AOC Was Unaware of Relevant Leading Practices and Did Not Support Claims on the Need to Quickly Execute Cogeneration Contract

Since issuing its long-term energy plan in 2009, AOC has pursued an iterative planning approach without fully updating the long-term plan or following key leading practices. AOC officials said they were generally unaware of the applicability of the leading practices we cited. AOC officials said they instead relied on other sources of federal guidance, such as NIST's handbook on determining the life cycle costs of energy conservation projects or DOE's guidance for using UESCs to finance such projects, an approach that led them to believe that it was unnecessary to fully update the long-term energy plan before executing a contract for the cogeneration project since its intent is to replace aging boilers.[59] However, the guidance AOC cited generally applies after an agency has conducted a needs assessment and conducted a capital-planning process using GAO, OMB, and other relevant guidance cited above. Thus, the guidance AOC officials said they followed does not substitute for first completing an up-to-date capital plan. Without following key leading capital practices, AOC's planning could commit the agency to a project that does not fully and cost-effectively meet its needs—thereby not providing taxpayers or Congress with the most efficient use of funds in a time when the federal government faces significant financial challenges.

In August 2014, we discussed with AOC shortcomings in its planning for the cogeneration project relative to leading practices and referred the agency to documents outlining these practices. AOC officials then provided the aforementioned set of planning documents in December 2014 that the agency stated were intended to address our concerns.[60] AOC officials also provided several reasons why they needed to continue planning the project and quickly execute a contract. These included (1) that certain existing boilers were near the end of their useful life and that AOC might face challenges meeting demand for steam in the near future, and (2) that AOC needed to start construction soon or the Washington, D.C. government would retract the project's construction and air quality permits.

[59]NIST handbook 135; Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, *Utility Energy Services Contracts: Enabling Documents* (Washington, D.C.: June 2013).

[60]The documents included AOC's Project Summary, an analysis by NREL, a consultant's independent cost estimate for construction costs, and a consultant's risk and uncertainty analysis on construction costs.

Our review did not identify valid support for these claims. Reports on the condition of the boilers provided by AOC did not identify the remaining useful life of the two boilers in question. Additionally, AOC did not provide documents supporting its statement that the permits for the project were at risk; AOC officials told us they believed the planning steps the agency had taken would be sufficient to keep the permits in effect.

Conclusions

AOC has implemented many measures to manage the costs of heating and cooling the Capitol Complex and has achieved measurable results. The agency has additional opportunities to manage these costs through conservation. AOC and its contractors have identified hundreds of additional energy conservation measures, and the agency intends to act on some of them when resources become available.

Related to this, AOC's planning to evaluate the relative merits of the currently proposed cogeneration project has not followed key leading practices identified in OMB, GAO, and other relevant capital-planning guidance. These include not (1) fully updating the agency's 2009 long-term energy plan to reflect changes in energy costs and demand that occurred since the plan was issued; (2) fully assessing long-term energy needs or the performance gap the project would address in light of changes in key variables that could affect its relative merits; (3) identifying a full range of alternatives for meeting future needs, including non-capital or conservation measures; (4) conducting valid sensitivity or uncertainty analyses; or (5) engaging an independent panel of experts to review AOC's updates of its long-term plan. AOC officials said they were unaware of some of these leading practices and therefore did not follow them. AOC's planning was insufficient for us to discern whether the cogeneration project would generate enough savings to cover its costs or prove more cost-effective than other options for meeting the agency's needs. Thus, without addressing the shortcomings listed above, AOC's planning does not provide confidence that the proposed project will decrease the need for future energy-related appropriations.

Recommendations for Agency Action

GAO is making two recommendations to the Architect of the Capitol.

We recommend that the Architect of the Capitol, prior to undertaking future major capital projects related to its energy needs, fully update its long-term energy plan while following key leading capital-planning practices. As part of this effort, the agency should:

- fully assess the complex's long-term needs and identify any performance gaps, while taking into account the effects of possible changes in demand—including the impacts of ongoing and planned energy conservation measures and other factors that could affect the demand for CPP's services;

- identify and evaluate a range of alternatives for how to best meet the agency's needs, including non-capital options and energy conservation measures that could reduce the demand for CPP's services; and

- identify key assumptions and risks of the alternatives considered and perform valid sensitivity and uncertainty analyses to determine which alternatives could prove the most cost-effective under a range of potential future conditions.

As AOC updates its long-term energy plan, the Architect should seek a review of the plan by an independent panel of experts to ensure it follows key leading practices and provide the results of the review to Congress.

Agency Comments and Our Evaluation

We provided a draft of this report to the AOC for review and comment. In its written comments, included as appendix II, the Architect disagreed with our findings, conclusions, and recommendations. However, AOC also said that the agency has effectively implemented our recommendations in a "manner sufficient to move forward with the planned cogeneration project." As we discuss below, AOC provided two new reports focusing on the need to replace its oldest boilers and potential risks and costs associated with the proposed cogeneration project. We did not review these reports because AOC did not provide them or make us aware of them until after we had completed our work. We plan to review these studies in the future and discuss them with Congress. While these reports may expand on the justification for the cogeneration project, we continue to believe that AOC should first update its overall long-term strategic energy plan and evaluate a full range of alternatives for best meeting its needs prior to undertaking major energy projects in the future. We also acknowledge that AOC may need to replace certain steam-generating equipment, in part or in whole, at some point in the future. AOC also provided technical comments, which we addressed as appropriate in the report.

In its written comments, AOC stated that contrary to our recommendations and assertions in the draft report, AOC adhered to key

leading capital-planning practices based on its 2009 long-term energy plan, 2014 revalidation efforts, and additional documentation. AOC's written comments contradict statements by AOC officials in April 2015 that they were not aware of the key leading capital-planning practices cited in our draft report. At that time, these officials said that AOC instead followed NIST guidance on performing life-cycle cost analyses for energy conservation projects and DOE guidance for financing energy projects using non-appropriated funds. Furthermore, the agency did not provide evidence that contradicted our finding about it not adhering to these practices during our review. We therefore maintain that we reached the correct conclusion about AOC's adherence to key leading capital-planning practices.

As part of our first recommendation, we said that AOC should fully assess the complex's long-term needs and identify any performance gaps. As part of its written comments, AOC provided additional documentation that the agency said fully explains how the agency has already assessed these needs through preparing a justification for replacing the complex's aging boilers. The documentation expands on its efforts to support the proposed cogeneration project, including a report on the condition of two of its oldest boilers and an updated sensitivity analysis comparing the long-term benefits of installing new boilers or a cogeneration system. We did not assess the validity of these documents because AOC did not provide them or make us aware of them until after we had sent the draft report for comment. Moreover, AOC did not use this information as part of the basis for selecting the current planned cogeneration project. We maintain that AOC should conduct such an analysis prior to making a decision about energy projects, rather than as part of efforts to validate decisions made in 2009 and 2014.

Another part of our first recommendation said that AOC should identify and evaluate a range of alternatives for how to best meet the agency's needs, and identify key assumptions and risks of the alternatives. Regarding identifying and evaluating a range of alternatives, including non-capital options and energy conservation measures, AOC said that it did so in 2009 and selected cogeneration to replace the aging boilers. AOC added that it updated key assumptions used in the 2009 plan in 2014 and further evaluated the two technically feasible options—natural gas boilers and cogeneration—in extensive detail, which AOC stated validated that cogeneration remained the best option. We agree that the 2009 long-term energy plan broadly considered a range of alternatives for meeting the agency's long-term energy needs, but the analysis conducted in 2014 focused solely on two options. From 2009 to the present, many

factors have changed that could potentially lead AOC to reach a different, more cost-effective solution to meet any future performance gaps. For example, the costs of fuels, electricity, and labor have changed since 2009. In addition, the demand for AOC's services has changed as the agency has pursued conservation and other energy-saving efforts. We therefore continue to believe that AOC should fully update its long-term energy plan, taking into account changes in key variables and the full range of options for how best to meet the agency's needs, including non-capital options and energy conservation measures.

The last part of our first recommendation said that AOC should identify key assumptions and risks and perform valid sensitivity and uncertainty analyses to identify cost-effective alternatives under a range of future scenarios. In its written comments, AOC said that it identified key assumptions and risks and subsequently performed valid sensitivity and uncertainty analyses. The Department of Energy's National Renewable Energy Laboratory (NREL), as a third-party reviewer of the cogeneration validation effort, conducted a deterministic sensitivity analysis of the cogeneration project's life-cycle cost, and AOC performed its own sensitivity analysis in its December 2014 draft plan. Our report identified shortcomings of these analyses, raising questions about their usefulness in identifying a cost-effective alternative. AOC also used a different third party to perform a probabilistic risk assessment of the project's construction cost, which we acknowledged in our report. In addition, AOC said the agency also used another third party to complete an additional probabilistic risk assessment of the project's life-cycle cost in May 2015. We did not assess the validity of this analysis because AOC did not provide it to us until after we had sent the draft report for comment. While AOC has conducted some sensitivity and uncertainty analyses, it did so to support a decision made in 2009, rather than to evaluate alternatives in the context of a full update of its long-term energy plan. We, therefore, continue to believe that AOC should fully update its long-term energy plan and follow leading practices for analyzing alternatives in that context.

Our second recommendation states that, as AOC updates its long-term energy plan, the Architect should seek an independent review of the plan by an expert panel to ensure it follows key leading practices and provide the results of the review to Congress. In its written comments, AOC stated that it had engaged an outside entity to review AOC's 2014 effort to validate its choice to pursue a cogeneration project. However, a review of a partial update to a 2009 plan does not address our recommendation that AOC fully update its long-term energy plan and then seek outside review by an independent panel of experts, as it did in 2009.

AOC's written comments included additional details about its disagreement with our findings, conclusions, and recommendations, which we address in appendix II.

We are sending copies of this report to the appropriate congressional committees, the Architect of the Capitol, and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact Frank Rusco at (202) 512-3841 or ruscof@gao.gov or Lori Rectanus at (202) 512-2834 or rectanusl@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributors to this report are listed in appendix III.

Frank Rusco
Director, Natural Resources and Environment

Lori Rectanus
Director, Physical Infrastructure

List of Committees

The Honorable Thad Cochran
Chairman
The Honorable Barbara A. Mikulski
Vice Chairwoman
Committee on Appropriations
United States Senate

The Honorable Shelley Moore Capito
Chairman
The Honorable Brian Schatz
Ranking Member
Subcommittee on the Legislative Branch
Committee on Appropriations
United States Senate

The Honorable Harold Rogers
Chairman
The Honorable Nita M. Lowey
Ranking Member
Committee on Appropriations
House of Representatives

The Honorable Tom Graves
Chairman
The Honorable Debbie Wasserman Schultz
Ranking Member
Subcommittee on the Legislative Branch
Committee on Appropriations
House of Representatives

Appendix I: Objectives, Scope, and Methodology

Our work for this report focused on the Architect of the Capitol's (AOC) Capitol Power Plant (CPP) and actions taken by AOC to manage the costs of providing heating and cooling services to the complex. In particular, this report examines: (1) measures AOC implemented since GAO's 2008 report to manage the energy-related costs of the buildings served by CPP and opportunities, if any, to further manage these costs, and (2) how AOC decided to procure a cogeneration system and the extent to which AOC followed leading capital-planning practices.

To identify measures AOC has implemented since 2008 to manage energy-related costs, we examined AOC and CPP appropriations, obligations, and expenditures data from 2009 to 2013 to identify the costs incurred by AOC related to production, distribution, and consumption of heating, cooling, and electricity by the complex. We assessed the reliability of these data—for example, by reviewing related documentation and interviewing knowledgeable AOC budget and finance officials—and found them sufficiently reliable for our reporting purposes. We also reviewed relevant AOC reports and documents, and interviewed AOC and CPP officials.

To identify measures AOC could potentially implement to further manage its energy-related costs, we reviewed AOC reports and other documents, such as energy audits of CPP's steam and chilled water systems. We assessed the reliability of the data in these audits by reviewing related documentation and interviewing knowledgeable AOC officials and found these data sufficiently reliable for our reporting purposes. We also interviewed eight operators of other district energy systems to learn about measures they have implemented to manage costs, as well as the benefits and costs associated with those measures. We identified these operators based on, among other things, our preliminary research; interviews with CPP staff and managers of other district energy systems; we selected the operators based on similarities to the CPP, such as whether the operators were located in climates similar to Washington, D.C. We selected eight operators: five in the Washington, D.C., area and three in the Boston, Massachusetts, area. Four of the operators are public entities and the remaining four are private, two of which are private universities (see table 7). The information collected during these interviews cannot be generalized to all district heating or cooling systems.

Table 7: District Energy Systems GAO Interviewed

Geographic area	District energy system	Type of entity
Boston, MA	Hanscom Air Force Base	Public
Boston, MA	Harvard University	Private (University)
Boston, MA	Veolia Energy	Private
Washington, DC	American University	Private (University)
Washington, DC	U.S. Department of Defense—Pentagon	Public
Washington, DC	U.S. Food and Drug Administration—White Oak	Public
Washington, DC	U.S. General Services Administration—Central Heating and Refrigeration Plant	Public
Washington, DC (Baltimore)	Veolia Energy	Private

Source: GAO. | GAO-15-436

To review AOC's planning effort to further manage its energy-related costs, we reviewed AOC's planning documents and recent updates, including (1) AOC's 2009 Strategic Long-Term Energy Plan, (2) AOC's draft Strategic Long-Term Energy Plan released in the summer of 2014, and (3) AOC's draft Cogeneration at Capitol Power Plant Project Summary and accompanying consultant reports issued in December 2014. We identified four sources of federal guidance on capital planning and alternatives analysis and compared the guidance in those documents to AOC's planning documents.[61] We also interviewed AOC officials to discuss the agency's planning documents and efforts.

We conducted our work from December 2013 to September 2015 in accordance with all sections of GAO's Quality Assurance Framework that are relevant to our objectives. The framework requires that we plan and perform the engagement to obtain sufficient and appropriate evidence to meet our stated objectives and to discuss any limitations in our work. We believe the information and data obtained, and the analysis conducted, provide a reasonable basis for any findings and conclusions in this product.

[61]GAO, *GAO Cost Estimating and Assessment Guide*, GAO-09-3SP (Washington, D.C.: Mar. 2, 2009); GAO, *Executive Guide: Leading Practices in Capital Decision-Making*, GAO/AIMD-99-32 (Washington, D.C.: Dec. 1, 1998); Office of Management and Budget (OMB), *Capital Programming Guide, Supplement to OMB Circular A-11: Planning, Budgeting, and Acquisition of Capital Assets* (Washington, D.C.: July 2013); and National Institute of Standards and Technology, *Life-Cycle Costing Manual for the Federal Energy Management Program*, NIST Handbook 135 (Washington, D.C.: February 1996).

