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# GREEN INFORMATION TECHNOLOGY

Agencies Have Taken  
Steps to Implement  
Requirements, but  
Additional Guidance  
on Measuring  
Performance Needed

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## Why GAO Did This Study

The federal government's substantial use of information technology (IT) contributes significantly to federal agencies' energy use and environmental impact. To help mitigate this impact, organizations have adopted practices for using computing resources in a sustainable and more environmentally friendly manner—sometimes referred to as “green IT.” These practices include equipment acquisition, use, disposal, and related processes.

GAO was asked to (1) determine the extent to which the government has defined policy and guidance on green IT and how selected federal agencies are implementing this policy and guidance, and (2) identify leading green IT practices used by federal agencies, state and local governments, and private-sector organizations. To do this, GAO evaluated federal guidance and policy, as well as guidance and initiatives at selected agencies; identified and characterized efforts in the public and private sectors; and interviewed officials.

## What GAO Recommends

GAO recommends OMB and CEQ develop green IT guidance to help agencies more effectively measure performance and encourage the use of leading practices. In comments on this report, OMB and CEQ partially concurred with the recommendations. They agreed to encourage the use of leading green IT practices but did not agree that additional guidance was needed for measuring performance. GAO continues to believe that additional guidance is needed to help determine the effectiveness of agencies' efforts.

View [GAO-11-638](#) or key components. For more information, contact David A. Powner at (202) 512-9286 or [pownerd@gao.gov](mailto:pownerd@gao.gov) or Frank Rusco at (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov).

## GREEN INFORMATION TECHNOLOGY

### Agencies Have Taken Steps to Implement Requirements, but Additional Guidance on Measuring Performance Needed

## What GAO Found

Two executive orders, from 2007 and 2009 respectively, assign responsibility to federal agencies for increasing their environmental sustainability and contain green IT-related requirements. These requirements include acquiring electronic products that meet certain environmental standards, extending the useful life of electronic equipment, implementing power management on computers, and managing federal data centers in a more energy efficient manner. In meeting these and other sustainability requirements, agencies are required to designate senior sustainability officers and develop performance plans that prioritize actions for meeting the requirements in the executive orders. The six agencies in GAO's review (the Departments of Agriculture, Commerce, Energy, and Health and Human Services; the Environmental Protection Agency; and the General Services Administration) have developed sustainability performance plans and taken additional steps to implement the executive orders' requirements. For example, they have increased their acquisition of certified energy-efficient IT equipment, established and implemented policies to extend the useful life of agency equipment, and developed environmental policies for disposing of electronic equipment. However, the overall effectiveness of the agencies' efforts cannot be measured because key performance information is not available. Specifically, the agencies have not identified the information needed to measure the progress or results of their efforts. For example, the agencies have generally not established baselines (starting points) or developed performance targets that are consistently defined in terms of quantifiable benefits, such as a reduction in energy. This is in part because the Office of Management and Budget (OMB) and a key White House council—the Council on Environmental Quality (CEQ)—have not developed specific guidance on establishing performance measures for green IT efforts. Without such guidance, the effectiveness of these efforts and their contribution to overall federal sustainability goals will remain unclear.

GAO identified a number of leading practices used by federal, state, and local government and private-sector organizations that are relevant to green IT. These practices include enhanced leadership, dedicated funding, prioritization of efforts, and improved employee training, as well as acquiring IT equipment with the highest energy efficiency ratings; consolidating equipment and services; reducing use of paper; and using new, more efficient computers. For example, according to a 2009 survey of federal employees, agencies spend about \$440.4 million per year on unnecessary printing. By contrast, in the non-federal sector, a major IT equipment company implemented managed print services that reportedly reduced the number of printers by 47 percent globally, cut per-page print costs by up to 90 percent, and saved more than \$3 million in 2 years in the United States alone.

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## Abbreviations

CEQ	Council on Environmental Quality
DOC	Department of Commerce
DOE	Department of Energy
EPA	Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
FEC	Federal Electronics Challenge
GSA	General Services Administration
HHS	Department of Health and Human Services
IT	information technology
NASCIO	National Association of State Chief Information Officers
OMB	Office of Management and Budget
USDA	U.S. Department of Agriculture

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**G A O**

Accountability \* Integrity \* Reliability

**United States Government Accountability Office**  
Washington, DC 20548

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July 28, 2011

The Honorable Susan M. Collins  
Ranking Member  
Committee on Homeland Security  
and Governmental Affairs  
United States Senate

The Honorable Thomas R. Carper  
Chairman  
The Honorable Scott P. Brown  
Ranking Member  
Subcommittee on Federal Financial Management,  
Government Information, Federal Services,  
and International Security  
Committee on Homeland Security  
and Governmental Affairs  
United States Senate

The federal government anticipates spending \$79 billion on information technology (IT) in fiscal year 2011. This substantial use of IT makes a significant contribution to federal agencies' energy use and environmental impact. For example, computer equipment contains lead and mercury that can have an adverse impact on human health and the environment. This equipment also requires significant energy to operate. To help mitigate these impacts, organizations have adopted practices to use computing resources in a sustainable and more environmentally friendly manner—sometimes referred to as “green IT.” Green IT can include a wide range of practices covering the lifecycle of products and systems, such as purchasing more energy-efficient technology, managing IT operations to conserve energy and resources, and disposing of equipment that has reached the end of its useful life in an environmentally sound way.

This report responds to your request that we review green IT issues. Our objectives were to (1) determine the extent to which the federal government has defined policy and guidance on green IT and how selected federal agencies are implementing this policy and guidance, and (2) identify leading green IT practices used by federal agencies, state and local governments, and private-sector organizations.

