United States Government Accountability Office

Report to the Ranking Member, Subcommittee on Cybersecurity, Information Technology, and Government Innovation, Committee on Oversight and Accountability, House of Representatives

September 2023

AIR POLLUTION

EPA Needs to Develop a Business Case for Replacing Legacy Air Quality Data Systems

Accessible Version

GAO-23-105618

GAO Highlights

Highlights of GAO-23-105618, a report to the Ranking Member, Subcommittee on Cybersecurity, Information Technology, and Government Innovation, Committee on Oversight and Accountability, House of Representatives

Why GAO Did This Study

EPA depends on IT systems to manage air quality data. These data are critical to efforts to reduce air pollution and related public health risks. The data inform regulatory and compliance decisions that have billions of dollars in economic impacts.

Prior GAO work has reported concerns about the antiquated nature of AQS. In addition, EPA listed AQS in a 2017 memorandum as one of its top three mission-critical systems in need of modernization.

GAO was asked to evaluate EPA's IT systems for air quality data. This report examines (1) how EPA uses IT systems to manage air quality data, (2) any challenges these systems present for EPA and other data providers and users, and (3) the extent to which EPA has addressed challenges.

GAO reviewed literature and EPA documents and policies; interviewed EPA officials and six stakeholders from associations of air monitoring agencies and nongovernmental organizations, selected based on their experience providing data to, or using data from, EPA's air quality data systems; and compared EPA efforts with leading practices.

What GAO Recommends

GAO is making three recommendations to EPA, including to identify factors for evaluating IT systems that may be ready for replacement and develop a business case for a new IT system. EPA agreed with two recommendations and disagreed with the one to identify factors for evaluating IT systems. GAO continues to believe identifying such factors could assist with oversight, as discussed in the report.

View GAO-23-105618. For more information, contact J. Alfredo Gómez at (202) 512-3841 or GomezJ@gao.gov.

September 2023

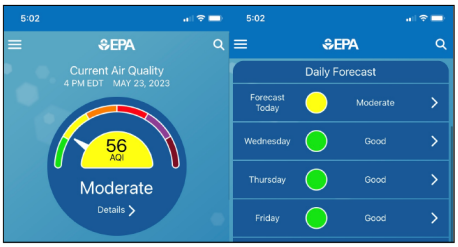
AIR POLLUTION

EPA Needs to Develop a Business Case for Replacing Legacy Air Quality Data Systems

What GAO Found

The Environmental Protection Agency (EPA) primarily uses two legacy IT systems—the Air Quality System (AQS) and AirNow—to manage ambient, that is, outdoor, air quality data collected by the monitoring agencies. These agencies—tribal, state, local, or territorial—design and operate air monitoring sites. EPA developed AQS in 1996 to manage data that are used for regulatory purposes, such as identifying areas that do not meet air quality standards. EPA developed the AirNow system in the late 1990s to provide near real-time information about air pollution levels to the public.

The Environmental Protection Agency's (EPA) AirNow Mobile App



EPA's AirNow app automatically displays the current Air Quality Index (AQI), a color-coded scale designed to communicate whether air quality is healthy or unhealthy, for a user's local area.

Source: EPA's AirNow mobile app. | GAO-23-105618

Due to their age and design, AQS and AirNow can be difficult to maintain, access, and use, according to GAO's analysis of EPA and stakeholder views. This limits their functionality and poses resource and other challenges for EPA, monitoring agencies, and other data users. For example, EPA officials said it was particularly challenging to find and retain IT staff with experience or knowledge to work with AQS's outdated software. Moreover, the use of multiple systems to manage air quality data results in inefficient use of resources for EPA and monitoring agencies, according to GAO's analysis of EPA and stakeholder views.

EPA is considering replacing AQS and AirNow with a new, single system to address the legacy system challenges, but progress has been limited partly due to competing priorities and resource limitations, according to EPA officials. Despite listing AQS as a system in need of modernization in 2017, EPA has not clearly identified AQS and AirNow as candidates for replacement through its recent IT management and oversight processes. According to EPA guidance, the agency should assess mature systems to ascertain their continued effectiveness in supporting mission requirements and consider replacement options. However, EPA's processes do not specify factors for evaluating systems that may be ready for replacement, such as if the system has deteriorated beyond economical repair. Identifying factors for consideration could help ensure that EPA identifies such systems and collects information it needs to optimize its resources. Furthermore, EPA has not developed a business case for a new system, which is a step in EPA's IT management process needed to secure management approval for modernizing IT systems or developing a new one. Developing and documenting a business case for a new system could better position EPA to make decisions about whether to replace AQS and AirNow.