Appendix II: Comments from the Architect of the Capitol

Architect of the Capitol
U.S. Capitol, Room SB-16
Washington, DC 20515
202.228.1793

www.aoc.gov

July 22, 2015

Mr. Frank Rusco
Director, Natural Resources and Environment
U.S. Government Accountability Office
Washington, DC 20548

Dear Mr. Rusco:

Thank you for providing the Architect of the Capitol (AOC) with the opportunity to comment on the Government Accountability Office's (GAO's) draft report to the House and Senate Committees on Appropriations regarding ongoing strategies for cost savings at the Capitol Power Plant (CPP). The GAO's draft report addresses two topics:

- Steps the AOC has taken to manage energy-related costs and plans to further manage these costs.
- The process by which the AOC validated its decision to procure and construct a Cogeneration system.

I appreciate the GAO's recognition of the AOC's successful energy savings efforts. However, I disagree with the GAO's characterizations of the AOC's decision-making process to procure and construct a Cogeneration system.

Since 2011, I have testified before Congress about our need to build the Cogeneration plant and make this important investment in the CPP's infrastructure to support the Capitol campus. Our strategy to execute this project through a Utility Energy Service Contract (UESC) allows us to request appropriated funding for other critical infrastructure projects for which alternative funding sources are not available. This is a sound investment strategy given that our backlog of Deferred Maintenance and Capital Renewal work currently exceeds $1.4 billion.

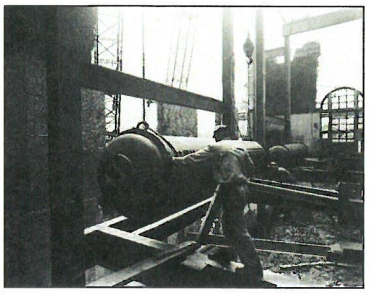
This letter provides additional documentation and further clarifies information previously shared with GAO to address the key points raised in the draft report. In this response the AOC will:

- Further establish the urgent need to replace the existing 60-year-old coal boilers.
- Further demonstrate the use of leading capital planning practices when evaluating and revalidating the need to construct a Cogeneration plant at the CPP.
- Further detail the substantial benefits gained from Cogeneration over installing a new gas boiler.

The GAO's draft report recommended the AOC fully update its long-term energy plan while following key leading capital planning practices prior to undertaking future major capital projects related to energy needs. The GAO specifically stated that the AOC should:

- Fully assess the complex's long-term needs and identify any performance gaps.
- Identify and evaluate a range of alternatives including non-capital options and energy conservation measures.
- Identify key assumptions and risks and perform valid sensitivity and uncertainty analyses.
- Seek an independent review of the plan to ensure it follows key leading practices and provide the result of the review to Congress.

Contrary to these recommendations and the assertions in the GAO's draft report, the AOC adhered to key leading capital planning practices based upon its 2009 Strategic Long Term Energy Plan (2009 Plan), 2014 revalidation efforts, and additional documentation included with this response. Given the urgent need to replace the existing 60-year-old coal boilers, there are substantial benefits gained from Cogeneration over installing a new gas boiler. In addition, the AOC has effectively implemented all of these recommendations in a manner sufficient to move forward with the planned Cogeneration project as explained below.



Wickes Boilers that were installed in the Capitol Power Plant in the 1950s are still in use today.

- **The AOC fully assessed the complex's long-term needs and identified performance gaps.** The CPP Steam Load Forecasts and Wickes Boiler Replacement Justification (Attachment 1) fully explain how the AOC has already assessed the Capitol campus' long-term needs through replacing the CPP's aging boilers. The CPP's two oldest coal boilers have deteriorated and need to be replaced as soon as possible. These boilers can either be replaced in kind (with another boiler) or can be replaced with Cogeneration. While both a boiler and Cogeneration could produce the same amount of steam, Cogeneration also produces electricity. In addition to being a significantly more cost-effective use of taxpayer's dollars, Cogeneration offers a more resilient, efficient and environmentally-sound solution to modernizing the CPP.

- **The AOC identified and evaluated a range of alternatives, including non-capital options and energy conservation measures.** The AOC followed industry best practices and, in 2009, selected Cogeneration to replace the aging boilers. In 2014, in accordance with industry best practices, the AOC updated key assumptions used in the 2009 Plan and further evaluated the two technically-feasible options in extensive detail. The AOC validated that Cogeneration remained the best option. The AOC also has conducted additional exploration and evaluation of non-capital options, as well as the impact of past and future energy conservation measures. Attachment 1 further explains the impact of the AOC's energy conservation measures, and clearly shows they will have no effect on the need for Cogeneration.

- **The AOC identified key assumptions and risks, and subsequently performed valid sensitivity and uncertainty analyses.** The Department of Energy (DOE) National Renewable Energy Laboratory (NREL) served as the independent third-party reviewer of the 2014 validation effort of Cogeneration, and conducted a deterministic sensitivity analysis of the project life-cycle cost. The AOC also used a third party to perform a probabilistic risk assessment of the project's construction cost. Following receipt of the GAO's Statement of Facts, the AOC used a third party to complete an additional probabilistic risk assessment of the project life-cycle cost in May 2015 (Attachment 2).

- **The AOC completed an independent review of the plan and provided the results to Congress.** Leading capital planning practices do not call for using independent review panels for a new plan or a validation effort. Nevertheless, the AOC engaged NREL to independently review the AOC's 2014 validation effort. NREL confirmed that the AOC's effort met or exceeded program requirements, and subsequently both NREL and AOC staff briefed the Legislative Branch Appropriations Subcommittee staffs on the findings. Specifically, NREL noted that Cogeneration would save money with electric savings, revenues and lower maintenance costs overall.

Enclosed with this letter and its attachments are the AOC's technical and general comments to the GAO's draft report (Attachment 3).

Establishing the urgent need to replace the existing 60-year-old coal boilers

The Capitol Power Plant began operating in 1910 to provide steam and electricity to just three buildings: the U.S. Capitol, the Library of Congress (Jefferson Building), and a new office building being constructed for the House of Representatives (Cannon Building).

Today, the CPP provides steam and chilled water to heat and cool 23 facilities on Capitol Hill. The CPP's steam plant infrastructure includes seven boilers; three Wickes boilers date back to when Dwight Eisenhower was president and Studebakers were a popular family car. Today, Studebakers are considered classics.

According to the American Boiler Manufacturers Association, the typical design life of boilers is 35 years, making the CPP's coal-fired boilers classics twice over.

After 60 years of use, the boilers have experienced advanced corrosion that has contributed to extensive and costly repairs.

Much like car enthusiasts rebuild the engine in a classic car – using spare parts wherever they can find them – the CPP mechanics must salvage for spare parts for these antiquated, obsolete boilers whenever they break down, which happens frequently.

For example, in December 2005, the CPP experienced a gear box failure on a coal boiler grate drive. The manufacturer was no longer in business and parts were not available. The CPP was able to locate a spare gear box at a military installation in Alaska, where the boilers had been decommissioned years

before. After establishing an inter-agency agreement, the CPP had the gear box shipped via special overnight delivery in order to bring the coal boiler back into service.

The urgent need to replace the boilers also was made very clear on eight days between July 2014 and June 2015. On these eight days, the CPP did not have sufficient capacity to meet the peak winter steam demand. A major crisis was averted due to the fact the days for which insufficient capacity was available were during warmer months, however, the next time the CPP may not be so fortunate. This would have a significant impact on Congress' ability to conduct its business.

For an additional 138 days during this same time, due to needed repairs to critical boiler components, the CPP only had enough capacity to meet the peak winter demand. These periods of great risk to meeting demand are largely due to the fact that repairs were required on both of the existing 60-year-old coal boilers.

In 2009, a panel of industry experts noted that portions of the CPP are at the end of their useful life noting, "With growing public concern about improved energy efficiency, reduction of greenhouse gas emissions, and reduced dependence on imported oil, the renewal of the CPP and its distribution network presents a significant opportunity to showcase energy-efficient technologies and lead the nation by example."

See comment 1

Six years later, the situation has only grown more dire, and the risks associated with trying to maintain obsolete equipment continue to grow. Even though the 60-year-old coal boilers are effectively on life support, they are still relied upon when the CPP needs to meet peak demand each winter.

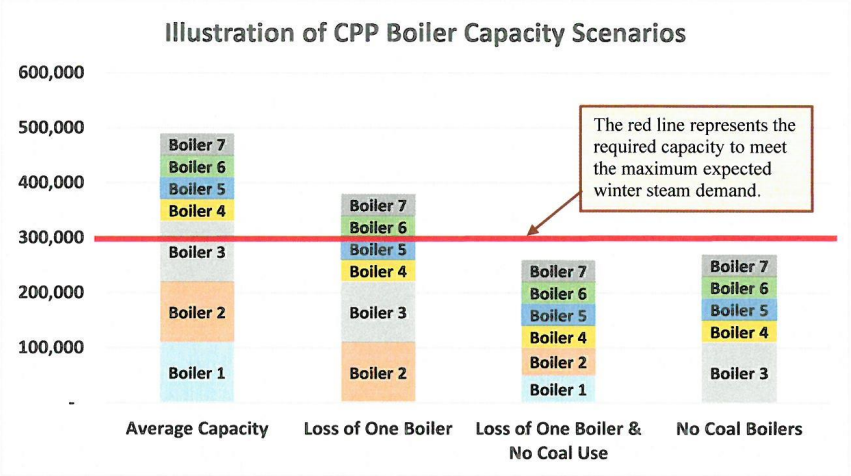
In order to ensure that the CPP meets steam demand and upholds its mission to provide heat to congressional buildings 365 days a year, 24 hours a day, the AOC acted on the 2009 Plan's recommendation to install Cogeneration to address the serious and urgent need to replace the failing coal boilers.

I believe the coal boiler condition assessments, and other data provided to GAO, unequivocally demonstrate the need to replace the coal boilers. The reduction in available capacity of the CPP boilers, due to failure of coal boiler components in 2014 for an extended period of time, further demonstrates that these boilers are beyond their useful lives. Recent failures include economizer leaks, bag house corrosion, antique control systems, flame scanner failures and coal scale failures. The AOC is providing additional documentation that summarizes previous condition assessments provided and further justifies the urgent need to replace the coal boilers (Attachment 1).

Even with the numerous energy reduction efforts put in place by the AOC, the peak steam demand for the Capitol campus will not be reduced to the point where the CPP can forego replacing the existing coal boilers. The following information further clarifies how the AOC evaluated the long-term campus steam demand requirements and revalidated the need for Cogeneration based on possible energy conservation measures and future campus development.

The design nameplate data for the CPP's boilers total a maximum steam supply of 620,000 pounds per hour. However, just as a driver wouldn't keep their foot constantly pressed down on the accelerator, it is not normal or prudent to run the boilers at 100 percent capacity. Considering this, along with the age of the boilers, and other boiler-specific limitations, the CPP uses the "average" capacity to determine

the available capacity of the boilers. This results in a sustainable available capacity of 490,000 pounds of steam per hour.



See comment 2

Due to the critical nature of the CPP to congressional operations, the CPP must be able to meet the peak steam demand even if a boiler fails due to a mechanical issue. A way to illustrate this situation is shown in the chart above. The first column shows the total boiler (average) capacity of 490,000 pounds of steam per hour when all of the boilers are available. The next column represents the boiler capacity of 380,000 pounds of steam per hour if one of the large boilers failed. In this scenario, the CPP would still be able to meet the peak steam demand of 300,000 pounds of steam per hour. However, if the CPP were to lose one boiler and cease burning coal or lose both coal boilers, as shown in the last two columns, it would not have the capacity to meet the peak steam demand.

Demonstrating the Use of Leading Capital Planning Practices when Evaluating and Revalidating Need to Construct a Cogeneration Plant

The AOC Used Leading Practices to Select and Revalidate Cogeneration. With the assistance of the National Academy of Sciences (NAS), in September 2009, the AOC completed its Strategic Long Term Energy Plan to guide future CPP renovations and identify options to improve its efficiency, reduce environmental impacts and provide cost savings.

The NAS committee noted, "The single greatest challenged faced by the CPP is the aging infrastructure and physical assets of the plant and distribution system. In 2002 the CPP started a major effort to expand its refrigeration plant to accommodate for increased load requirements of the new Capitol Visitor Center. This effort was the first such effort to renew or expand the capacity and capabilities of the CPP in over thirty years. Much of the steam plant and distribution infrastructure is also approaching or has already reached the end of its useful life."

See comment 3

A broad range of technical options were considered, including options that focused on providing distributed steam and chilled water to buildings and decentralizing the CPP, as well as options that explored viable technologies to replace aging boilers and chillers. Specifically, the 2009 Plan provided a comprehensive look at the CPP's future, analyzed 20 different operational options, and ranked those options on the basis of economics, environmental benefits, energy savings and security/resiliency.

Each of the options considered examined the initial and life-cycle costs, environmental impacts, efficiency impacts and energy security. The NAS committee noted it was impressed with the depth of the AOC's efforts to explore various options for the CPP, and stated, "Now, as the CPP approaches its 100th anniversary, technology has changed again and electric generation (or Cogeneration) is the best long term strategy for AOC to achieve its mission of reliable, cost-effective, efficient, and environmentally sound utility services."

Attributes of the AOC Cogeneration Validation Process. The following table, "Attributes of the Architect of the Capitol's Cogeneration Validation Process," illustrates the progression of the AOC's efforts to plan and validate Cogeneration. It seeks to clarify Table 6 in GAO's draft report by the characterization of costs and summation of work involved.

Attributes of the AOC Cogeneration Validation Process

Attribute Noted in Architect of the Capitol Plan	Plan	Vendor 1	Vendor 2
	2009 *Strategic Long Term Energy Plan: Final Report*	September 2013 Business Case Reviews and Bid	December 2014: *Cogeneration at the Capitol Power Plant: Project Summary*
Scope and Purpose of Proposed Cogeneration Systems	Phase 1 - One 7.5 MW combustion turbine Phase 2 - One 7.5 MW combustion turbine Phase 3 - One 15 MW combustion turbine, as wells as five natural gas boilers, installed over three phases over 20 years	Two 7.5 MW combustion turbines (representing the first and second phases of 2009 plan)	One 7.5 MW combustion turbine (representing the first phase of the 2009 plan)
Rough Order of Magnitude	$120.3	n/a	n/a
Approximate Construction Cost - Estimate (millions)	n/a	$67.2	$55.5
Approximate Construction Cost - Bid (millions)	n/a	$117.1	$57.0
Third-Party Financing Costs (millions)	n/a	$69.4	$24.3
Total Project Cost (millions)	n/a	$204.9*	$85.4*
Peak Steam Generating Capacity of Combustion Turbines	Phase 1 - 100,000 pph Phase 2 - 100,000 pph Phase 3 - 120,000 pph	200,000 pph	100,000 pph
Peak Steam Generating Capacity of New Natural Gas Boilers	340,000 pph	n/a	n/a
Provides Power to the Capitol Power Plant	☑	☑	☑
Provide Power to Capitol Complex	Phase 1 - ☐ Phase 2 - ☐ Phase 3 - ☑	n/a	n/a
Sells Excess Power to Electricity Grid	☑	☑	☑
Long-Term Steam Demand Forecasts	☑	☑	☑

* Total Project Cost figure excludes AOC project management and funds AOC has obligated to date.