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To accomplish our objectives, we conducted our work at the Office of Management and Budget (OMB), the White House Council on Environmental Quality (CEQ), and at a nonprobability sample of six selected agencies to provide examples of agency green IT efforts—the Departments of Agriculture (USDA), Commerce (DOC), Energy (DOE), and Health and Human Services (HHS); the Environmental Protection Agency (EPA); and the General Services Administration (GSA). DOE and EPA were selected based on their missions to protect the environment. DOC and HHS were selected because they were two of the four top agencies for fiscal year 2009 IT spending.<sup>1</sup> GSA and USDA were selected for their ongoing green IT efforts. To determine the extent to which the federal government has defined policy and guidance on green IT, we reviewed executive orders and other guidance from OMB and CEQ and interviewed officials from these offices. To determine how agencies are implementing this policy and guidance, we analyzed internal guidance developed at each agency in response to federal green IT-related requirements and interviewed selected agency officials.

In addition, we identified leading green IT practices that have been used by federal agencies, state and local governments, and private-sector organizations; we identified these practices through multiple sources, including our attendance at national IT symposia (e.g., the GreenGov Symposium held in Washington, D.C., in October 2010); a review of industry publications, such as ComputerWorld and InfoWorld; an examination of leading green IT practice information contained on the federal electronics stewardship Web site, known as FedCenter.gov; and interviews with various federal and state officials and industry representatives. Detailed information on the scope and methodology for our review is provided in appendix I.

We conducted this performance audit from August 2010 through July 2011 in accordance with generally accepted government auditing standards. Those standards required that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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<sup>1</sup>The other two agencies in the top four were the Departments of Defense and Homeland Security; we did not select these because we have extensive ongoing work at these agencies.

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## Background

In recognition of the cost, energy usage, and environmental impact of IT, the federal government has undertaken various initiatives to promote the acquisition and use of more efficient and environmentally friendly IT products, commonly referred to as electronic stewardship or “green IT.” According to OMB Circular A-11, green IT refers to the application of sustainable and environmentally efficient practices so that computing resources are used in a sustainable and environmentally efficient manner.<sup>2</sup>

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### Green IT Encompasses the Environmentally Sound Practices of Purchasing, Managing, and Disposing of IT Equipment

Green IT applies to a broad range of activities that span the entire lifecycle of IT capital assets, including but not limited to the acquisition, operations and use, and disposition of equipment. These activities include developing programs for purchasing equipment that meets certain environmental standards, operating and managing IT equipment in ways that reduce energy usage and conserve resources, and disposing of equipment in ways that lessen the environmental impact of potentially hazardous waste.

*Purchasing equipment.* Tools exist to help organizations purchase more environmentally friendly IT equipment. One such industry tool is the Electronic Product Environmental Assessment Tool (EPEAT®), which was developed along the lines of EPA and DOE’s Energy Star program<sup>3</sup> to assist consumers in comparing and selecting laptop computers, desktop computers, and monitors with environmentally preferable attributes. Through EPEAT, manufacturers are rewarded for meeting increasing levels of energy efficiency and environmental standards by providing them with a certification label of bronze, silver, or gold. Using this tool, consumers can also evaluate the design of an electronic product for energy conservation, reduced toxicity, extended lifespan, and end-of-life recycling, among other things.

*Operating and managing IT resources.* Effective management of IT equipment in use can help reduce energy usage and conserve resources. For example, monitoring and efficiently managing IT equipment’s power

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<sup>2</sup>OMB, Circular No. A-11: Preparation, Submission, and Execution of the Budget, §53.4.

<sup>3</sup>Energy Star is a joint program of EPA and DOE that delivers the technical information and tools that organizations and consumers need to choose energy-efficient solutions and best management practices.

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use can help organizations track and reduce specific energy costs. Software can be used to turn off or power down personal computers when they are not being used and to track network power usage. New techniques, such as computer virtualization, are also being used to save energy. Computer virtualization allows multiple, software-based virtual machines with different operating systems to run in isolation, side-by-side, on the same physical machine. Virtual machines can be stored as files, making it possible to save a virtual machine and move it from one physical server to another. Virtualization is often used as part of cloud computing.<sup>4</sup>

*Disposing of equipment.* Finally, IT equipment may be donated, sold, recycled, or returned to the manufacturer in lieu of disposal in a landfill. Organizations donate usable electronics to qualified organizations, such as public schools, and sell usable or refurbishable equipment to the general public. Another option is to recycle unusable and unsold equipment using environmental practices that help keep components out of landfills and recover materials for use in the manufacture of new products.

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## Environmental Impact and Roles of Key Organizations

The federal government purchases or leases approximately 1 million computers and monitors each year and estimates it will spend about \$79 billion on IT in fiscal year 2011. This investment in IT has environmental impacts that can be described in terms of cost, energy usage, and waste. Examples of these impacts include the following:

- According to the Federal Electronics Challenge (FEC)<sup>5</sup> Program Manager, the federal government disposes of approximately 750,000 computers and monitors that have reached the end of their useful lives each year—50 percent are reused; 40 percent are recycled; and 10 percent are discarded.

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<sup>4</sup>Cloud computing is an emerging form of computing that relies on Internet-based services and resources to provide computing services to customers, including the use of virtualization.

<sup>5</sup>FEC is a partnership program that encourages federal facilities and agencies to purchase greener electronic products, reduce impacts of electronic products during use, and manage obsolete electronics in an environmentally safe way. FEC is managed by EPA and the Office of the Federal Environmental Executive.