Contents

Figures

Abbreviations

API	Application Programming Interface
AQI	Air Quality Index
AQS	Air Quality System
CIO	Chief Information Officer
CPIC	Capital Planning and Investment Control
EPA	Environmental Protection Agency
EPA's air office	Office of Air and Radiation
OMB	Office of Management and Budget
SLCM	System Life Cycle Management

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

September 6, 2023

The Honorable Gerald E. Connolly
Ranking Member
Subcommittee on Cybersecurity, Information Technology, and Government Innovation
Committee on Oversight and Accountability
House of Representatives

Dear Mr. Connolly:

The Environmental Protection Agency (EPA) relies on air quality data and the related IT systems to implement its mission to protect human health and the environment. For example, EPA depends on its IT systems to manage air quality data, which play a critical role in efforts to reduce air pollution and related public health risks. The data inform regulatory and compliance decisions that have associated economic impacts totaling billions of dollars, including the costs of reducing air pollution and the benefits associated with reducing adverse health effects from poor air quality. Demand for more comprehensive and real-time air quality data by an assortment of users—such as public health organizations, academic researchers, and private citizens—has increased in recent years, driven partly by concerns about health effects from exposure to pollutants that are not monitored in key locations.

The Clean Air Act of 1970, as amended, requires EPA to issue regulations establishing an air quality monitoring system that, among other things, provides for periodic analysis and reporting of air quality data to the general public.[1] Under these regulations, EPA establishes requirements for, and oversees, the national ambient air quality monitoring system.[2] EPA also provides technical assistance and funding to the designated monitoring agencies. The monitoring agencies—tribal, state, local, or territorial—design and operate air monitoring sites that

[1]42 U.S.C. § 7619(a). The Clean Air Act provides the framework for protecting air quality in the United States. The purposes of the Clean Air Act are, among other things, to protect and enhance the quality of the nation's air resources so as to promote the public health and welfare and the productive capacity of its population. The Clean Air Act has been amended several times.

[2]"Ambient air" means that portion of the atmosphere, external to buildings, to which the general public has access. 40 C.F.R. § 50.1(e).

make up the national ambient air quality monitoring system using methods, including technologies, and quality assurance procedures approved by EPA. These agencies are responsible for collecting, assessing, validating, and delivering air quality data to EPA's IT systems.

In November 2020, we reported on concerns about the antiquated nature of EPA's Air Quality System (AQS), one of EPA's IT systems for managing data collected by the national ambient air quality monitoring system. We reported that the inflexibility of AQS created significant barriers to completing work, according to EPA officials.[3] For example, officials at the time said that it was difficult to modify AQS to reflect the evolving data and report data in ways that met user needs. EPA's acting Chief Information Officer (CIO) listed AQS as one of EPA's top three mission-critical systems in need of modernization in a 2017 memorandum written in response to a request from Members of Congress regarding legacy systems.

You asked us to evaluate EPA's IT systems for ambient air quality data. This report examines (1) how EPA uses IT systems to manage air quality data, (2) any challenges that EPA's IT systems for air quality data present for EPA and other data providers and users, and (3) the extent to which EPA has addressed challenges presented by its IT systems for air quality data.

To examine how EPA uses IT systems to manage air quality data, we reviewed EPA documents that describe these systems and interviewed relevant officials. For example, we reviewed agency presentations, manuals, and guidance to understand the architecture of the systems, the nature of the data stored, quality assurance standards, procedures for data submission and data queries, and other considerations relevant to EPA's management of the data. We interviewed EPA officials from the Office of Air Quality Planning and Standards—a group within the Office of Air and Radiation (EPA's air office)—that is responsible for management of these systems.[4]

To examine any challenges that EPA's IT systems for air quality data present for EPA and other data providers and users, we conducted a

[3]GAO, *Air Pollution: Opportunities to Better Sustain and Modernize the National Air Quality Monitoring System*, GAO-21-38 (Washington, D.C.: Nov. 12, 2020).