See comment 4

Effectively, the AOC has progressed through three key milestones:

- The 2009 Plan identified the need for Cogeneration
- Additional validation and procurement of a UESC with the first vendor
- Additional validation and procurement of a UESC with a second (current) vendor

A significant correction to GAO's Table 6 is the elimination of the "July 2014" column. That column mischaracterizes the effort associated with that stage of review and study by the AOC as being "final." Actually, and as the AOC previously indicated to GAO, the July 2014 effort was undertaken in an investigative manner and served as draft input for the Project Summary produced by the AOC in December 2014. The remaining rows represent the attributes described in a more accurately comparative manner than GAO's previous table.

The comprehensive review and revalidation work the AOC has completed continues to show that reliable capacity to meet peak steam demand is urgently needed, and that Cogeneration is the best course of action to meet that need. The 2014 revalidation of the 2009 Plan evaluated both Cogeneration and a gas boiler, implementing either technology using appropriated funds or a UESC. An independent review by NREL substantiated the AOC's conclusion that Cogeneration is the best, most reliable and most cost-effective option. This conclusion took into account the unlikely availability of appropriated funds for construction, life-cycle costs, energy efficiency, reliability and security, and environmental impacts.

See comment 5

During the AOC's 2014 revalidation, which was fully consistent with OMB guidelines, the AOC addressed the key steps GAO recommended as important with regard to leading capital planning practices. The AOC considered:

- Changes in demand, including the impacts of energy conservation measures, gas and electric prices, construction and life-cycle costs, and interest rates.
- Capital and non-capital alternatives to filling the performance gap that requires urgent attention.
- Key assumptions and risks by performing valid sensitivity and uncertainty analyses under various potential future conditions, and the AOC had its validation effort independently reviewed.

While leading practices call for validating planning decisions prior to acquisition, there is no requirement that this be done in one document. The AOC's iterative process to re-examine needs and requirements, technologies and other alternatives, life-cycle costs, risks, and other evaluation factors further confirmed that Cogeneration is the best option. Further, the application of sound engineering judgement enables the AOC not to repeat previous efforts but to further build upon viable options, thereby saving hundreds of thousands of dollars.

See comment 6

The AOC Fully Assessed Long-Term Needs and Identified Performance Gaps. There is an urgent need to replace the 60-year-old coal boilers to meet current steam load requirements. The AOC completed an evaluation and redeveloped its long-term steam load forecasts to address this urgent need. The results are briefly summarized below and the full analysis is provided in Attachment 1.

To assess the long-term needs and consider possible demand changes, it is important to discuss two criteria: maximum steam demand and expected annual steam consumption.

Maximum Steam Demand: On the coldest days of the year, the congressional buildings under the AOC's care require sufficient steam to maintain comfortable indoor temperatures. The AOC designs its heating systems to maintain constant indoor temperatures down to an outside temperature of zero degrees Fahrenheit. Energy conservation measures can contribute some reduction in the peak steam loads, including lowering the amount of fresh outdoor air to condition, and/or sealing the building envelope.

1. Reduction of Steam Demand. The AOC's conservation efforts have reduced maximum steam demand from 325,000 pounds per hour to 300,000 pounds per hour. While the energy conservation efforts have reduced annual energy consumption by 30 percent, peak loads are down only 8 percent. Output from the two coal boilers is still required to meet the current peak steam demands. Cogeneration simply replaces the capacity of these unreliable boilers.

2. Reduction of Steam Load. The AOC has identified an additional $100 million in unfunded energy conservation measures that could result in an additional 20,000 pounds per hour reduction to the CPP's maximum steam loads. The majority of the peak steam reductions could be realized in the Library of Congress buildings and the Thurgood Marshall Federal Judiciary Building through appropriated or performance-based energy conservation projects. These projects could lower the peak steam load to 280,000 pounds per hour. In this scenario, the need for steam production by the coal boilers would still be required to meet the peak load of 280,000 pounds per hour.

Annual Steam Consumption: The CPP continues to rely on the coal boilers to meet current and future expected peak demand requirements. This takes into account reductions in demand from completed energy conservation measures. However, the AOC's completed energy conservation measures have not reduced the peak steam demand as significantly as it has reduced the CPP's overall steam use. Even if the AOC were to request and receive an additional $100 million in appropriated funds or use an Energy Savings Performance Contract to implement future energy reduction projects, this would not significantly reduce peak steam demand enough to eliminate the need to replace the coal boilers. To analyze the merits of any potential new steam generation solution, there is a need to understand how much steam will be required annually. The annual consumption requirements will help determine energy inputs required by various systems (i.e., Cogeneration or a gas boiler) and all systems should be evaluated using the same expected annual consumption. As such, the AOC conducted economic analysis of consumption data for the current and future years.

Consumption Data for Current Year: In late 2014, the AOC used the CPP's 2013 annual consumption data to run the economic analysis of various options. It is important to note that the 2014 consumption data for the economic analysis work was not used as the CPP's 2014 consumption was skewed higher by record cold winter weather in January through April 2014. The CPP's 2015 steam consumption data are nearly identical to its 2013 consumption data. Therefore, the economic analysis was completed using the most relevant, current, annual consumption data.

See comment 7

The AOC Identified and Evaluated Alternatives Including Non-Capital Options and Energy Conservation Measures.

Alternative Technologies: As part of the AOC's due diligence, it reviewed the broad range of options assessed in its 2009 Plan. Following consultations with industry trade groups and others, the AOC determined that there were no new feasible technologies on the market that had a practical use on the Capitol campus. The only feasible capital options available to the CPP are Cogeneration and a new gas boiler.

Non-Capital Options: The AOC examined several non-capital alternatives and none were deemed to be practical. These included various forms of privatization, such as Enhanced Use Leasing, purchasing steam from GSA, or borrowing from the Federal Financing Bank. In addition, the CPP cannot suddenly stop providing steam to the customers it serves by law, as referenced in GAO's draft report, at least in the short term.

In these fiscally challenging times, the AOC is not likely to receive appropriated funds for Cogeneration construction. It is unclear when or if the AOC would receive appropriated funds for a new gas boiler, making a public-private partnership for Cogeneration, as proposed under a UESC, the most sound and practical path forward. The CPP also researched the possibility of using an Enhanced Use Lease, a form of privatization; mechanisms used by the Department of Defense for acquiring on-base utility services; and borrowing from the Federal Financing Bank. Any of these alternatives would potentially require some form of legislation to give the AOC the authority to proceed. Therefore, none of these options are viable to meet the AOC's current needs. The AOC even discussed other alternatives with GAO staff familiar with challenges faced by federal agencies in obtaining funding for capital investments. However, they were unable to assist in identifying other options.

See comment 8

Energy Conservation Measures: The AOC conducted additional sensitivity analyses of Cogeneration and new gas boiler project economics in a scenario where steam consumption is reduced further in the future. In this analysis, the AOC developed a low steam case that assumed the CPP's steam loads would be reduced by an additional 20 percent. This scenario would require completion of the $100 million in identified but unfunded energy conservation projects, the 10-year Cannon House Office Building Renewal project, and the renewal of an additional 1.7 million square feet of space connected to the CPP. The total investment in these projects would exceed $2 billion.

The AOC appropriately concluded that this scenario represents the highest level of energy conservation possible within its portfolio; in total, a 50 percent reduction from its 2003 baseline. The UESC-financed Cogeneration project still carried a positive net present value. The financed gas boiler option, using these reduced loads, had potential for a negative net present value. If future steam demand grows, the net present value economics of Cogeneration improves from the base analysis as more of the produced electricity is used within the CPP for chilled water generation versus exported to the electrical power grid.

Recently, Executive Order 13693 was issued requiring the federal government to further reduce energy consumption by 25 percent between 2015 and 2025. Should Congress adopt these new goals for all federal facilities, as it did with the Energy Independence and Security Act of 2007, which required a 30 percent reduction in energy consumption over 10 years, Cogeneration would be a key component in the AOC's overall strategy to meet future energy reduction goals.

See comment 9

The AOC Identified Key Assumptions and Performed Valid Sensitivity and Uncertainty Analyses. GAO's draft report is incorrect in stating that the AOC did not update its 2009 Plan in response to changes in key assumptions since that time, including natural gas prices and steam demand. To the contrary, the AOC did update the key assumptions in its validation effort during the course of GAO's review. In updating the life-cycle cost analysis in 2014 and early 2015, the AOC used current information on steam demand, gas and electric prices, interest rates, and construction and maintenance costs. These analyses were included in the Project Summary spreadsheets previously provided. GAO declined the AOC's offers to discuss these spreadsheets.

To address GAO's initial inquiries, in October 2014, the AOC completed a probabilistic risk assessment consistent with GAO's cost estimating guidelines on Cogeneration's construction cost, specifically applicable to the UESC program. The results showed that the AOC could be highly confident of completing construction within budget. The AOC also completed a deterministic sensitivity analysis of key factors on the overall project life-cycle cost. However, when GAO delivered its Statement of Facts in April 2015, it became clear that it was looking for a probabilistic risk assessment of the life-cycle cost for Cogeneration.

See comment 10

Therefore, in May 2015, the AOC completed a probabilistic risk assessment consistent with GAO's cost estimating guidelines. Again, this showed that considering the key assumptions, sensitivities, risks, and uncertainties associated with Cogeneration and a new gas boiler, the AOC is highly confident that Cogeneration, financed using a UESC, will provide savings to Congress and the American taxpayers. It also has a better net present value than installing one gas boiler.

The probabilistic risk assessment identified and quantified the cost drivers that pose the most risk of increasing project cost when considered alone, and captured the cumulative effect of various risks expected. The bottom line showed that the expected net present value of Cogeneration is positive and greater than the expected positive net present value of installing a gas boiler. Based on data available as of the July 2015 receipt of GAO's draft report, with respect to Cogeneration, the study concluded that the CPP can be 64 percent confident that the proposed system will generate the $7.3 million net present value (NPV) that has been estimated as part of the revalidation effort. The confidence levels derived from these analyses are well within the range GAO considers desirable, which is between 55 and 80 percent.

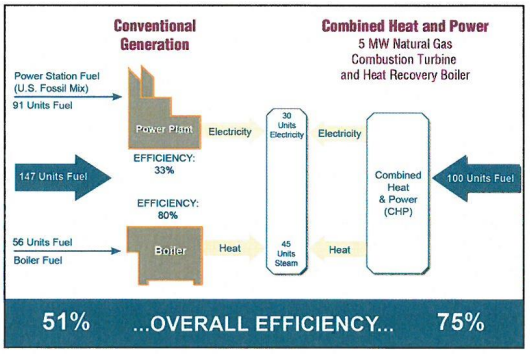
The analysis also shows the resultant expected NPV to be approximately $3.6 million higher, or totaling closer to $11 million, and 86 percent confidence that Cogeneration will provide a positive payback over a 25-year period. In addition, while GAO's draft report refers to the project being financed over a 27-year analysis period, under the AOC's current proposed project execution plan, the period is actually 23 years, comprising approximately two years for construction performance and 21 years for loan payback.

See comment 11

The AOC Completed an Independent Review of the Plan. The AOC has adhered to key leading capital planning practices, and has effectively performed all of these recommendations in a manner fully sufficient to move forward with Cogeneration. In fall 2014, the AOC engaged NREL to review its revalidation effort regarding the 2009 decision to proceed with Cogeneration. NREL concluded that the AOC had thoroughly addressed the relevant issues and met or exceeded UESC program requirements.

NREL's conclusions also noted that "the selection of the Combined Heat and Power (CHP) option is a better option than a new 100,000 pound per hour gas boiler for a number of reasons."

The NREL-produced graphic (at right) illustrates the difference in efficiencies between Cogeneration and a gas boiler for a typical system, such as the one the CPP would be installing.



After careful review and appropriate updating, the AOC does not believe that another independent panel review of the 2009 decision to use Cogeneration to provide reliable capacity to meet peak steam demand is necessary nor cost effective.

This is particularly apparent when considering the results of the work done to address expected future demand, changes in utility prices and the risks associated with Cogeneration.

See comment 12

Cogeneration Provides Many Benefits and Is Ready to Proceed

The AOC performed an extensive comparative analysis between a boiler and Cogeneration, and determined that Cogeneration is the best option for the Capitol campus.

Cogeneration inherently is more energy efficient than producing steam and electricity separately. The overall energy efficiency of Cogeneration is typically 75 percent efficient whereas the overall energy efficiency of separately producing steam and purchasing electricity is 51 percent efficient as show in the above graphic.

Cogeneration lowers the impact on the environment. By burning less fuel than the boiler option of producing steam and purchasing electricity, the Cogeneration plant would reduce emissions of hazardous air pollutants by 18 percent and have a lower carbon foot print.

Cogeneration provides increased energy reliability and security for Congress. The planned 7.5 megawatt system would allow the CPP to continuously produce enough electricity to fully power the steam plant and about 20 percent of the refrigeration plant which better supports the Capitol campus in the event of a power failure.

Based on this analysis, as supported by a panel of national experts and validated by NREL, Cogeneration is the most cost-effective, energy-efficient and environmentally-friendly solution to modernize the CPP.

Cogeneration is a proven technology – there are more than 4,400 Cogeneration facilities throughout the United States. It also provides other benefits, including enhanced energy efficiency, reduced environmental emissions, increased energy reliability and security. Most importantly, it provides a

See comment 13

return on the government's investment without imposing undue risks as evidenced by results of the AOC's probabilistic risk assessment.

While the CPP has air permits from the District of Columbia for Cogeneration construction, the permits expire in June 2016. If construction is not substantially underway by this time, the CPP will be at risk of losing the construction permit. It would likely take 12-18 months to receive a new construction permit, during which time, no work on Cogeneration can proceed. Should this happen, Congress will be at risk of not having sufficient steam for peak demand, and the CPP would almost certainly face higher construction costs due to price escalation.

If the CPP acquired a new gas boiler, it must first obtain necessary air permits, which would be a lengthy process, secure appropriated funds, and procure design and construction services. While Cogeneration could be operational by 2017 if construction began soon – assuming that appropriated funds are received for a gas boiler – it is likely that a new boiler would not be operational until 2018, at the earliest. Preparing a new plan, as suggested by GAO, would add approximately two years to the timeframes for both options.

In addition to the increased reliability and efficiencies the CPP will realize with Cogeneration, it will provide a number of other benefits that were not included or elaborated upon in GAO's draft report. Specifically, on a regional basis, Cogeneration also provides significant reductions in the CPP's emissions and improves energy efficiency as well as energy security as discussed below.

See comment 14

Environmental Impacts – Cleaner Electricity and Improved Air Quality. Since 2007, the CPP has steadily increased its reliance on natural gas as its primary fuel source. While the AOC has reduced coal use at the CPP over the past several years, it cannot cease using coal completely until the Cogeneration plant is constructed. The reduction of coal use at the CPP has significantly reduced annual emissions of key criteria pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NO_x) and particulate matter (PM). The AOC has seen similar reductions in Hazardous Air Pollutants (HAPs), and in carbon dioxide equivalent (CO_2e) emissions.

The permits obtained to install Cogeneration impose very stringent emissions limits at the CPP. The new emissions limits in the EPA and DDOE permits set significant reductions in allowable emissions from the CPP when compared to the previous permits. For example, NO_x emissions limits will be reduced by 78 percent. Further, when compared to the use of one coal boiler, Cogeneration is significantly cleaner than the coal-fired boiler.