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- Office electronics can contain materials such as lead, mercury, and other constituents that are harmful to human health and the environment.
  - The global greenhouse gas<sup>6</sup> emissions attributable to information and communication technologies, including data centers and computers, are nearly 2 percent of all emissions.<sup>7</sup>

According to FEC data, there are potential environmental benefits of implementing green IT in federal agencies. While we did not validate the data reported by various federal agencies, FEC estimated that energy savings of over 500,000 megawatts were achieved in fiscal year 2009 as a result of related efforts by federal agencies, as well as cost savings of over \$48 million.

Two federal organizations play key roles related to green IT:

- OMB reviews and approves agency plans and prepares scorecards to track agencies' progress toward achieving various federal goals and requirements, including those for electronic stewardship.
- CEQ, in conjunction with OMB, coordinates federal environmental efforts and works with agencies in the development of policies and initiatives.

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<sup>6</sup>Greenhouse gases are trace gases in the lower atmosphere that trap heat through a natural process called the "greenhouse effect."

<sup>7</sup>Wipro Council for Industry Research, "Cutting Costs with Greener IT" (Philadelphia, Pa.: *Knowledge@Wharton*, October 2009), p. 2, <http://knowledgeatwharton.upenn.edu>.

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## High-Level Green IT Policy and Guidance Exist, but Effectiveness of Selected Agencies' Efforts Cannot Be Measured

Federal policy and guidance direct agencies to take a variety of green IT-related actions. Specifically, two executive orders outline broad requirements for green IT as part of a larger sustainability effort. The six agencies in our review have taken steps to implement these green IT-related requirements. However, the benefits of the agencies' efforts cannot be measured because key performance information is not available.

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## Executive Orders Outline Broad Green IT-Related Requirements as Part of a Larger Sustainability Effort

Two executive orders—13423 and 13514—assign responsibility to federal agencies for meeting green IT-related requirements. These requirements, often referred to as electronic stewardship, are part of a much larger effort covered by the executive orders to move federal operations toward environmental sustainability.<sup>8</sup> According to Executive Order 13423 implementing instructions, electronic stewardship seeks to reduce the environmental and energy impacts of electronic product acquisition, operation and maintenance, and disposition through continual improvement for each of these lifecycle phases.

In 2007, Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," set goals for federal agencies to improve energy efficiency and reduce greenhouse gas emissions, among others. In addition, Section 2(h) of the executive order contains four broad green IT-related requirements that federal agencies are to follow:

- meet at least 95 percent of agencies' requirements for new electronic products with EPEAT-registered products, unless no applicable EPEAT standard exists;
- enable the Energy Star feature on agency computers and monitors;

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<sup>8</sup>Executive Order 13514 states that "sustainability" and "sustainable" mean to create and maintain conditions under which humans and nature can exist in productive harmony and that permit the fulfillment of social, economic, and other requirements of both present and future generations.

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- establish and implement policies to extend the useful life of agency electronic equipment; and
  - use environmentally sound practices with respect to disposition of agency electronic equipment that has reached the end of its useful life.

To assist the agencies in accomplishing Executive Order 13423 requirements, CEQ provided implementing instructions and directed the agencies to develop Electronic Stewardship Plans. The implementing instructions elaborated on the goals in the executive order and included certain targets that agencies should set for implementing each requirement. Specifically, each agency should

- ensure that 95 percent of its product acquisitions are EPEAT registered;
- enable the Energy Star feature on 100 percent of its computers and monitors;
- use in-house agency computers for a minimum of 4 years before replacing them; and
- identify acceptable partners for electronic recycling.

In 2009, Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," expanded on the agency requirements of Executive Order 13423. The executive order required federal agencies to submit to the Chair of CEQ and the Director of OMB a 2020 greenhouse gas pollution reduction target within 90 days and to increase energy efficiency, reduce fleet petroleum consumption, conserve water, reduce waste, support sustainable communities, and leverage federal purchasing power to promote environmentally responsible products and technologies. The executive order requires agencies to meet broad sustainability goals, such as

- 30 percent reduction in vehicle fleet petroleum use by fiscal year 2020;
- 26 percent improvement in water efficiency by fiscal year 2020; and
- 50 percent non-hazardous waste diversion by fiscal year 2015.

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With regard to green IT, section 2(i) of the order contains five broad goals. Three of these are similar to those in Executive Order 13423, but the goals also include requirements related to power management and data center consolidation. Specifically, under this section, agencies are to

- ensure procurement preference for EPEAT-registered electronic products;
- establish and implement policies to enable power management, duplex printing, and other energy-efficient or environmentally preferable features on all eligible agency electronic products;
- employ environmentally sound practices with respect to the agency's disposition of all agency excess or surplus equipment;
- ensure the procurement of Energy Star and Federal Energy Management Program-designated<sup>9</sup> electronic equipment; and
- implement best management practices for energy-efficient management of servers and federal data centers.

To meet these requirements, Executive Order 13514 assigns the agencies several duties. The order requires agencies to designate a Senior Sustainability Officer, who is accountable for agency conformance to the requirements of the order. The sustainability officer is to develop and implement an annual Strategic Sustainability Performance Plan<sup>10</sup> and monitor the agency's performance and progress in implementation. The plan is to be updated and submitted annually to the CEQ Chair and the OMB Director. Each sustainability plan is to identify agency goals, a schedule for meeting those goals, milestones, approaches for achieving results, quantifiable metrics for agency implementation, and prioritized actions based on lifecycle return on investment.

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<sup>9</sup>The Federal Energy Management Program is a Department of Energy program that works to reduce the cost and environmental impact of the federal government by advancing energy efficiency and water conservation, promoting the use of distributed and renewable energy, and improving utility management decisions at federal sites.