The environmental benefits of Cogeneration reach beyond the emissions coming from the CPP and have a much more dramatic impact on emissions regionally in the District of Columbia, Maryland and Virginia. This is because the emissions coming directly from the CPP are only part of the overall picture. A secondary benefit of Cogeneration will be the decrease in emissions regionally through the clean and efficient generation of electricity. Over 45 percent of the electricity in the DC Metro region is generated by coal.[1] By generating electricity using natural gas, the CPP will reduce its purchase of electricity. Additionally, the electricity the AOC purchases for the Capitol campus is typically generated at approximately 33 percent efficiency, while the electricity generated by Cogeneration is generated at approximately 60-80 percent efficiency. The use of natural gas and increased efficiency of

[1] EPA eGrid2012 Version 1.0 Year 2009 Summary Tables

Cogeneration lead to significant regional reductions in emissions, and is a collateral project benefit to public health and the environment from this project.

Installing Cogeneration will significantly reduce NO_x, SO_x and greenhouse gas emissions, helping to improve the air quality in the District of Columbia. For example, the benefit of installing Cogeneration over the current practice of importing electricity from a coal-fired power plant could be equivalent to reducing the amount of greenhouse gas emissions associated with the operation of 15,000 vehicles each year.[2]

Energy Security. The implementation of Cogeneration would address a growing concern – the CPP's energy security due to the availability of an on-site source of electric generation in the event of a regional or local electrical power grid outage. There have been numerous occurrences of wide-spread electrical service outages by the local utility company over the past decade, as well as troubling manhole cover explosions and fires. Because the mission of the CPP is to provide uninterrupted steam and chilled water service to Congress, the possibility of an interruption in electrical power to the CPP is of particular concern. The AOC's analysis has shown that only Cogeneration provides improved energy security at the CPP.

Additional Clarifications to the GAO's Draft Report

The AOC is providing technical corrections to GAO's draft report along with this response. The information below provides additional clarification to specific statements included in GAO's draft report.

See comment 15

Clarity of Leading Practice Guidance. GAO's draft report suggests the capital planning guidance it cites is clear and leaves no room for misunderstanding or misinterpretation by agencies regarding the information to be collected, analyzed, included or reviewed in a capital planning document. This was not the AOC's experience. GAO's and OMB's capital planning guidance cited by the GAO conflicts with NIST 135 (e.g. application of sensitivity analysis to fuel price escalation rates). In other areas, such as the use of expert panels, their guidance is silent.

GAO's and OMB's guidance applies to capital planning in general, while NIST 135 is applicable specifically to energy-related capital projects. With respect to sensitivity analyses, NIST 135 reflects a requirement as opposed to guidance. Both GAO's and OMB's guidance focuses on developing new plans, whereas OMB's guidance recognizes that time lapses between a plan's completion and project acquisition. It also provides for a validation of the planning decision during the acquisition phase. OMB's guidance does not specify that validation efforts must include the development of an entirely new plan or "full update."

Both GAO's and OMB's capital planning guidance cites examples of the types of information considered important, but neither definitively specify what must be included in capital planning documents or how the information should be conveyed. OMB's guidance states that agencies can tailor its guidance to their needs as long as the basic thrust of its guidance is captured. OMB's guidance also acknowledges that all an agencies' information related to capital planning does not have to be in one document, although it suggests that the key information be captured in an executive summary.

[2] http://www.epa.gov/cleanenergy/energy-resources/refs.html

See comment 16

Project Prioritization. In GAO's draft report, it correctly states that the AOC did not assess the planned Cogeneration project through its capital planning prioritization process. This process seeks to rank proposed projects and recommends the highest ranking for annual appropriated funding. GAO's draft report further says that, consequently, the AOC did not analyze the project and its merits relative to other projects using its criteria for capital planning.

This is not the case. The AOC uses its prioritization process to evaluate the most efficient and cost-effective means of executing projects through the use of appropriated funds. Outside of a small percentage of funds devoted to project management costs, the AOC did not intend to request annual appropriations for the planned Cogeneration project and has testified before Congress that it intends to use a UESC. Therefore, the AOC appropriately did not include this proposed project in the annual prioritization process for appropriated projects.

Cogeneration has been analyzed for its merits using much of the same criteria used in the project prioritization process. For example, it has been assessed for regulatory compliance, resilience and security, mission accommodation, economics, and energy conservation. The AOC took these same components into consideration during development of the 2009 Plan while formulating the project business case, and during validation efforts with each of the potential UESC vendors. So, while Cogeneration was not prioritized against other capital projects for which the AOC was seeking appropriated funding, it did receive the same level of scrutiny.

See comment 17

Project Design, Preconstruction, and Execution Costs. While the Cogeneration project has incurred obligations to date of approximately $16 million, procurement of a gas boiler would have required use of a significant portion of this same amount of funds. As alluded to in GAO's draft report, more than 50 percent of the obligated funds were used for planning and development, engineering, permitting, preparation of the space to receive the new Cogeneration equipment, and the agency's management of the overall effort. Due to the then-existing state of the receiving facility, this allocation of funds would have been necessary regardless of which option was selected.

In addition, for technical consistency and in following key leading capital planning practices, it would be inappropriate for the AOC to "have procured a natural gas boiler" without a full evaluation of parameters and variables associated with such a decision. Similar to the expectations for any major capital energy project, the AOC should be expected to evaluate and forecast campus demand, utility rates, regulatory environment, current market, etc., prior to making any decision to invest in a gas boiler. To do any less in a rush to replace the old coal boilers would be a misapplication of current guidance. The AOC's 2014 revalidation efforts included re-examining the gas boiler option compared to Cogeneration in light of the relevant evaluation factors in a manner consistent with leading capital planning practices. It was determined that Cogeneration remains the superior option.

See comment 18

The Need to Maintain One Coal Boiler in Operating Condition. While the CPP can maintain adequate redundancy given the loss of a single coal boiler, as demonstrated in winter 2014, it cannot maintain adequate capacity to meet peak demand if both coal boilers fail. Replacing a single coal boiler will add sufficient reliable capacity to meet peak demand if a single boiler fails. While the CPP believes that replacing both coal boilers is a priority, it is critical to replace one as soon as possible.

See comment 19

Using a Public-Private Partnership to Finance Cogeneration Project. In these fiscally challenging times, the AOC is not likely to receive appropriated funds for Cogeneration construction. It is unclear when or if the AOC would receive appropriated funds for a new gas boiler, making a public-private partnership for Cogeneration, financed with a UESC, the most practical path forward.

OMB specifically cites funding availability as an important factor to consider in capital planning. The AOC even discussed other alternatives with GAO staff familiar with challenges faced by federal agencies in obtaining funding for capital investments. However, they were unable to assist in identifying other options.

The AOC engaged NREL in fall 2014 to independently review its analyses of the gas boiler and Cogeneration options to ensure they met UESC program requirements. NREL concluded that the CPP met or exceeded these requirements.

See comment 20

Conclusion

The selection and revalidation of Cogeneration have been iterative processes, and the AOC has followed relevant key federal capital planning practices. As a result, the AOC has revalidated that Cogeneration is the best option to deliver the utility needs of the Capitol campus. This letter has further established the urgent need to replace the existing 60-year old coal boilers; demonstrated that the AOC used leading capital planning practices when evaluating and revalidating the project, and has detailed the substantial benefits of Cogeneration.

After more than 100 years in operation, significant investment is needed to replace aging infrastructure and equipment in the Capitol Power Plant as it plays an essential role in the AOC's long-term energy conservation efforts.

In my professional opinion, Cogeneration is the most cost-effective, energy-efficient and environmentally-friendly solution to provide for the utility needs of the Capitol campus. Our strategy to execute this project through a UESC allows us to request less in appropriated funds and address other critical infrastructure issues through direct appropriations.

We used key leading practices to perform an extensive comparative analysis between a boiler and Cogeneration, and have determined that it is the preferred option for a variety of reasons.

Cogeneration is a superior investment and it is more energy efficient than a boiler. This technology is inherently more energy efficient than producing steam and electricity separately.

Cogeneration lowers the impact on the environment. By burning less fuel than the boiler option of producing steam and purchasing electricity, Cogeneration reduces emissions of hazardous air pollutants and has a lower carbon footprint.

Cogeneration provides increased energy reliability and security for Congress. This 7.5 megawatt system allows the CPP to continuously produce enough electricity to fully power the steam plant and about 20 percent of the refrigeration plant which, along with emergency generators, better supports the Capitol campus in the event of a power failure.

Cogeneration is a proven technology and is currently used in more than 4,400 facilities across the country. Cogeneration is considered a best practice and supported by the Department of Energy and the Environmental Protection Agency for use in district energy systems.

Based on this analysis, as supported by a panel of national experts and validated by NREL, Cogeneration is the most cost-effective, energy-efficient and environmentally-friendly solution to modernize the CPP, and we should continue to move forward with this vital project.

Again, thank you for this opportunity to provide additional information and clarity on these important subjects. Should you require additional information or clarification, please don't hesitate to contact my office at 202.228.1793.

Sincerely,

Stephen T. Ayers, FAIA, LEED AP
Architect of the Capitol

Attachments

Doc. No. 150715-18-01

Comments from GAO

Comment 1: We agree that CPP has equipment that may need replacement, in part or in whole, at some point in the future. However, AOC has not provided information on the likelihood of any such failures. After we provided our draft report to AOC for comment, the agency provided a new report on justifying the replacement of some of its older boilers, dated July 17, 2015, that provides anecdotes on problems AOC has overcome in maintaining the boilers but did not provide information quantifying the operational or budget impacts of these problems or estimates of the likelihood of a sudden failure of the boilers in the near future. Furthermore, AOC has not provided us with information—other than condition reports we reviewed finding that the boilers were in good to fair condition for their ages—supporting AOC's claims that the boilers are effectively "on life support."

Comment 2: We agree that AOC should operate and maintain CPP with the goal of meeting peak steam demand. However, AOC has not quantified any negative effects that would occur if CPP had to meet peak steam demand while operating its boilers only on natural gas and experiencing a temporary boiler outage. Furthermore, as AOC has noted, the proposed cogeneration system would not provide enough steam to allow AOC to meet its peak steam demand without using one of the two older boilers it intends to replace. Therefore, AOC will continue to incur some of the increased costs associated with infrequent use of one of the two older boilers that the agency stated the cogeneration project was meant to address. Furthermore, it is not clear when the agency intends to fully replace the capacity of the two oldest boilers. We therefore continue to believe that AOC should fully update its long-term energy plan while following leading capital-planning practices to ensure the agency fully assesses its needs and finds the most cost-effective ways to meet them.

Comment 3: We agree that AOC's 2009 long-term energy plan assessed a broad range of technical options for providing heating and cooling to the complex. However, given that many factors have changed that could potentially lead AOC to reach a different, more cost-effective solution to meet any future performance gaps, we continue to recommend that AOC fully update its long-term energy plan while following key leading capital-planning practices and seek an independent review of the plan and provide the results of this review to Congress. In its letter, AOC noted that the NRC committee that reviewed its 2009 plan stated that "electric generation (or Cogeneration) is the best long-term strategy for AOC to achieve its mission of reliable, cost-effective, efficient, and environmentally sound utility services."

However, we did not find this statement in the NRC committee's 2009 report;[62] instead, it is an AOC statement included in its final 2009 long-term energy plan.

Comment 4: AOC sought to clarify the progression of its planning efforts, which we summarized in Table 6 in our report. However, it is unclear why AOC stated that we mischaracterized its July 2014 *Strategic Long Term Energy Plan Update: Draft Final Report*, which we described as a draft plan throughout our report. In August 2014, we discussed with AOC shortcomings in its planning for the cogeneration project relative to leading practices and referred the agency to documents outlining these practices. AOC officials later wrote that the agency addressed the presented shortcomings by completing the December 2014 draft plan and supporting documents, which called for a cogeneration system with a configuration that differed from the July 2014 draft plan.

Comment 5: AOC stated that its 2014 revalidation addressed the key leading capital-planning practices we cited, but this revalidation focused on two technical options and did not, as called for in leading practices, fully assess the complex's long-term needs and identify and evaluate a full range of options for best meeting those needs. We continue to maintain that, prior to undertaking major energy projects, AOC should fully update its 2009 long-term energy plan as called for in leading capital-planning practices, given that key factors have changed that could have changed the plan's conclusions.

Comment 6: AOC stated that it completed an evaluation and redeveloped its long-term steam demand forecasts to address the urgent need to replace its older coal-firing boilers. We did not assess the validity of this evaluation because AOC did not provide it, or make us aware of it, until after we had sent the draft report to the agency for its comments. This evaluation did not accompany the agency's December 2014 draft plan, which AOC used to justify the need for and scope of the proposed cogeneration project.

Comment 7: We agree that AOC reviewed a broad range of options for meeting its long-term needs in its 2009 long-term energy plan. However, AOC did not examine non-capital options in the 2009 plan—such as operational changes or conservation measures—and it is unclear how or when AOC assessed some of the capital or financing options it cited in its written comments. Since 2009, AOC has assessed two capital options—a cogeneration system or a natural gas boiler. From 2009 to the

[62]National Research Council: Committee on the Evaluation of Future Strategic and Energy Efficient Alternatives for the U.S Capitol Power Plant, *Evaluation of Future Strategic and Energy Efficient Options for the U.S. Capitol Power Plant* (Washington, D.C.; 2009).

present, many factors have changed that could potentially lead AOC to reach a different, more cost-effective solution to meet its needs. Therefore, we continue to believe that AOC should identify and assess a wide range of options for meeting its needs in a full update of its long-term energy plan.

Comment 8: We have not assessed AOC's additional sensitivity analysis, as the agency provided it after we had completed our draft report. We do not know the basis for AOC's statement that the group of energy conservation measures it identified would reduce the complex's steam demand by 20 percent or the basis for the statement that the cost of the measures—including some or all of the costs of the Cannon House Office Building Renewal project—would exceed $2 billion.

Comment 9: AOC disagreed with our statement that the agency did not update its 2009 long-term plan in response to changes in key assumptions, citing the analyses it performed in 2014 and 2015 on the life cycle costs of the proposed cogeneration system and an alternative of a natural gas boiler. However, AOC did not update the key assumptions in the context of a full update of its 2009 plan, which assessed a broad range of options for meeting the complex's heating and cooling needs. AOC stated that it included updated assumptions in its spreadsheets on the life cycle costs of the proposed cogeneration project and a natural gas boiler alternative, and stated that we declined its offers to discuss these spreadsheets. However, we reviewed these spreadsheets containing AOC's life cycle cost analyses and identified shortcomings that we describe in our report.

Comment 10: AOC stated that it completed a probabilistic risk assessment in May 2015 that was consistent with GAO's Cost Estimating Guide, which identifies some key leading capital-planning practices. However, AOC did not make us aware of or provide this assessment until after we had completed our review and prepared our draft report.

Comment 11: AOC stated that the Department of Energy's National Renewable Energy Laboratory (NREL) provided an independent review of its December 2014 draft plan, which compared the proposed cogeneration system to an alternative of a natural gas boiler. NREL's review of a partial update to a 2009 plan, rather than a full update, does not address our recommendation. AOC needs to fully update its long-term energy plan and then seek outside review by an independent panel of experts, as it did in 2009.

Comment 12: We agree that cogeneration can offer benefits in certain settings. However, given the significantly higher upfront costs of cogeneration when compared to alternatives like a natural gas boiler, it is important that the planning involved in selecting the technology over viable alternatives exhibit the aspects of key leading capital-planning practices we cited—such as fully assessing needs, assessing a

range of alternatives, and using valid sensitivity and uncertainty analyses to identify key risks and confirm the superiority of a chosen option over its alternatives. To ensure that AOC's choices for meeting its long-term energy needs result from planning that exhibits these leading practices, we continue to believe that AOC should fully update its long-term energy plan while following the key leading practices we cited.

Comment 13: AOC stated that the construction permit for the proposed cogeneration project will expire in June 2016 and that fully implementing our recommendations would introduce a delay of approximately two years to either option for obtaining additional steam generating capacity. We maintain it is important for AOC to make the correct decisions about its capital and long-term energy needs through planning that follows key leading capital-planning practices, regardless of when any permits may expire for a particular project. Furthermore, AOC did not provide a basis for its claim that fully updating its long-term energy plan would cause a delay of an additional two years to either option for adding new steam generating capacity, and if AOC's claim is accurate then the agency should start the update as expeditiously as possible. Therefore, we continue to recommend that AOC fully update its long-term energy plan while following leading capital-planning practices before undertaking future major capital projects related to its energy needs.

Comment 14: We agree that AOC faces limits on its continued use of coal at CPP and on its emission of air pollutants, and we believe AOC should factor in such constraints in a full update of its long-term energy plan.

Comment 15: AOC stated in its letter that our report suggested that capital-planning guidance is clear and leaves no room for misunderstanding or misinterpretation by agencies. During the course of our review, and after receiving a preview of our report's findings, AOC officials said they were generally unaware of the applicability of the leading practices we cited. We identify in our report GAO's prior work that recommends the use of independent panels by agencies when addressing complex issues such as those facing AOC, and as the agency itself used in 2009 to review its draft long-term energy plan. As part of fulfilling our recommendation that the agency fully update its long-term energy plan while following leading capital-planning practices, we continue to believe AOC should submit the plan for review by an independent panel of experts and submit the results to Congress.

Comment 16: AOC did not assess the proposed cogeneration project using its capital planning prioritization process for projects to be funded with upfront appropriations, stating that it is the agency's strategy to use a UESC to finance the proposed cogeneration project—thereby allowing AOC to request appropriations to fund other critical infrastructure projects for which AOC stated such alternative funding sources are not available. As we stated in our report, by not assessing the

proposed project using the agency's capital planning prioritization, AOC did not analyze the project relative to other projects for which the AOC was seeking appropriated funding using the agency's pre-determined criteria for capital planning.

Comment 17: We agree that, like the proposed cogeneration project, AOC would have incurred some pre-construction obligations for design and project management to replace the steam-generating capacity of one or both of its older coal-firing boilers with a natural gas boiler. AOC's draft December 2014 plan shows that a natural gas boiler providing the same amount of steam as the proposed cogeneration system would cost approximately $9.3 million. It is not clear to what extent this estimate includes pre-construction obligations, which for the cogeneration project totaled about $16 million as of March 2015.

Comment 18: We agree that CPP may not be able maintain adequate capacity to meet peak demand should both older coal-firing boilers fail at the same time, but this does not change the need for AOC to fully assess its long-term energy needs and evaluate a range of alternatives for meeting them in the context of a full update of its long-term energy plan.

Comment 19: AOC officials stated appropriations would likely not be available for the cogeneration project and therefore selected a UESC to finance the project. Because the agency did not intend to use upfront appropriations to acquire the system, AOC did not assess the project using its capital planning prioritization process. As we reported, acquiring the system using a UESC results in more upfront costs and financing costs than if the agency used upfront appropriations. AOC stated that it discussed its funding challenges with GAO, but it is not GAO's role to advise agencies as they seek funding for their proposed capital projects.

Comment 20: AOC stated that its selection of the proposed cogeneration project and its revalidation efforts have followed key leading practices. However, as we state in our report and our response, we remain unconvinced that AOC's planning followed key leading capital-planning practices and therefore AOC has not demonstrated whether the proposed cogeneration project will prove more cost-effective than other alternatives for meeting the agency's needs. We therefore continue to recommend that AOC, prior to undertaking major energy projects, fully update its 2009 long-term energy plan while following key leading capital-planning practices, including: fully assessing its energy needs, identifying and evaluating a range of alternatives for meeting its needs, and identifying key assumptions and risks and performing valid sensitivity and uncertainty analyses. We also continue to recommend, given the complexity of the issues it is facing, that AOC seek a review by an independent panel of experts as it fully updates its long-term energy plan and provide the results of this review to Congress.

Appendix III: GAO Contacts and Staff Acknowledgments

GAO Contacts

Frank Rusco, (202) 512-3841 or ruscof@gao.gov
Lori Rectanus, (202) 512-2834 or rectanusl@gao.gov

Staff Acknowledgments

In addition to the individuals names above, Michael Armes (Assistant Director); Michael Hix (Assistant Director); John Delicath; Philip Farah; Cindy Gilbert; Geoff Hamilton; Dan Paepke; Mick Ray; and Shep Ryen made key contributions to this report.

Appendix IV: Accessible Data

Accessible Text and Data Tables

Accessible Text for Figure 1: Primary Capitol Power Plant Facilities

Highlighted buildings are between South Capitol Street and New Jersey Ave SE (West to East) and between E Street SE and Southeast Freeway (695) (North to South):

- **West Refrigeration Plant**;
- **West Refrigeration Plant Expansion**;
- **Administration**;
- **East Refrigeration Plant**;
- **Boiler Plant**.

South of Southeast Freeway (695): **Coal Yard**.

Source: GAO. | GAO-15-436

Accessible Text for Figure 2: Primary Capitol Complex Facilities Served by the Capitol Power Plant

Capital Power Plant: refer to previous accessible text.

Capitol Complex served by CPP (U.S. Capitol and several neighboring buildings):

- Adams Building, Library of Congress;
- Cannon House Office Building;
- Capitol Visitor Center;
- Dirksen Senate Office Building;
- Hart Senate Office Building;
- Jefferson Building, Library of Congress;
- Longworth House Office Building;
- Madison Building, Library of Congress;
- Rayburn House Office Building;
- Russell Senate Office Building;
- U.S. Botanic Garden;
- U.S. Capitol;
- U.S. Supreme Court.

Purchase steam/chilled water from CPP (Buildings located north of Massachusetts Avenue):

- Folger Shakespeare Library (located directly southeast of U.S. Supreme Court, south of Massachusetts Avenue);
- Postal Square Building;
- Thurgood Marshall Federal Judiciary Building;

- Union Station;
- U.S. Government Printing Office.

Part of Capitol Complex, but receives steam/chilled water from another source:

- Ford House Office Building (located southwest of U.S. Capitol and west of Capitol Power Plant)

Source: GAO. | GAO-15-436

Note: The Capitol Power Plant serves additional facilities, including parking garages and the page dormitory.

Accessible Text for Figure 3: Conceptual Illustration of Capitol Power Plant's District Energy System

Production: District Energy System (illustration of factory building).

Distribution: Chilled water and steam go from District Energy System to End User Buildings and End User Buildings to District Energy System.

Consumption: End User Buildings (illustration of tall buildings with windows).

Source: GAO. | GAO-15-436

Accessible Text for Figure 4: Potential Cash Flows from Energy Savings Performance Contracts (ESPC)

1. **Before energy savings performance contract:** "Energy and other costs [Note A]";
   (All dollars up to "Energy cost baseline")
2. Energy conservation measures installed;
3. **Performance period:** "Energy and other costs [Note A]" and "Savings used to pay contractor";
   (Adds up to all dollars up to "Energy cost baseline" with "Energy and other costs" approximately 66%)
4. Energy conservation measures paid off;
5. **Post-performance period:** "Energy and other costs [Note A]" and "Savings retained by the agency [Note B]".
   (Adds up to all dollars up to "Energy cost baseline" with "Energy and other costs" approximately 66%)

Source: GAO, based on review of DOE documents. | GAO-15-436

Note A: Agencies' costs for energy, water, and related expenses for operations, maintenance, and repair and replacement are all generally allowable sources of ESPC cost savings under statute.

Note B: Savings generated after an ESPC's performance period would generally be in the form of lower utility costs. Post-performance period savings are not measured and verified, and agencies do not generally track such savings.

Data Table for Figure 5: Consumption of Steam and Chilled Water by Capitol Complex Facilities (2010–2014)

Million BTUs of steam or chilled water use per degree day

Fiscal Year	Chilled Water / Cooling Degree Day	Steam / Heating Degree Day
FY2010	645.77	223.35
FY2011	634.68	212.69
FY2012	570.41	281.24
FY2013	596.09	234.04
FY2014	567.24	218.04

Source: GAO analysis of energy data provided by the Architect of the Capitol. | GAO-15-436

Note A: One British thermal unit is the heat required to raise the temperature of one pound of water by one degree Fahrenheit. Steam consumption moved from a low of about 205 million BTUs per heating degree day in fiscal year FY2014 to a high of about 270 million BTUs per heating degree day in fiscal year FY2012.

Accessible Text for Figure 6: Proposed Cogeneration System Using a Combustion Turbine

Water:

1. Heat recovery unit;
2. Steam;
3. Heating;
4. Capitol Complex.

Natural gas:

1. Combustion turbine - Hot exhaust gases go to Heat recovery unit";
2. Generator (Electricity);
3. Chillers - Excess electricity (not used by chillers and sold) goes to "Grid";
4. Chilled water;
5. Cooling;
6. Capitol Complex.

Source: GAO analysis of Architect of the Capitol planning documents. | GAO-15-436

Agency Comments

Architect of the Capitol

Page 1

Accessible Text for Appendix II: Comments from the Architect of the Capitol

Architect of the Capitol
U.S. Capitol, Room SB-16
Washington, DC 20515
202.228.1793
www.aoc.gov

July 22, 2015

Mr. Frank Rusco
Director, Natural Resources and Environment
U.S. Government Accountability Office
Washington, DC 20548

Dear Mr. Rusco:

Thank you for providing the Architect of the Capitol (AOC) with the opportunity to comment on the Government Accountability Office's (GAO's) draft report to the House and Senate Committees on Appropriations regarding ongoing strategies for cost savings at the Capitol Power Plant (CPP). The GAO's draft report addresses two topics:

Steps the AOC has taken to manage energy-related costs and plans to further manage these costs.

The process by which the AOC validated its decision to procure and construct a Cogeneration system.

I appreciate the GAO's recognition of the AOC's successful energy savings efforts. However, I disagree with the GAO's characterizations of the AOC's decision-making process to procure and construct a Cogeneration system.

Since 2011, I have testified before Congress about our need to build the Cogeneration plant and make this important investment in the CPP's infrastructure to support the Capitol campus. Our strategy to execute this project through a Utility Energy Service Contract (UESC) allows us to request appropriated funding for other critical infrastructure projects for which alternative funding sources are not available. This is a sound

investment strategy given that our backlog of Deferred Maintenance and Capital Renewal work currently exceeds $1.4 billion.

This letter provides additional documentation and further clarifies information previously shared with GAO to address the key points raised in the draft report. In this response the AOC will:

Further establish the urgent need to replace the existing 60-year-old coal boilers.

Further demonstrate the use of leading capital planning practices when evaluating and revalidating the need to construct a Cogeneration plant at the CPP.

Further detail the substantial benefits gained from Cogeneration over installing a new gas boiler.

Page 2

The GAO's draft report recommended the AOC fully update its long-term energy plan while following key leading capital planning practices prior to undertaking future major capital projects related to energy needs. The GAO specifically stated that the AOC should:

- Fully assess the complex's long-term needs and identify any performance gaps.
- Identify and evaluate a range of alternatives including non-capital options and energy conservation measures.
- Identify key assumptions and risks and perform valid sensitivity and uncertainty analyses.
- Seek an independent review of the plan to ensure it follows key leading practices and provide the result of the review to Congress.

Contrary to these recommendations and the assertions in the GAO's draft report, the AOC adhered to key leading capital planning practices based upon its 2009 Strategic Long Term Energy Plan (2009 Plan), 2014 revalidation efforts, and additional documentation included with this response. Given the urgent need to replace the existing 60-year-old coal boilers, there are substantial benefits gained from Cogeneration over installing a new gas boiler. In addition, the AOC has effectively implemented all of these recommendations in a manner sufficient to move forward with the planned Cogeneration project as explained below.

Image 1: Black and white photograph of a man working with a boiler.
Caption: Wickes Boilers that were installed in the Capitol Power Plant in the 1950s are still in use today.

- **The AOC fully assessed the complex's long-term needs and identified performance gaps:** The CPP Steam Load Forecasts and Wickes Boiler Replacement Justification (Attachment 1) fully explain how the AOC has already assessed the Capitol campus' long-term needs through replacing the CPP's aging boilers. The CPP's two oldest coal boilers have deteriorated and need to be replaced as soon as possible. These boilers can either be replaced in kind (with another boiler) or can be replaced with Cogeneration. While both a boiler and Cogeneration could produce the same amount of steam, Cogeneration also produces electricity. In addition to being a significantly more cost-effective use of taxpayer's dollars, Cogeneration offers a more resilient, efficient and environmentally-sound solution to modernizing the CPP.
- **The AOC identified and evaluated a range of alternatives, including non-capital options and energy conservation measures:** The AOC followed industry best practices and, in 2009, selected Cogeneration to replace the aging boilers. In 2014, in accordance with industry best practices, the AOC updated key assumptions used in the 2009 Plan and further evaluated the two technically-feasible options in extensive detail. The AOC validated that Cogeneration remained the best option. The AOC also has conducted additional exploration and evaluation of non-capital options, as well as the impact of past and future energy conservation measures. Attachment 1 further explains the impact of the AOC's energy conservation measures, and clearly shows they will have no effect on the need for Cogeneration.

Page 3

- **The AOC identified key assumptions and risks, and subsequently performed valid sensitivity and uncertainty analyses:** The Department of Energy (DOE) National Renewable Energy Laboratory (NREL) served as the independent third-party reviewer of the 2014 validation effort of Cogeneration, and conducted a deterministic sensitivity analysis of the project life-cycle cost. The AOC also used a third party to perform a probabilistic risk assessment of the project's construction cost. Following receipt of the GAO's Statement of Facts, the AOC used a third party to complete an additional probabilistic risk assessment of the project life-cycle cost in May 2015 (Attachment 2).
- **The AOC completed an independent review of the plan and provided the results to Congress:** Leading capital planning practices do not call for using independent review panels for a new plan or a validation effort. Nevertheless, the AOC engaged NREL to independently review the AOC's 2014 validation effort. NREL confirmed that the AOC's effort met or exceeded program

requirements, and subsequently both NREL and AOC staff briefed the Legislative Branch Appropriations Subcommittee staffs on the findings. Specifically, NREL noted that Cogeneration would save money with electric savings, revenues and lower maintenance costs overall.