<sup>10</sup>According to CEQ officials, these sustainability plans replace agencies' electronic stewardship plans required by Executive Order 13423.

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In addition, both OMB and CEQ have responsibilities and have taken actions related to agencies' progress in meeting the executive order requirements. Specifically, CEQ reviews and OMB approves each agency's sustainability plan. CEQ's duties include preparing, in coordination with OMB, reporting metrics to determine each agency's progress on the goals of the executive order and establishing interagency working groups that provide recommendations to CEQ for areas of improvement. To assist the agencies in implementing the requirements, OMB and CEQ provided guidance through a template for developing the sustainability plans. According to CEQ officials, this template was not mandatory, but agencies were instructed to justify using a different approach.

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### Agencies Have Taken Steps to Implement Green IT-Related Requirements

The six agencies in our review are taking steps toward implementing the green IT-related requirements of the two executive orders. Each agency has designated a senior sustainability officer and submitted its sustainability plan to OMB and CEQ for review. Further, the agencies reported on various initiatives aimed at meeting the requirements. For example, according to officials, EPA donates the majority of its excess electronics to schools, state and local governments, eligible nonprofit organizations, and other federal agencies.

Table 1 shows the agencies' progress in implementing the green IT-related requirements of Executive Order 13423 (issued in 2007).

**Table 1: Progress in Implementing 2007 Executive Order Requirements**

Requirement	DOC	DOE	EPA	GSA	HHS	USDA
When acquiring an electronic product to meet agency requirements, meet at least 95 percent of those requirements with an EPEAT-registered electronic product, unless there is no EPEAT standard for such product	√	√	√	√	√	√
Enable Energy Star features on agency computers and monitors	—	√	√	√	—	√
Establish and implement policies to extend the useful life of agency electronic equipment	√	√	√	√	√	√
Use environmentally sound practices with respect to disposition of agency electronic equipment that has reached the end of its useful life <sup>a</sup>	√	√	√	√	—	√

√ Implemented — Not implemented

Source: GAO analysis of agency data.

<sup>a</sup>Because we have an ongoing review of federal electronic stewardship initiatives, this evaluation did not include an in-depth assessment of the extent to which agencies have engaged in environmentally sound disposition practices with respect to electronic equipment. We limited our work to determining whether agencies have developed policies and procedures for the disposition of agency electronic equipment.

As the table shows, the selected agencies have implemented most of the requirements associated with this executive order. They also all have plans to address the unmet ones. For example, DOC described an action planned to meet the Energy Star requirement and plans to report its progress in its updated sustainability plan.

Table 2 shows the agencies' progress in implementing the green IT-related requirements of Executive Order 13514 (issued in 2009).

**Table 2: Progress in Implementing 2009 Executive Order Requirements**

Requirement	DOC	DOE	EPA	GSA	HHS	USDA
Ensure procurement preference for EPEAT-registered electronic products	√	√	√	√	√	√
Establish and implement policies to enable power management, duplex printing, and other energy-efficient or environmentally preferable features on all eligible agency electronic equipment	—	—	√	√	√	—
Employ environmentally sound practices with respect to the agency's disposition of all agency excess or surplus equipment <sup>a</sup>	√	√	√	√	—	√
Ensure the procurement of Energy Star and Federal Energy Management Program-designated electronic equipment	√	√	√	√	√	√
Implement best management practices for energy-efficient management of servers and federal data centers <sup>a</sup>	—	—	—	—	—	—

√ Implemented— Not implemented

Source: GAO analysis of agency data.

<sup>a</sup>Because we have an ongoing review of federal electronic stewardship initiatives, this evaluation did not include an in-depth assessment of the extent to which agencies have engaged in environmentally sound disposition practices of excess or surplus electronic equipment. For this review, we limited our work to determining whether agencies have developed policies and procedures for the disposition of agency electronic equipment. We also have an ongoing evaluation of federal data centers.

As table 2 shows, implementation to date of the requirements of this more recent executive order is not as far along. For requirements that have not yet been implemented, all six agencies described plans and efforts to meet them. For example, although none of the agencies have completed the requirement to implement best management practices for energy-efficient management of servers and data centers, they all described plans to do so.

### Additional Data Needed to Measure Benefits of Agencies' Efforts

While agencies have taken a variety of steps to implement green IT practices, the effectiveness of these efforts cannot be measured because of a lack of performance data. As previously mentioned, Executive Order 13514 requires the agencies to develop, implement, and annually update their sustainability plans to allow them to prioritize agency actions based on the lifecycle return on investment. Among other things, these plans are to (1) identify agency goals, milestones, and quantifiable metrics and (2) identify opportunities for improvement and evaluate performance to determine benefits.

Each of the agencies' 2010 sustainability plans includes planned actions for meeting the requirements of the executive order. These are related to increasing the number of devices covered by Energy Star, improving data

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center efficiencies, and increasing the use of virtualization and cloud computing. In addition, most of the agencies' plans contained actions with associated percentage-based targets and milestones for meeting them over several fiscal years.<sup>11</sup> However, the plans do not identify baseline information for the planned actions. A baseline is a starting point for measurement (e.g., an agency's current energy usage) that provides a basis for measuring progress. Our research has shown that measuring progress toward performance targets requires establishing such baseline information.<sup>12</sup> Without baselines, it will be unclear what progress agencies have made in meeting their targets.