Enclosed with this letter and its attachments are the AOC's technical and general comments to the GAO's draft report (Attachment 3).

Establishing the urgent need to replace the existing 60-year-old coal boilers

Image 2: Photograph of a damaged boiler machine.
Caption: After 60 years of use, the boilers have experienced advanced corrosion that has contributed to extensive and costly repairs.

The Capitol Power Plant began operating in 1910 to provide steam and electricity to just three buildings: the U.S. Capitol, the Library of Congress (Jefferson Building), and a new office building being constructed for the House of Representatives (Cannon Building).

Today, the CPP provides steam and chilled water to heat and cool 23 facilities on Capitol Hill. The CPP's steam plant infrastructure includes seven boilers; three Wickes boilers date back to when Dwight Eisenhower was president and Studebakers were a popular family car. Today, Studebakers are considered classics.

According to the American Boiler Manufacturers Association, the typical design life of boilers is 35 years, making the CPP's coal-fired boilers classics twice over.

Much like car enthusiasts rebuild the engine in a classic car -using spare parts wherever they can find them -the CPP mechanics must salvage for spare parts for these antiquated, obsolete boilers whenever they break down, which happens frequently.

For example, in December 2005, the CPP experienced a gear box failure on a coal boiler grate drive. The manufacturer was no longer in business and parts were not available. The CPP was able to locate a spare gear box at a military installation in Alaska, where the boilers had been decommissioned years

Page 4

before. After establishing an inter-agency agreement, the CPP had the gear box shipped via special overnight delivery in order to bring the coal boiler back into service.

The urgent need to replace the boilers also was made very clear on eight days between July 2014 and June 2015. On these eight days, the CPP did not have sufficient capacity to meet the peak winter steam demand. A major crisis was averted due to the fact the days for which insufficient capacity was available were during warmer months, however, the next time the CPP may not be so fortunate. This would have a significant impact on Congress' ability to conduct its business.

For an additional 138 days during this same time, due to needed repairs to critical boiler components, the CPP only had enough capacity to meet the peak winter demand. These periods of great risk to meeting demand are largely due to the fact that repairs were required on both of the existing 60-year- old coal boilers .

In 2009, a panel of industry experts noted that portions of the CPP are at the end of their useful life noting, "With growing public concern about improved energy efficiency, reduction of greenhouse gas emissions, and reduced dependence on imported oil, the renewal of the CPP and its distribution network presents a significant opportunity to showcase energy-efficient technologies and lead the nation by example."

Six years later, the situation has only grown more dire, and the risks associated with trying to maintain obsolete equipment continue to grow. Even though the 60-year-old coal boilers are effectively on life support, they are still relied upon when the CPP need s to meet peak demand each winter.

Comment 1 from GAO: We agree that CPP has equipment that may need replacement, in part or in whole, at some point in the future. However, AOC has not provided information on the likelihood of any such failures. After we provided our draft report to AOC for comment, the agency provided a new report on justifying the replacement of some of its older boilers, dated July 17, 2015, that provides anecdotes on problems AOC has overcome in maintaining the boilers but did not provide information quantifying the operational or budget impacts of these problems or estimates of the likelihood of a sudden failure of the boilers in the near future. Furthermore, AOC has not provided us with information—other than condition reports we reviewed finding that the boilers were in good to fair condition for their ages—supporting AOC’s claims that the boilers are effectively “on life support.”

In order to ensure that the CPP meets steam demand and upholds its mission to provide heat to congressional buildings 365 days a year, 24 hours a day, the AOC acted on the 2009 Plan's recommendation to install Cogeneration to address the serious and urgent need to replace the failing coal boilers.

I believe the coal boiler condition assessments, and other data provided to GAO, unequivocally demonstrate the need to replace the coal boilers. The reduction in available capacity of the CPP boilers, due to failure of

coal boiler components in 2014 for an extended period of time, further demonstrates that these boilers are beyond their useful lives. Recent failures include economizer leaks, bag house corrosion, antique control systems, flame scanner failures and coal scale failures. The AOC is providing additional documentation that summarizes previous condition assessments provided and further justifies the urgent need to replace the coal boilers (Attachment 1).

Even with the numerous energy reduction efforts put in place by the AOC, the peak steam demand for the Capitol campus will not be reduced to the point where the CPP can forego replacing the existing coal boilers. The following information further clarifies how the AOC evaluated the long-term campus steam demand requirements and revalidated the need for Cogeneration based on possible energy conservation measures and future campus development.

The design nameplate data for the CPP's boilers total a maximum steam supply of 620,000 pounds per hour. However, just as a driver wouldn't keep their foot constantly pressed down on the accelerator, it is not normal or prudent to run the boilers at 100 percent capacity. Considering this, along with the age of the boilers, and other boiler-specific limitations, the CPP uses the "average" capacity to determine

Page 5

the available capacity of the boilers. This results in a sustainable available capacity of 490,000 pounds of steam per hour.

Image 3: Graph titled “Illustration of CPP Boiler Capacity Scenarios”. See description in following paragraph

Accessible Text for Appendix II, Image 3: Illustration of CPP Boiler Capacity Scenarios

300,000 = Required capacity to meet the maximum expected winter steam demand.

Average Capacity: Boilers 1, 2, 3, 4, 5, 6, and 7 add up to almost 500,000. Boilers 1, 2, and 3 total more than 300,000.

Loss of One Boiler: Boiler 1 is gone. Boilers 2, 3, 4, 5, 6, and 7 add up to almost 400,000. Boilers 2, 3, 4, and 5 total 300,000.

Loss of One Boiler & No Coal Use: Boiler 3 is gone. Boilers 1, 2, 4, 5, 6, and 7 add up to less than 300,000.

No Coal Boilers: Boilers 1 and 2 are gone. Boilers 3, 4, 5, 6, and 7 add up to less than 300,000.

Due to the critical nature of the CPP to congressional operations, the CPP must be able to meet the peak steam demand even if a boiler fails due to a mechanical issue. A way to illustrate this situation is shown in the

chart above. The first column shows the total boiler (average) capacity of 490,000 pounds of steam per hour when all of the boilers are available. The next column represents the boiler capacity of 380,000 pounds of steam per hour if one of the large boilers failed. In this scenario, the CPP would still be able to meet the peak steam demand of 300,000 pounds of steam per hour. However, if the CPP were to lose one boiler and cease burning coal or lose both coal boilers, as shown in the last two columns, it would not have the capacity to meet the peak steam demand.

Comment 2 from GAO: We agree that AOC should operate and maintain CPP with the goal of meeting peak steam demand. However, AOC has not quantified any negative effects that would occur if CPP had to meet peak steam demand while operating its boilers only on natural gas and experiencing a temporary boiler outage. Furthermore, as AOC has noted, the proposed cogeneration system would not provide enough steam to allow AOC to meet its peak steam demand without using one of the two older boilers it intends to replace. Therefore, AOC will continue to incur some of the increased costs associated with infrequent use of one of the two older boilers that the agency stated the cogeneration project was meant to address. Furthermore, it is not clear when the agency intends to fully replace the capacity of the two oldest boilers. We therefore continue to believe that AOC should fully update its long-term energy plan while following leading capital-planning practices to ensure the agency fully assesses its needs and finds the most cost-effective ways to meet them.

Demonstrating the Use of Leading Capital Planning Practices when Evaluating and Revalidating Need to Construct a Cogeneration Plant

The AOC Used Leading Practices to Select and Revalidate Cogeneration: With the assistance of the National Academy of Sciences (NAS), in September 2009, the AOC completed its Strategic Long Term Energy Plan to guide future CPP renovations and identify options to improve its efficiency, reduce environmental impacts and provide cost savings.

The NAS committee noted, "The single greatest challenged faced by the CPP is the aging infrastructure and physical assets of the plant and distribution system. In 2002 the CPP started a major effort to expand its refrigeration plant to accommodate for increased load requirements of the new Capitol Visitor Center. This effort was the first such effort to renew or expand the capacity and capabilities of the CPP in over thirty years. Much of the steam plant and distribution infrastructure is also approaching or has already reached the end of its useful life."

Page 6

A broad range of technical options were considered, including options that focused on providing distributed steam and chilled water to buildings and decentralizing the CPP, as well as options that explored viable technologies to replace aging boilers and chillers. Specifically, the 2009 Plan provided a comprehensive look at the CPP's future, analyzed 20

different operational options, and ranked those options on the basis of economics, environmental benefits, energy savings and security/resiliency.

Comment 3 from GAO: We agree that AOC's 2009 long-term energy plan assessed a broad range of technical options for providing heating and cooling to the complex. However, given that many factors have changed that could potentially lead AOC to reach a different, more cost-effective solution to meet any future performance gaps, we continue to recommend that AOC fully update its long-term energy plan while following key leading capital-planning practices and seek an independent review of the plan and provide the results of this review to Congress. In its letter, AOC noted that the NRC committee that reviewed its 2009 plan stated that "electric generation (or Cogeneration) is the best long-term strategy for AOC to achieve its mission of reliable, cost-effective, efficient, and environmentally sound utility services." However, we did not find this statement in the NRC committee's 2009 report;[1] instead, it is an AOC statement included in its final 2009 long-term energy plan.

Each of the options considered examined the initial and life-cycle costs, environmental impacts, efficiency impacts and energy security. The NAS committee noted it was impressed with the depth of the AOC's efforts to explore various options for the CPP, and stated, "Now, as the CPP approaches its 100th anniversary, technology has changed again and electric generation (or Cogeneration) is the best long term strategy for AOC to achieve its mission of reliable, cost-effective, efficient, and environmentally sound utility services."

Attributes of the AOC Cogeneration Validation Process: The following table, "Attributes of the Architect of the Capitol's Cogeneration Validation Process," illustrates the progression of the AOC's efforts to plan and validate Cogeneration. It seeks to clarify Table 6 in GAO's draft report by the characterization of costs and summation of work involved.

[1]National Research Council: Committee on the Evaluation of Future Strategic and Energy Efficient Alternatives for the U.S Capitol Power Plant, *Evaluation of Future Strategic and Energy Efficient Options for the U.S. Capitol Power Plant* (Washington, D.C.; 2009).

Page 7

Data Table for Appendix II, Table 1: Attributes of the AOC Cogeneration Validation Process

	Plan	Vendor 1	Vendor 2
Attribute Noted in Architect of the Capitol Plan	2009 *Strategic Long Term Energy Plan: Final Report*	September 2013 Business Case Reviews and Bid	December 2014: *Cogeneration at the Capitol Power Plant: Project Summary*
Scope and Purpose of Proposed Cogeneration Systems	Phase 1: One 7.5 MW combustion turbine; Phase 2: One 7.5 MW combustion turbine; Phase 3: One 15 MW combustion turbine, as wells as five natural gas boilers, installed over three phases over 20 years	Two 7.5 MW combustion turbines (representing the first and second phases of the 2009 plan)	One 7.5 MW combustion turbine (representing the first phase of the 2009 plan)
Rough Order of magnitude	$120.3	n/a	n/a
Approximate Construction Cost – Estimate (millions)	n/a	$67.2	$55.5
Approximate Construction Cost – Bid (millions)	n/a	$117.1	$57.0
Third-Party Financing Costs (millions)	n/a	$69.4	$24.3
Total Project Cost (millions)	n/a	$204.9 [Note 1]	$85.4 [Note 1]
Peak Steam Generating Capacity of Combustion Turbines	Phase 1: 100,000 pph; Phase 2: 100,000 pph; Phase 3: 120,000 pph	200,000 pph	100,000 pph
Peak Steam Generating Capacity of New Natural Gas Boilers	340,000 pph	n/a	n/a
Provides Power to the Capitol Power Plant	Yes	Yes	Yes
Provides Power to Capitol Complex	Phase 1: No; Phase 2: No; Phase 3: Yes	n/a	n/a
Sells Excess Power to Electricity Grid	Yes	Yes	Yes
Long-Term Steam Demand Forecasts	Yes	Yes	Yes

Note 1: Total Project Cost figure excludes AOC project management and funds AOC has obligated to date.

Page 8

Effectively, the AOC has progressed through three key milestones:

- The 2009 Plan identified the need for Cogeneration
- Additional validation and procurement of a UESC with the first vendor
- Additional validation and procurement of a UESC with a second (current) vendor

A significant correction to GAO's Table 6 is the elimination of the "July 2014" column. That column mischaracterizes the effort associated with that stage of review and study by the AOC as being "final." Actually, and as the AOC previously indicated to GAO, the July 2014 effort was undertaken in an investigative manner and served as draft input for the Project Summary produced by the AOC in December 2014. The remaining rows represent the attributes described in a more accurately comparative manner than GAO's previous table.

Comment 4 from GAO: AOC sought to clarify the progression of its planning efforts, which we summarized in Table 6 in our report. However, it is unclear why AOC stated that we mischaracterized its July 2014 *Strategic Long Term Energy Plan Update: Draft Final Report*, which we described as a draft plan throughout our report. In August 2014, we discussed with AOC shortcomings in its planning for the cogeneration project relative to leading practices and referred the agency to documents outlining these practices. AOC officials later wrote that the agency addressed the presented shortcomings by completing the December 2014 draft plan and supporting documents, which called for a cogeneration system with a configuration that differed from the July 2014 draft plan.

The comprehensive review and revalidation work the AOC has completed continues to show that reliable capacity to meet peak steam demand is urgently needed, and that Cogeneration is the best course of action to meet that need. The 2014 revalidation of the 2009 Plan evaluated both Cogeneration and a gas boiler, implementing either technology using appropriated funds or a UESC. An independent review by NREL substantiated the AOC's conclusion that Cogeneration is the best, most reliable and most cost-effective option. This conclusion took into account the unlikely availability of appropriated funds for construction, life-cycle costs, energy efficiency, reliability and security, and environmental impacts.

During the AOC's 2014 revalidation, which was fully consistent with OMB guidelines, the AOC addressed the key steps GAO recommended as important with regard to leading capital planning practices. The AOC considered:

Comment 5 from GAO: AOC stated that its 2014 revalidation addressed the key leading capital-planning practices we cited, but this revalidation focused on two technical options and did not, as called for in leading practices, fully assess the complex's long-term needs and identify and evaluate a full range of options for best meeting those needs. We continue to maintain that, prior to undertaking major energy projects, AOC should fully update its 2009 long-term energy plan as called for in leading

capital-planning practices, given that key factors have changed that could have changed the plan's conclusions.

- Changes in demand, including the impacts of energy conservation measures, gas and electric prices, construction and life-cycle costs, and interest rates.
- Capital and non-capital alternatives to filling the performance gap that requires urgent attention.
- Key assumptions and risks by performing valid sensitivity and uncertainty analyses under various potential future conditions, and the AOC had its validation effort independently reviewed.

While leading practices call for validating planning decisions prior to acquisition, there is no requirement that this be done in one document. The AOC's iterative process to re-examine needs and requirements, technologies and other alternatives, life-cycle costs, risks, and other evaluation factors further confirmed that Cogeneration is the best option. Further, the application of sound engineering judgement enables the AOC not to repeat previous efforts but to further build upon viable options, thereby saving hundreds of thousands of dollars.

The AOC Fully Assessed Long-Term Needs and Identified Performance Gaps: There is an urgent need to replace the 60-year-old coal boilers to meet current steam load requirements. The AOC completed an evaluation and redeveloped its long-term steam load forecasts to address this urgent need. The results are briefly summarized below and the full analysis is provided in Attachment 1.

Comment 6 from GAO: AOC stated that it completed an evaluation and redeveloped its long-term steam demand forecasts to address the urgent need to replace its older coal-firing boilers. We did not assess the validity of this evaluation because AOC did not provide it, or make us aware of it, until after we had sent the draft report to the agency for its comments. This evaluation did not accompany the agency's December 2014 draft plan, which AOC used to justify the need for and scope of the proposed cogeneration project.

Page 9

To assess the long-term needs and consider possible demand changes, it is important to discuss two criteria: maximum steam demand and expected annual steam consumption.

Maximum Steam Demand: On the coldest days of the year, the congressional buildings under the AOC's care require sufficient steam to maintain comfortable indoor temperatures. The AOC designs its heating systems to maintain constant indoor temperatures down to an outside temperature of zero degrees Fahrenheit. Energy conservation measures can contribute some reduction in the peak steam loads, including lowering the amount of fresh outdoor air to condition, and/or sealing the building envelope.

1. Reduction of Steam Demand. The AOC's conservation efforts have reduced maximum steam demand from 325,000 pounds per hour to 300,000 pounds per hour. While the energy conservation efforts have reduced annual energy consumption by 30 percent , peak loads are down only 8 percent. Output from the two coal boilers is still required to meet the current peak steam demands. Cogeneration simply replaces the capacity of these unreliable boilers .
2. Reduction of Steam Load. The AOC has identified an additional $100 million in unfunded energy conservation measures that could result in an additional 20,000 pounds per hour reduction to the CPP's maximum steam loads. The majority of the peak steam reductions could be realized in the Library of Congress buildings and the Thurgood Marshall Federal Judiciary Building through appropriated or performance-based energy conservation projects. These projects could lower the peak steam load to 280,000 pounds per hour. In this scenario, the need for steam production by the coal boilers would still be required to meet the peak load of 280,000 pounds per hour.

Annual Steam Consumption: The CPP continues to rely on the coal boilers to meet current and future expected peak demand requirements. This takes into account reductions in demand from completed energy conservation measures. However, the AOC's completed energy conservation measures have not reduced the peak steam demand as significantly as it has reduced the CPP's overall steam use. Even if the AOC were to request and receive an additional $100 million in appropriated funds or use an Energy Savings Performance Contract to implement future energy reduction projects, this would not significantly reduce peak steam demand enough to eliminate the need to replace the coal boilers. To analyze the merits of any potential new steam generation solution, there is a need to understand how much steam will be required annually. The annual consumption requirements will help determine energy inputs required by various systems (i.e., Cogeneration or a gas boiler) and all systems should be evaluated using the same expected annual consumption. As such, the AOC conducted economic analysis of consumption data for the current and future years.

Consumption Data for Current Year: In late 2014, the AOC used the CPP's 2013 annual consumption data to run the economic analysis of various options. It is important to note that the 2014 consumption data for the economic analysis work was not used as the CPP's 2014 consumption was skewed higher by record cold winter weather in January through April 2014. The CPP's 2015 steam consumption data are nearly identical to its 2013 consumption data. Therefore, the economic analysis

was completed using the most relevant, current, annual consumption data.

Page 10

The AOC Identified and Evaluated Alternatives Including Non-Capital Options and Energy Conservation Measures:

Comment 7 from GAO: We agree that AOC reviewed a broad range of options for meeting its long-term needs in its 2009 long-term energy plan. However, AOC did not examine non-capital options in the 2009 plan—such as operational changes or conservation measures—and it is unclear how or when AOC assessed some of the capital or financing options it cited in its written comments. Since 2009, AOC has assessed two capital options—a cogeneration system or a natural gas boiler. From 2009 to the present, many factors have changed that could potentially lead AOC to reach a different, more cost-effective solution to meet its needs. Therefore, we continue to believe that AOC should identify and assess a wide range of options for meeting its needs in a full update of its long-term energy plan.

Alternative Technologies: As part of the AOC's due diligence, it reviewed the broad range of options assessed in its 2009 Plan. Following consultations with industry trade groups and others, the AOC determined that there were no new feasible technologies on the market that had a practical use on the Capitol campus. The only feasible capital options available to the CPP are Cogeneration and a new gas boiler.

Non-Capital Options: The AOC examined several non-capital alternatives and none were deemed to be practical. These included various forms of privatization, such as Enhanced Use Leasing, purchasing steam from GSA, or borrowing from the Federal Financing Bank. In addition, the CPP cannot suddenly stop providing steam to the customers it serves by law, as referenced in GAO's draft report, at least in the short term.

In these fiscally challenging times, the AOC is not likely to receive appropriated funds for Cogeneration construction. It is unclear when or if the AOC would receive appropriated funds for a new gas boiler, making a public-private partnership for Cogeneration, as proposed under a UESC, the most sound and practical path forward. The CPP also researched the possibility of using an Enhanced Use Lease, a form of privatization; mechanisms used by the Department of Defense for acquiring on- base utility services; and borrowing from the Federal Financing Bank. Any of these alternatives would potentially require some form of legislation to give the AOC the authority to proceed. Therefore, none of these options are viable to meet the AOC's current needs. The AOC even discussed other alternatives with GAO staff familiar with challenges faced by federal agencies in obtaining funding for capital investments. However, they were unable to assist in identifying other options.

Energy Conservation Measures: The AOC conducted additional sensitivity analyses of Cogeneration and new gas boiler project economics in a scenario where steam consumption is reduced further in the future. In this analysis, the AOC developed a low steam case that assumed the CPP's steam loads would be reduced by an additional 20 percent. This scenario would require completion of the $100 million in identified but unfunded energy conservation projects, the 10-year Cannon House Office Building Renewal project, and the renewal of an additional 1.7 million square feet of space connected to the CPP. The total investment in these projects would exceed $2 billion.

Comment 8 from GAO: We have not assessed AOC's additional sensitivity analysis, as the agency provided it after we had completed our draft report. We do not know the basis for AOC's statement that the group of energy conservation measures it identified would reduce the complex's steam demand by 20 percent or the basis for the statement that the cost of the measures—including some or all of the costs of the Cannon House Office Building Renewal project—would exceed $2 billion.

The AOC appropriately concluded that this scenario represents the highest level of energy conservation possible within its portfolio; in total, a 50 percent reduction from its 2003 baseline. The UESC-financed Cogeneration project still carried a positive net present value. The financed gas boiler option, using these reduced loads, had potential for a negative net present value. If future steam demand grows, the net present value economics of Cogeneration improves from the base analysis as more of the produced electricity is used within the CPP for chilled water generation versus exported to the electrical power grid.

Recently, Executive Order 13693 was issued requiring the federal government to further reduce energy consumption by 25 percent between 2015 and 2025. Should Congress adopt these new goals for all federal facilities, as it did with the Energy Independence and Security Act of 2007, which required a 30 percent reduction in energy consumption over 10 years, Cogeneration would be a key component in the AOC's overall strategy to meet future energy reduction goals.

Page 11

The AOC Identified Key Assumptions and Performed Valid Sensitivity and Uncertainty Analyses: GAO's draft report is incorrect in stating that the AOC did not update its 2009 Plan in response to changes in key assumptions since that time, including natural gas prices and steam demand. To the contrary, the AOC did update the key assumptions in its validation effort during the course of GAO's review. In updating the life-cycle cost analysis in 2014 and early 2015, the AOC used current information on steam demand, gas and electric prices, interest rates, and construction and maintenance costs. These analyses were included in the

Project Summary spreadsheets previously provided. GAO declined the AOC's offers to discuss these spreadsheets.

Comment 9 from GAO: AOC disagreed with our statement that the agency did not update its 2009 long-term plan in response to changes in key assumptions, citing the analyses it performed in 2014 and 2015 on the life cycle costs of the proposed cogeneration system and an alternative of a natural gas boiler. However, AOC did not update the key assumptions in the context of a full update of its 2009 plan, which assessed a broad range of options for meeting the complex's heating and cooling needs. AOC stated that it included updated assumptions in its spreadsheets on the life cycle costs of the proposed cogeneration project and a natural gas boiler alternative, and stated that we declined its offers to discuss these spreadsheets. However, we reviewed these spreadsheets containing AOC's life cycle cost analyses and identified shortcomings that we describe in our report.

To address GAO's initial inquiries, in October 2014, the AOC completed a probabilistic risk assessment consistent with GAO's cost estimating guidelines on Cogeneration's construction cost, specifically applicable to the UESC program. The results showed that the AOC could be highly confident of completing construction within budget. The AOC also completed a deterministic sensitivity analysis of key factors on the overall project life-cycle cost. However, when GAO delivered its Statement of Facts in April 2015, it became clear that it was looking for a probabilistic risk assessment of the life-cycle cost for Cogeneration.

Therefore, in May 2015, the AOC completed a probabilistic risk assessment consistent with GAO's cost estimating guidelines. Again, this showed that considering the key assumptions, sensitivities, risks, and uncertainties associated with Cogeneration and a new gas boiler, the AOC is highly confident that Cogeneration, financed using a UESC, will provide savings to Congress and the American taxpayers. It also has a better net present value than installing one gas boiler.

Comment 10 from GAO: AOC stated that it completed a probabilistic risk assessment in May 2015 that was consistent with GAO's Cost Estimating Guide, which identifies some key leading capital-planning practices. However, AOC did not make us aware of or provide this assessment until after we had completed our review and prepared our draft report.

The probabilistic risk assessment identified and quantified the cost drivers that pose the most risk of increasing project cost when considered alone, and captured the cumulative effect of various risks expected. The bottom line showed that the expected net present value of Cogeneration is positive and greater than the expected positive net present value of installing a gas boiler. Based on data available as of the July 2015 receipt of GAO's draft report, with respect to Cogeneration , the study concluded that the CPP can be 64 percent confident that the proposed system will generate the $7.3 million net present value (NPV) that has been estimated as part of the revalidation effort. The confidence levels derived from these analyses are well within the range GAO considers desirable, which is between 55 and 80 percent.

The analysis also shows the resultant expected NPV to be approximately $3.6 million higher, or totaling closer to $11 million, and 86 percent confidence that Cogeneration will provide a positive payback over a 25-year period. In addition, while GAO's draft report refers to the project being financed over a 27-year analysis period , under the AOC's current proposed project execution plan, the period is actually 23 years, comprising approximately two years for construction performance and 21 years for loan payback.

The AOC Completed an Independent Review of the Plan: The AOC has adhered to key leading capital planning practices, and has effectively performed all of these recommendations in a manner fully sufficient to move forward with Cogeneration. In fall 2014, the AOC engaged NREL to review its revalidation effort regarding the 2009 decision to proceed with Cogeneration. NREL concluded that the AOC had thoroughly addressed the relevant issues and met or exceeded UESC program requirements.

Comment 11 from GAO: AOC stated that the Department of Energy's National Renewable Energy Laboratory (NREL) provided an independent review of its December 2014 draft plan, which compared the proposed cogeneration system to an alternative of a natural gas boiler. NREL's review of a partial update to a 2009 plan, rather than a full update, does not address our recommendation. AOC needs to fully update its long-term energy plan and then seek outside review by an independent panel of experts, as it did in 2009.

Page 12

NREL's conclusions also noted that "the selection of the Combined Heat and Power (CHP) option is a better option than a new 100,000 pound per hour gas boiler for a number of reasons."

Image 4: Complex flow chart. Refer to the following accessible table.

Data Table for Appendix II, Image 4

147 Units Fuel	Conventional Generation				Combined Heat and Power: 5 MW Natural Gas Combustion Turbine and Heat Recovery Boiler	100 Units Fuel
Power Station Fuel (U.S. Fossil Mix) – 91 Units Fuel [Arrow right]	**Power Plant** (Efficiency: 33%0	Electricity [Arrow right]	30 Units Electricity	Electricity [Arrow left]	**Combined Heat & Power (CHP)**	100 Units Fuel [Arrow left]
56 Units Fuel – Boiler Fuel [Arrow right]	**Boiler** (Efficiency: 80%)	Heat [Arrow right]	45 Units Steam	Heat [Arrow left]		
Overall Efficiency	51%				75%	

The NREL-produced graphic (previous table) illustrates the difference in efficiencies between Cogeneration and a gas boiler

After careful review and appropriate updating, the AOC does not believe that another independent panel review of the 2009 decision to use Cogeneration to provide reliable capacity to meet peak steam demand is necessary nor cost effective.

This is particularly apparent when considering the results of the work done to address expected future demand, changes in utility prices and the risks associated with Cogeneration.

Cogeneration Provides Many Benefits and Is Ready to Proceed

The AOC performed an extensive comparative analysis between a boiler and Cogeneration, and determined that Cogeneration is the best option for the Capitol campus.

Comment 12 from GAO: We agree that cogeneration can offer benefits in certain settings. However, given the significantly higher upfront costs of cogeneration when compared to alternatives like a natural gas boiler, it is important that the planning involved in selecting the technology over viable alternatives exhibit the aspects of key leading capital-planning practices we cited—such as fully assessing needs, assessing a range of alternatives, and using valid sensitivity and uncertainty analyses to identify key risks and confirm the superiority of a chosen option over its alternatives. To ensure that AOC's choices for meeting its long-term energy needs result from planning that exhibits these leading practices, we continue to believe that AOC should fully update its long-term energy plan while following the key leading practices we cited.

Cogeneration inherently is more energy efficient than producing steam and electricity separately. The overall energy efficiency of Cogeneration is typically 75 percent efficient whereas the overall energy efficiency of separately producing steam and purchasing electricity is 51 percent efficient as show in the above graphic.

Cogeneration lowers the impact on the environment. By burning less fuel than the boiler option of producing steam and purchasing electricity, the Cogeneration plant would reduce emissions of hazardous air pollutants by 18 percent and have a lower carbon foot print.

Cogeneration provides increased energy reliability and security for Congress. The planned 7.5 megawatt system would allow the CPP to continuously produce enough electricity to fully power the steam plant and about 20 percent of the refrigeration plant which better supports the Capitol campus in the event of a power failure.

Based on this analysis, as supported by a panel of national experts and validated by NREL, Cogeneration is the most cost-effective, energy-efficient and environmentally-friendly solution to modernize the CPP.

Cogeneration is a proven technology -there are more than 4,400 Cogeneration facilities throughout the United States. It also provides other benefits , including enhanced energy efficiency, reduced environmental emissions, increased energy reliability and security. Most importantly, it provides a

Page 13

return on the government's investment without imposing undue risks as evidenced by results of the AOC's probabilistic risk assessment.