In addition, the agency plans do not identify benefits linked to their specific green IT efforts. Specifically, the targets identified in the agencies' plans are not defined in terms of benefits (such as dollar or energy savings), and as a result the agencies are not positioned to identify benefits from their activities and to use that information to evaluate and prioritize their efforts. For example, USDA had a goal to reduce the number of its data centers by 5 percent during fiscal year 2010. However, it is unclear whether or by how much meeting this 5 percent reduction goal was expected to result in energy or dollar savings or other benefits.

The limitations in the data on the effectiveness of agencies' efforts are due, in part, to challenges related to developing performance information, as well as to the guidance provided to the agencies by OMB and CEQ, which did not include instructions related to collecting this information.

- Officials from all six agencies stated that it was challenging to estimate baseline costs and energy use and to quantify the cost savings and reduction of energy consumption resulting from implementation of the executive order requirements. EPA officials stated that one reason for this is that not all of their buildings are sub-metered at the level necessary to capture this information. While we acknowledge that establishing baselines and identifying quantifiable benefits for some agency green IT activities can be challenging,

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<sup>11</sup>EPA's and DOE's Strategic Sustainability Performance Plans did not contain targets for all of the planned action by fiscal year.

<sup>12</sup>GAO, *Executive Guide: Measuring Performance and Demonstrating Results of Information Technology Investments*, [GAO/AIMD-98-89](#) (Washington, D.C.: March 1998).

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developing such information, where possible, could help agencies better determine their progress toward meeting targets.

- In addition, the guidance that OMB and CEQ provided to the agencies did not include instructions for developing baselines. CEQ officials told us that, other than the sustainability plan template, they have not issued any further guidance for the plans and do not plan to develop implementing instructions for Executive Order 13514.

While CEQ does not plan to issue additional guidance, the agency has been working to develop a national strategy, or road map, for green IT-related initiatives. According to a November 2010 letter, CEQ requested that EPA and GSA join with the council in co-chairing an interagency task force to develop such a strategy. This strategy is to include an action plan to direct federal agencies in achieving requirements related to green IT. As of June 2011, this strategy, which was due on May 6, 2011—180 days after the memorandum was issued—had not been released. If appropriately developed and implemented, such a strategy could provide additional guidance for agencies to measure the effectiveness of green IT efforts.

Without specific guidance related to establishing targets and identifying baselines that measure benefits, agencies, OMB, and CEQ will continue to be challenged in determining the actual benefits of green IT efforts. Further, it will continue to be unclear to what extent these efforts are supporting the federal government's broader sustainability initiatives.

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## Leading Green IT Practices Range from Increased Leadership to Improved Print Management

In addition to the activities agencies have underway to meet the requirements of the executive orders, we identified a number of leading practices used by government entities and private sector organizations that are relevant to green IT. Among others, these practices include leadership, funding, prioritization, and employee training and involvement:

*Obtain senior management commitment.* Senior management commitment can remove potential obstacles when implementing green IT initiatives and establishing goals. For example, according to a 2009 study of the key drivers of green IT, research showed that identifying an

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executive sponsor who will champion the green IT initiative will help to remove the road blocks to implementation.<sup>13</sup>

*Align green IT with the organization's budget.* According to a 2007 industry report on creating a green IT action plan, green IT must fit within an organization's anticipated budget.<sup>14</sup> In recognition of the importance of adequate funding to program success, the 2009 executive order states that, starting in fiscal year 2011, strategic sustainability efforts, which include electronics stewardship (green IT), should be integrated into the agency's strategic planning and budgeting process, including the agency's strategic plan.

*Evaluate and prioritize green IT options.* With various green IT options available, lifecycle return on investment can be a useful tool for determining which options provide the greatest return on investment in an environment of reduced agency budgets. According to a 2009 survey of IT professionals by a national IT services and solutions provider, IT departments may be foregoing large, long-term savings by ranking factors such as cost over energy efficiency in their purchasing decisions.<sup>15</sup> One recommendation from the survey is that organizations need to prioritize their actions based on costs and benefits.

*Provide appropriate agency personnel with sufficient green IT training.* As part of a 2010 private-sector survey of federal chief information officers, industry officials also offered some observations, including that agencies should work with the Office of Personnel Management to improve the IT workforce.<sup>16</sup> The survey noted that, in doing so, government organizations should use existing best practices, such as those found at the Department of Defense, to train employees and develop new leaders. In recognition of the importance of training, the 2007 executive order states that agencies are to establish programs for environmental management training. Implementing instructions associated with that order require that

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<sup>13</sup>Fujitsu Australia, "Green IT: The Convenient Truth, a Report on How the Australian IT Departments Are Responding to the Emerging Carbon Priced Economy," April 2009.

<sup>14</sup>Forrester Research, "Creating the Green IT Action Plan," October 19, 2007.

<sup>15</sup>CDW, 2009 Energy Efficient IT Report.

<sup>16</sup>TechAmerica's 20<sup>th</sup> Annual Survey of Federal Chief Information Officers: Transparency and Transformation through Technology, March 2010.

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each agency shall ensure that all personnel whose actions are affected by the executive order receive initial awareness training as well as necessary refresher training on the goals of the executive order. Overseas, one British report indicated that increasing the capability of staff will not only improve the performance of overall IT operations, it could also reduce the amount that the public sector spends on IT consultants and contractors by some 50 percent.<sup>17</sup>

*Procure IT equipment that meets the most stringent EPEAT standard available, if economically practical.* As discussed previously, EPEAT is a tool to help purchasers in the public and private sectors evaluate, compare, and select electronic products based on their environmental attributes. EPEAT-registered products must meet 23 required environmental performance criteria. The products are then rated gold, silver, or bronze based on whether the products met 75 percent or greater, 50 percent to 74 percent, or less than 50 percent, respectively, of 28 optional criteria. The three EPEAT level ratings differ to a small, but measurable, extent in their environmental benefits. As we reported in 2009,<sup>18</sup> if federal agencies replaced 500,000 non-EPEAT rated laptop computers and computer monitors with either EPEAT bronze-rated, silver-rated, or gold-rated units, the federal government would achieve energy savings equivalent to 182,796 U.S. households, 183,151 households, or 183,570 households, respectively. In the non-federal government sector, in March 2009 the city of San Francisco upgraded its environmental requirement for IT purchases to the EPEAT gold-level as its procurement baseline whenever possible.

*Consolidate and standardize IT equipment and services.* In an earlier 2011 report, we noted that, because procurement at federal departments and agencies is decentralized, the federal government is not fully leveraging its aggregate buying power to obtain the most advantageous terms and conditions for its procurements.<sup>19</sup> The report also stated that

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<sup>17</sup>Cabinet Office of the Government of the United Kingdom, *ICT Strategy: Smarter, Cleaner, Greener*, January 2010.

<sup>18</sup>GAO, *Federal Electronics Management: Federal Agencies Could Improve Participation in EPA's Initiatives for Environmentally Preferable Electronic Products*, [GAO-10-196T](#) (Washington, D.C.: Oct. 27, 2009).

<sup>19</sup>GAO, *Opportunities to Reduce Potential Duplication in Government Programs, Save Tax Dollars, and Enhance Revenue*, [GAO-11-318SP](#) (Washington, D.C.: March 2011).

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applying strategic sourcing best practices throughout the federal procurement system could produce significant savings.<sup>20</sup> Similarly, according to a 2010 report by a private-sector IT council, the federal government's costs of operating IT systems are higher than they need to be, in some cases by more than a factor of two.<sup>21</sup> The report estimated that at least 20 percent to 30 percent of the more than \$70 billion spent annually on IT assets could be eliminated by reducing overhead, consolidating data centers, eliminating redundant networks, and standardizing applications. Therefore, the report recommended that the federal government consolidate IT infrastructure. In the non-federal sector, the IT council report indicated that IBM had cut its overall IT expenses in half over the past 5 years through consolidation and standardization. In addition, the National Association of State Chief Information Officers (NASCIO) identified consolidation/optimization, through centralizing or consolidating services, operations, resources, infrastructure, and data centers, as its number one priority for 2011.<sup>22</sup>

*Implement print management actions beyond duplex printing.* Using responses obtained from its 2009 survey of federal employees, an IT provider estimated that the federal government spends about \$1.3 billion annually on employee printing, and about one-third of that total, or about \$440.4 million per year, is spent on unnecessary printing.<sup>23</sup> The survey indicated that 89 percent of federal employees report that their agencies do not have formal printing policies in place—for example, according to federal employees, just 20 percent of agencies have restrictions on color printing; only 11 percent of agencies have policies dictating when to print or not to print; and only 5 percent of agencies require personal password codes to print. The survey further noted that 69 percent of federal employees believe that their agencies' documentation processes could

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<sup>20</sup>In an earlier report, we discussed strategy sourcing in the federal government, which is a process sometimes led by a central procurement organization that improves purchasing activities by moving a company away from numerous individual procurements to a broader aggregate approach. See [GAO-11-318SP](#).

<sup>21</sup>Technology CEO Council, "One Trillion Reasons: How Commercial Best Practices to Maximize Productivity Can Save Taxpayer Money and Enhance Government Services," October 2010.

<sup>22</sup>NASCIO, *State CIO Priorities for 2011*, October 2010.

<sup>23</sup>Lexmark, "2009 Government Printing Report—A Closer Look at Costs, Habits, Policies, and Opportunities for Savings," May 2009.

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realistically be converted from paper to digital trails. In the non-federal sector, Hewlett-Packard implemented managed print services that reportedly allowed a customer to reduce the number of printers by 47 percent globally, cut per-page print costs by up to 90 percent, and save more than \$3 million in 2 years in the United States alone.<sup>24</sup> In addition, California implemented the Go-Online program as an alternative to mainframe printing, reportedly reducing the number of pages printed by 54 million and reducing costs by \$700,000 annually.

*Utilize new IT tools, such as thin client technology.* An alternative to the use of desktops that is gaining attention is the use of thin client technology. A thin client is a computer or computer program that depends heavily on some other computer to fulfill its traditional computational needs. For thin client computers, the applications software, data, and computer processing power reside on a network server rather than on the client computer.<sup>25</sup> The Department of State, by the end of fiscal year 2010, replaced 8,187 standard desktop computers with thin clients, providing annual reported energy savings of 630,399 kilowatt hours and emission savings of 422.7 tons of CO<sub>2</sub>, an environmental impact equivalent to planting 1,900 trees or powering 71 households year round.

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## Conclusions

Initiatives to implement environmentally sound computing practices at federal agencies have the potential to generate savings through reduced energy use and other cost reductions. The agencies in our review, with the assistance of OMB and CEQ, have taken steps to implement green IT-related requirements contained in executive orders.

However, even with the potential of green IT, the effectiveness of agencies' efforts cannot be measured, in part, because OMB and CEQ have not provided specific guidance to assist agencies in establishing baselines and targets that measure energy or cost savings or other quantifiable benefits. Current OMB and CEQ guidance does not provide specificity to help agencies assess their progress in implementing environmentally sustainable IT practices. The national strategy being developed by CEQ, EPA, and GSA could provide the guidance needed

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<sup>24</sup>HPECO Solutions, "A Green IT Action Plan for Printing and Imaging," May 2009.

<sup>25</sup>USDA Departmental Regulation Number 3170-001, End User Workstation Standards, December 12, 2007.