While the CPP has air permits from the District of Columbia for Cogeneration construction, the permits expire in June 2016. If construction is not substantially underway by this time, the CPP will be at risk of losing the construction permit. It would likely take 12-18 months to receive a new construction permit, during which time, no work on Cogeneration can proceed . Should this happen, Congress will be at risk of not having sufficient steam for peak demand, and the CPP would almost certainly face higher construction costs due to price escalation.

Comment 13 from GAO: AOC stated that the construction permit for the proposed cogeneration project will expire in June 2016 and that fully implementing our recommendations would introduce a delay of approximately two years to either option for obtaining additional steam generating capacity. We maintain it is important for AOC to make the correct decisions about its capital and long-term energy needs through planning that follows key leading capital-planning practices, regardless of when any permits may expire for a particular project. Furthermore, AOC did not provide a basis for its claim that fully updating its long-term energy plan would cause a delay of an additional two years to either option for adding new steam generating capacity, and if AOC's claim is accurate then the agency should start the update as expeditiously as possible. Therefore, we continue to recommend that AOC fully update its long-term energy plan while following leading capital-planning practices before undertaking future major capital projects related to its energy needs.

If the CPP acquired a new gas boiler, it must first obtain necessary air permits, which would be a lengthy process, secure appropriated funds, and procure design and construction services. While Cogeneration could be operational by 2017 if construction began soon -assuming that appropriated funds are received for a gas boiler -it is likely that a new boiler would not be operational until 2018, at the earliest. Preparing a new plan, as suggested by GAO, would add approximately two years to the timeframes for both options.

In addition to the increased reliability and efficiencies the CPP will realize with Cogeneration, it will provide a number of other benefits that were not included or elaborated upon in GAO's draft report. Specifically, on a regional basis, Cogeneration also provides significant reductions in the CPP's emissions and improves energy efficiency as well as energy security as discussed below.

Environmental Impacts - Cleaner Electricity and Improved Air Quality: Since 2007, the CPP has steadily increased its reliance on natural gas as its primary fuel source. While the AOC has reduced coal use at the CPP over the past several years, it cannot cease using coal completely until the Cogeneration plant is constructed. The reduction of coal use at the CPP has significantly reduced annual emissions of key criteria pollutants such as sulfur dioxide (S02), nitrogen oxides (NOx) and particulate matter (PM). The AOC has seen similar reductions in Hazardous Air Pollutants (HAPs), and in carbon dioxide equivalent (C02e) emissions.

Comment 14 from GAO: We agree that AOC faces limits on its continued use of coal at CPP and on its emission of air pollutants, and we believe AOC should factor in such constraints in a full update of its long-term energy plan.

The permits obtained to install Cogeneration impose very stringent emissions limits at the CPP. The new emissions limits in the EPA and DDOE permits set significant reductions in allowable emissions from the CPP when compared to the previous permits. For example, NOx emissions limits will be reduced by 78 percent. Further, when compared to the use of one coal boiler, Cogeneration is significantly cleaner than the coal-fired boiler.

The environmental benefits of Cogeneration reach beyond the emissions corning from the CPP and have a much more dramatic impact on emissions regionally in the District of Columbia, Maryland and Virginia. This is because the emissions corning directly from the CPP are only part of the overall picture. A secondary benefit of Cogeneration will be the decrease in emissions regionally through the clean and efficient generation of electricity. Over 45 percent of the electricity in the DC Metro region is generated by coal [Note 2]. By generating electricity using natural gas, the CPP will reduce its purchase of electricity. Additionally, the electricity the AOC purchases for the Capitol campus is typically generated at approximately 33 percent efficiency, while the electricity generated by Cogeneration is generated at approximately 60-80 percent efficiency. The use of natural gas and increased efficiency of

Note 2: EPA eGrid2012 Version 1.0 year 2009 Summary Tables

Page 14

Cogeneration lead to significant regional reductions in emissions, and is a collateral project benefit to public health and the environment from this project.

Installing Cogeneration will significantly reduce NO_x, SO_x and greenhouse gas emissions, helping to improve the air quality in the District of Columbia. For example, the benefit of installing Cogeneration over the current practice of importing electricity from a coal-fired power plant could be equivalent to reducing the amount of greenhouse gas emissions associated with the operation of 15,000 vehicles each year [Note 3].

Energy Security: The implementation of Cogeneration would address a growing concern -the CPP's energy security due to the availability of an on-site source of electric generation in the event of a regional or local electrical power grid outage. There have been numerous occurrences of wide-spread electrical service outages by the local utility company over the past decade, as well as troubling manhole cover explosions and fires. Because the mission of the CPP is to provide uninterrupted steam and chilled water service to Congress, the possibility of an interruption in electrical power to the CPP is of particular concern. The AOC's analysis has shown that only Cogeneration provides improved energy security at the CPP.

Additional Clarifications to the GAO's Draft Report

The AOC is providing technical corrections to GAO's draft report along with this response. The information below provides additional clarification to specific statements included in GAO's draft report.

Clarity of Leading Practice Guidance: GAO's draft report suggests the capital planning guidance it cites is clear and leaves no room for misunderstanding or misinterpretation by agencies regarding the information to be collected, analyzed, included or reviewed in a capital planning document. This was not the AOC's experience. GAO's and OMB's capital planning guidance cited by the GAO conflicts with NIST 135 (e.g. application of sensitivity analysis to fuel price escalation rates). In other areas, such as the use of expert panels, their guidance is silent.

Comment 15 from GAO: AOC stated in its letter that our report suggested that capital-planning guidance is clear and leaves no room for misunderstanding or misinterpretation by agencies. During the course of our review, and after receiving a preview of our report's findings, AOC officials said they were generally unaware of the applicability of the leading practices we cited. We identify in our report GAO's prior work that recommends the use of independent panels by agencies when addressing complex issues such as those facing AOC, and as the agency itself used in 2009 to review its draft long-term energy plan. As part of fulfilling our recommendation that the agency fully update its long-term energy plan while following leading capital-planning practices, we continue to believe AOC should submit the plan for review by an independent panel of experts and submit the results to Congress.

GAO's and OMB's guidance applies to capital planning in general, while NIST 135 is applicable specifically to energy-related capital projects. With respect to sensitivity analyses, NIST 135 reflects a requirement as opposed to guidance. Both GAO's and OMB's guidance focuses on developing new plans, whereas OMB's guidance recognizes that time lapses between a plan's completion and project acquisition. It also provides for a validation of the planning decision during the acquisition phase. OMB's guidance does not specify that validation efforts must include the development of an entirely new plan or "full update."

Both GAO's and OMB's capital planning guidance cites examples of the types of information considered important, but neither definitively specify what must be included in capital planning documents or how the information should be conveyed. OMB's guidance states that agencies can tailor its guidance to their needs as long as the basic thrust of its guidance is captured. OMB's guidance also acknowledges that all an agencies' information related to capital planning does not have to be in one document, although it suggests that the key information be captured in an executive summary.

Note 3: http://www.epa.gov/cleanenergy/energy-resources/refs.html

Page 15

Project Prioritization: In GAO's draft report, it correctly states that the AOC did not assess the planned Cogeneration project through its capital planning prioritization process. This process seeks to rank proposed projects and recommends the highest ranking for annual appropriated funding. GAO's draft report further says that, consequently, the AOC did not analyze the project and its merits relative to other projects using its criteria for capital planning.

Comment 16 from GAO: AOC did not assess the proposed cogeneration project using its capital planning prioritization process for projects to be funded with upfront appropriations, stating that it is the agency's strategy to use a UESC to finance the proposed cogeneration project—thereby allowing AOC to request appropriations to fund other critical infrastructure projects for which AOC stated such alternative funding sources are not available. As we stated in our report, by not assessing the proposed project using the agency's capital planning prioritization, AOC did not analyze the project relative to other projects for which the AOC was seeking appropriated funding using the agency's pre-determined criteria for capital planning.

This is not the case. The AOC uses its prioritization process to evaluate the most efficient and cost- effective means of executing projects through the use of appropriated funds. Outside of a small percentage of funds devoted to project management costs, the AOC did not intend to request annual appropriations for the planned Cogeneration project and has testified before Congress that it intends to use a UESC. Therefore, the

AOC appropriately did not include this proposed project in the annual prioritization process for appropriated projects.

Cogeneration has been analyzed for its merits using much of the same criteria used in the project prioritization process. For example, it has been assessed for regulatory compliance, resilience and security, mission accommodation, economics, and energy conservation. The AOC took these same components into consideration during development of the 2009 Plan while formulating the project business case, and during validation efforts with each of the potential UESC vendors. So, while Cogeneration was not prioritized against other capital projects for which the AOC was seeking appropriated funding, it did receive the same level of scrutiny.

Project Design, Preconstruction, and Execution Costs: While the Cogeneration project has incurred obligations to date of approximately $16 million, procurement of a gas boiler would have required use of a significant portion of this same amount of funds. As alluded to in GAO's draft report, more than 50 percent of the obligated funds were used for planning and development, engineering, permitting, preparation of the space to receive the new Cogeneration equipment, and the agency's management of the overall effort. Due to the then-existing state of the receiving facility, this allocation of funds would have been necessary regardless of which option was selected.

Comment 17 from GAO: We agree that, like the proposed cogeneration project, AOC would have incurred some pre-construction obligations for design and project management to replace the steam-generating capacity of one or both of its older coal-firing boilers with a natural gas boiler. AOC's draft December 2014 plan shows that a natural gas boiler providing the same amount of steam as the proposed cogeneration system would cost approximately $9.3 million. It is not clear to what extent this estimate includes pre-construction obligations, which for the cogeneration project totaled about $16 million as of March 2015.

In addition, for technical consistency and in following key leading capital planning practices, it would be inappropriate for the AOC to "have procured a natural gas boiler" without a full evaluation of parameters and variables associated with such a decision. Similar to the expectations for any major capital energy project, the AOC should be expected to evaluate and forecast campus demand, utility rates, regulatory environment, current market, etc., prior to making any decision to invest in a gas boiler. To do any less in a rush to replace the old coal boilers would be a misapplication of current guidance. The AOC's 2014 revalidation efforts included re-examining the gas boiler option compared to Cogeneration in light of the relevant evaluation factors in a manner consistent with leading

capital planning practices. It was determined that Cogeneration remains the superior option.

The Need to Maintain One Coal Boiler in Operating Condition: While the CPP can maintain adequate redundancy given the loss of a single coal boiler, as demonstrated in winter 2014, it cannot maintain adequate capacity to meet peak demand if both coal boilers fail. Replacing a single coal boiler will add sufficient reliable capacity to meet peak demand if a single boiler fails. While the CPP believes that replacing both coal boilers is a priority, it is critical to replace one as soon as possible.

Comment 18 from GAO: We agree that CPP may not be able maintain adequate capacity to meet peak demand should both older coal-firing boilers fail at the same time, but this does not change the need for AOC to fully assess its long-term energy needs and evaluate a range of alternatives for meeting them in the context of a full update of its long-term energy plan.

Page 16

Using a Public-Private Partnership to Finance Cogeneration Project.: In these fiscally challenging times, the AOC is not likely to receive appropriated funds for Cogeneration construction. It is unclear when or if the AOC would receive appropriated funds for a new gas boiler, making a public-private partnership for Cogeneration, financed with a UESC, the most practical path forward.

Comment 19: AOC officials stated appropriations would likely not be available for the cogeneration project and therefore selected a UESC to finance the project. Because the agency did not intend to use upfront appropriations to acquire the system, AOC did not assess the project using its capital planning prioritization process. As we reported, acquiring the system using a UESC results in more upfront costs and financing costs than if the agency used upfront appropriations. AOC stated that it discussed its funding challenges with GAO, but it is not GAO's role to advise agencies as they seek funding for their proposed capital projects.

OMB specifically cites funding availability as an important factor to consider in capital planning. The AOC even discussed other alternatives with GAO staff familiar with challenges faced by federal agencies in obtaining funding for capital investments. However, they were unable to assist in identifying other options.

The AOC engaged NREL in fall 2014 to independently review its analyses of the gas boiler and Cogeneration options to ensure they met UESC program requirements. NREL concluded that the CPP met or exceeded these requirements.

Conclusion

The selection and revalidation of Cogeneration have been iterative processes, and the AOC has followed relevant key federal capital planning practices. As a result, the AOC has revalidated that

Cogeneration is the best option to deliver the utility needs of the Capitol campus. This letter has further established the urgent need to replace the existing 60-year old coal boilers; demonstrated that the AOC used leading capital planning practices when evaluating and revalidating the project, and has detailed the substantial benefits of Cogeneration.

Comment 20: AOC stated that its selection of the proposed cogeneration project and its revalidation efforts have followed key leading practices. However, as we state in our report and our response, we remain unconvinced that AOC's planning followed key leading capital-planning practices and therefore AOC has not demonstrated whether the proposed cogeneration project will prove more cost-effective than other alternatives for meeting the agency's needs. We therefore continue to recommend that AOC, prior to undertaking major energy projects, fully update its 2009 long-term energy plan while following key leading capital-planning practices, including: fully assessing its energy needs, identifying and evaluating a range of alternatives for meeting its needs, and identifying key assumptions and risks and performing valid sensitivity and uncertainty analyses. We also continue to recommend, given the complexity of the issues it is facing, that AOC seek a review by an independent panel of experts as it fully updates its long-term energy plan and provide the results of this review to Congress.

After more than 100 years in operation, significant investment is needed to replace aging infrastructure and equipment in the Capitol Power Plant as it plays an essential role in the AOC's long-term energy conservation efforts.

In my professional opinion, Cogeneration is the most cost-effective, energy-efficient and environmentally-friendly solution to provide for the utility needs of the Capitol campus. Our strategy to execute this project through a UESC allows us to request less in appropriated funds and address other critical infrastructure issues through direct appropriations.

We used key leading practices to perform an extensive comparative analysis between a boiler and Cogeneration, and have determined that it is the preferred option for a variety of reasons.

Cogeneration is a superior investment and it is more energy efficient than a boiler. This technology is inherently more energy efficient than producing steam and electricity separately.

Cogeneration lowers the impact on the environment. By burning less fuel than the boiler option of producing steam and purchasing electricity, Cogeneration reduces emissions of hazardous air pollutants and has a lower carbon footprint.

Cogeneration provides increased energy reliability and security for Congress. This 7.5 megawatt system allows the CPP to continuously produce enough electricity to fully power the steam plant and about 20

percent of the refrigeration plant which, along with emergency generators, better supports the Capitol campus in the event of a power failure.

Page 17

Cogeneration is a proven technology and is currently used in more than 4,400 facilities across the country. Cogeneration is considered a best practice and supported by the Department of Energy and the Environmental Protection Agency for use in district energy systems.

Based on this analysis, as supported by a panel of national experts and validated by NREL, Cogeneration is the most cost-effective, energy-efficient and environmentally-friendly solution to modernize the CPP, and we should continue to move forward with this vital project.

Again, thank you for this opportunity to provide additional information and clarity on these important subjects. Should you require additional information or clarification, please don't hesitate to contact my office at 202.228.1793.

Sincerely,

Signed by
Stephen T. Ayers, FAIA, LEED AP
Architect of the Capitol

Attachments

Doc. No. 1507 15-18-0 1