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for increased measurement of energy or cost savings related to green IT initiatives. In addition, opportunities exist to enhance these efforts through more widespread adoption of leading green IT practices identified by government entities and private-sector organizations. Without specific guidance, agencies, OMB, and CEQ will continue to be challenged in assessing the effectiveness of green IT efforts and the extent to which these efforts are supporting the federal government's broader sustainability initiatives.

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## Recommendations for Executive Action

To help federal managers better assess the effectiveness of progress made toward green IT-related sustainability goals, we recommend that the Director of the Office of Management and Budget, in conjunction with the White House Council on Environmental Quality, take the following two actions:

- update the existing green IT sustainability guidance, through the national strategy or another appropriate method, to direct agencies to develop baselines for their green IT-related goals and, where possible, targets that measure energy or cost savings or other quantifiable benefits and
- consider including the leading green IT practices identified in this report as part of this guidance.

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## Agency Comments and Our Evaluation

We received e-mail or written responses on a draft of this report from CEQ, OMB, and all six agencies that were included in our review. These comments and our evaluation are summarized below.

- The White House Council on Environmental Quality's Deputy General Counsel provided an e-mail response. In the comments, CEQ partially concurred with our recommendations and also provided technical comments, which we incorporated as appropriate. In response to our recommendations, CEQ agreed to consider including leading green IT practices as part of its update to sustainability guidance. CEQ did not concur that this guidance should direct agencies to develop baselines for their green IT-related goals and, where possible, targets that measure energy or cost savings or other quantifiable benefits. However, as we stated in this report, our research has shown that baselines are needed to measure progress. We also maintain that identifying and tracking benefits resulting from green IT-related efforts is needed to determine their effectiveness.

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- A representative from OMB's Office of General Counsel provided an e-mail response and stated that OMB generally concurred with our draft report and also concurred with comments on the draft provided by CEQ.
  - The Department of Commerce's Chief Information Officer provided written comments. In the comments, the department concurred with the findings as they apply to the Department of Commerce. These comments are reprinted in appendix II.
  - The Department of Energy's Deputy Chief Information Officer provided written comments in which the department agreed with our assessment of DOE's progress in meeting green IT requirements associated with Executive Orders 13423 and 13514. These comments are reprinted in appendix III.
  - The Department of Agriculture's representative from the Program Management Office, Office of the Chief Information Officer, e-mailed comments for GAO's consideration. We incorporated these comments as appropriate.
  - The Environmental Protection Agency's GAO Liaison Team Lead in the Office of Budget provided e-mail comments. The agency offered technical comments, which we incorporated as appropriate.
  - A General Services Administration management analyst from the Office of the Chief Financial Officer e-mailed a response in which the agency provided no comments.
  - A representative from the Department of Health and Human Services' Office of the Assistant Secretary for Legislation provided an e-mail response. The department offered technical comments that we incorporated as appropriate.

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As we agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 30 days from the date of this letter. At that time, we will send copies of this report to interested congressional committees, the Director of the Office of Management and Budget, the Chair of the White House Council on Environmental Quality, and other interested parties. The report will also be available at no charge on the GAO Web site at <http://www.gao.gov>.

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If you or your staff members have any questions about this report, please contact David Powner at (202) 512-9286 or [pownerd@gao.gov](mailto:pownerd@gao.gov) or Frank Rusco at (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@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 major contributions to this report are listed in appendix IV.



David A. Powner  
Director, Information Technology Management Issues



Frank Rusco  
Director, Natural Resources and Environment

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# Appendix I: Objectives, Scope, and Methodology

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Our objectives were to (1) determine the extent to which the federal government has defined policy and guidance on green IT and how selected federal agencies are implementing this guidance and policy and (2) identify leading green IT practices used by federal agencies, state and local governments, and private-sector organizations.

To accomplish our first objective, we obtained and evaluated executive orders, and Office of Management and Budget (OMB) instructions on green IT activities. We also interviewed OMB, White House Council on Environmental Quality (CEQ), and selected agency officials about agency requirements for electronic stewardship or green IT. We focused on a nonprobability sample of six agencies: the Departments of Agriculture (USDA), Commerce (DOC), Energy (DOE), and Health and Human Services (HHS); the Environmental Protection Agency (EPA); and the General Services Administration (GSA).

- USDA was selected because it developed a strategic plan focused solely on green IT, and the department had implemented a green purchasing program. Further, for fiscal year 2009, USDA IT spending was \$2.4 billion.
- DOC and HHS were among the top four federal departments in IT spending for fiscal year 2009, spending \$3.8 and \$5.7 billion, respectively. (The Departments of Defense and Homeland Security were also among the top four agencies in IT spending for fiscal year 2009. They were not selected because we have extensive ongoing work at these departments.)
- DOE and EPA have missions and initiatives related to green IT. They jointly operate the Energy Star program. DOE's Federal Energy Management Program has developed guidance that specifies the conditions for agencies to meet executive order requirements. In addition, EPA has a partnership program, known as the Federal Electronics Challenge, which among other things, encourages federal agencies to purchase green electronic products and manage obsolete electronics in an environmentally safe way.
- GSA is the federal government's supply arm, property manager, and procurement agency. The agency has several ongoing initiatives and has published information on some federal, state and local, and foreign initiatives.

At each agency, we focused on the electronic stewardship (i.e., green-IT-related) requirements found in Executive Orders 13514 and 13423. We analyzed internal guidance developed in response to the green IT-related requirements in the orders,<sup>1</sup> and instructions obtained; identified ongoing or planned initiatives; and obtained and analyzed examples of reported or proposed cost savings for these initiatives. In addition, we analyzed the sustainability plans produced by the agencies. As part of this analysis, we used GAO developed criteria on measuring performance.<sup>2</sup>

To accomplish our second objective, we utilized multiple sources to ascertain what leading green IT practices have been used by federal agencies, state and local governments, and private sector organizations. Those sources included, among other things, information presented at national IT-related symposia, such as (1) the GreenGov Symposium jointly sponsored by the Executive Office of the President and George Washington University and held in Washington, D.C., in October 2010; (2) the World Green IT Symposium held in Philadelphia, Pennsylvania, in November 2010; and (3) TechAmerica's release of its twenty-first annual survey of federal chief information officers held in Washington, D.C., in May 2011. In addition, we reviewed industry publications, such as ComputerWorld and InfoWorld, which have published annual listings of leading green IT practices. We also researched leading green IT practice information published by national IT industry research firms, such as Forrester Research. We further examined leading green IT practice information contained on the federal electronics stewardship Web site, FedCenter.gov. Lastly, we interviewed IT officials from the six agencies of focus listed above and representatives from the National Association of State Chief Information Officers about leading state and local green IT practices.

We conducted this performance audit from August 2010 through July 2011 in accordance with generally accepted government auditing

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<sup>1</sup>Because we have an ongoing review of federal electronic stewardship initiatives, this evaluation did not include an in-depth assessment of the extent to which agencies have engaged in environmentally sound disposition practices related to electronic equipment. We limited our work to determining whether agencies have established policies and procedures for the disposition of agency electronic equipment as required by executive orders.

<sup>2</sup>GAO, *Executive Guide: Measuring Performance and Demonstrating Results of Information Technology Investments*, GAO/AIMD-98-89 (Washington, D.C.: March 1998).

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standards. Those standards required that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

# Appendix II: Comments from the Department of Commerce



**UNITED STATES DEPARTMENT OF COMMERCE**  
**Chief Information Officer**  
Washington, D.C. 20230

JUL 14 2011

Mr. David A. Powner  
Director, Information Technology Management  
United States Government Accountability Office  
Washington, D.C. 20548

Dear Mr. Powner:

Thank you for the opportunity to comment on the draft report from the U.S. Government Accountability Office (GAO) entitled *Green Information Technology: Agencies Have Taken Steps to Implement Requirements, But Additional Guidance on Measuring Performance Needed* (GAO-11-638).

We concur with the general findings as they apply to the Department of Commerce as well as the specific findings that address Commerce. We support, in particular, the recommendation that the Office of Management and Budget, in conjunction with the White House Council on Environmental Quality, consider including leading green information technology (IT) practices in an update to the existing green IT sustainability guidance.

Please contact Lisa Westerback at 202-482-0694 if you have questions regarding the Commerce response.

Sincerely,

A handwritten signature in black ink, appearing to read "Simon Szykman".

Simon Szykman

# Appendix III: Comments from the Department of Energy



Department of Energy  
Washington, DC 20585

July 14, 2011

Mr. David A. Powner  
Director, Information Technology Management Issues  
Government Accountability Office  
411 G Street, NW  
Washington, D.C. 20548

Dear Mr. Powner:

Thank you for the opportunity to respond to the U.S. Government Accountability Office's (GAO) draft report entitled "Green Information Technology - Agencies Have Taken Steps to Implement Requirements, But Additional Guidance on Measuring Performance Needed".

We agree with your assessment of the Department of Energy's (DOE) progress in meeting green-IT requirements associated with Executive Order (EO) 13423 and 13514. We would like to point out the Department's 2011 Strategic Sustainability Performance Plan (SSPP) addresses EO 13514 requirements 2 "Establish and implement policies to enable power management, duplex printing, and other energy-efficient or environmentally preferable features on all eligible agency electronic equipment", and 5 "Implement best management practices for energy-efficient management of servers and federal data centers".

As specified in the SSPP, all DOE Sites are required to establish policies, plans and projects to address these requirements, taking into consideration any unique Site-specific environmental or mission criteria, allowing our Sites to tailor Site-specific policies to their specific needs while still meeting the objectives and goals of the EOs. Annually, DOE Sites submit a Site Sustainability Plan (SSP) which includes a self-assessment of their sustainability performance and identifies the planned activities and projects which are intended to meet the SSPP goals.

Recognizing the challenges faced by the austere budget environment, DOE Sites are strongly encouraged to pursue the use of alternative financing contracts, such as Energy Savings Performance Contracts (ESPC) and Utility Energy Services Contracts (UESC), combined with appropriated funding, to facilitate the implementation of major Green IT initiatives.

Again, thank you for the opportunity to review this report. DOE remains fully committed to meeting the objectives of EO 13423 and 13514. If you have any questions please contact Jake Wooley of my staff at (702) 234-1645.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert F. Brese".

Robert F. Brese  
Deputy Chief Information Officer



Printed with soy ink on recycled paper

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# Appendix IV: GAO Contacts and Staff Acknowledgments

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## GAO Contacts

David A. Powner (202) 512-9286 or [pownerd@gao.gov](mailto:pownerd@gao.gov)  
Frank Rusco (202) 512-3841 or [ruscof@gao.gov](mailto:ruscof@gao.gov)

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## Staff Acknowledgments

In addition to the individuals named above, Pam Lutricia Greenleaf, Assistant Director; Carlos E. Hazera, Assistant Director; Robert J. Baney; Kami Corbett; Wilfred B. Holloway; Franklin D. Jackson; Lee A. McCracken; Vasiliki Theodoropoulos; Adam Vodraska; and Eric D. Winter made key contributions to this report.

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