[4]EPA's air office develops national programs, policies, and regulations for controlling air pollution and radiation exposure.

series of interviews with officials from EPA's Office of Air Quality Planning and Standards and six stakeholder organizations. These stakeholders are three associations that represent tribal, state, local, or territorial air quality agencies; two nongovernmental organizations focused on air quality issues; and the consulting firm that manages EPA's Air Toxics Archive. To identify these stakeholders, we reviewed documents about the operation and use of EPA's IT systems for air quality data that describe users of the systems, as well as our prior report.[5] We also conducted searches to identify organizations that represent a range of views of the general public, community groups, and institutions and that have familiarity with EPA's IT systems for air quality data. Specifically, we conducted a literature search; reviewed material from conferences and presentations, such as EPA's National Ambient Air Monitoring Conference; and searched EPA's docket for public comments about IT systems for air quality data.[6]

We selected and interviewed stakeholders based on their experience either providing data to these systems or obtaining and using those data. We then analyzed stakeholder views to identify any challenges that EPA's IT systems for air quality data may present for data providers and users. The views of these stakeholders are nongeneralizable to all data providers and users.

To examine the extent to which EPA has addressed challenges presented by its IT systems for air quality data, we reviewed documents and interviewed officials to understand the steps the agency has taken to address these challenges. For example, we reviewed agency presentations on developing a new system and agency policies and procedures for managing IT systems. We interviewed officials from EPA's Office of Air Quality Planning and Standards and Office of Mission Support, the office that manages the IT policy and investment portfolio. We compared steps that EPA has taken with its policies and procedures for managing IT systems. We also compared these policies and procedures with Office of Management and Budget (OMB) guidance for managing IT systems and our Information Technology Investment

[5]GAO-21-38.

[6]We searched Regulations.gov, which serves as EPA's electronic public docket system. EPA's docket is a collection of documents made available for public viewing. These documents may include public comments received by EPA as part of a rulemaking process or another agency action.

Management Framework.[7] The framework identifies processes that are critical for the successful management of IT investments and can be used to evaluate and assess how well an agency selects and manages IT systems. For additional details on our scope and methodology, see appendix I.

We conducted this performance audit from December 2021 to September 2023 in accordance with generally accepted government auditing standards. Those standards require 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.

Background

Air Pollutants

EPA regulates many air pollutants under the Clean Air Act. One category of air pollutants, referred to as “criteria” pollutants, comprises six common or widespread pollutants that can harm public health and the environment and cause property damage. These pollutants are carbon monoxide, lead, ozone, particulate matter, nitrogen dioxide, and sulfur dioxide. They often come from sources such as power plants, factories, and motor vehicles. EPA has established standards—called the National Ambient Air Quality Standards—for the allowable levels of each criteria pollutant in the ambient air.[8] EPA sets these standards at levels intended to protect public health, including the health of susceptible and vulnerable populations, such as people with asthma, children, and elderly people,

[7]GAO, *Information Technology Investment Management: A Framework for Assessing and Improving Process Maturity,* GAO-04-394G (Washington, D.C.: Mar. 2004).

[8]EPA has established standards for two different sizes of particulate matter: particulate matter less than or equal to 10 micrometers in diameter, known as PM_{10}, and particulate matter less than or equal to 2.5 micrometers in diameter, known as fine particulate matter or $PM_{2.5}$. For context, the average human hair is about 70 micrometers in diameter—making it 30 times larger than the largest fine particle.

with an adequate margin of safety.[9] The act requires EPA to review the standards every 5 years and revise the standards as may be appropriate.

Another category of air pollutants comprises 188 pollutants listed under the 1990 Clean Air Act Amendments and subsequent EPA regulations as "hazardous air pollutants," which the agency also refers to as "air toxics."[10] These pollutants are known to cause, or suspected of causing, cancer, birth defects, reproduction problems, or other serious illnesses. Air toxics include pollutants such as benzene, found in gasoline, and mercury, which is emitted from sources such as power plants. EPA regulates these pollutants by establishing emissions standards for individual categories of sources.[11] The health risks of air toxics can vary considerably. Small quantities of more harmful pollutants can pose greater health risks than large quantities of less harmful pollutants. In addition, some air toxics can fall to the ground in rain or dust and contaminate land and water.

Under the Clean Air Act, states and territories—and, in some instances, tribal and local governments—are generally responsible for managing air quality in their jurisdictions.[12] Their responsibilities include monitoring air quality and establishing State Implementation Plans that describe how each state will attain and maintain compliance with the National Ambient

[9]Under the Clean Air Act, these standards designed to protect public health are called "primary standards." In addition, EPA sets "secondary standards" to protect the public welfare from adverse effects of a pollutant, including those related to effects on soils, waters, crops, and visibility.

[10]For a list of these pollutants, see Environmental Protection Agency, *Initial List of Hazardous Air Pollutants with Modifications,* accessed May 10, 2023, https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications. For more information on pollutants that EPA regulates under the Clean Air Act, see Congressional Research Service, *Clean Air Act: A Summary of the Act and Its Major Requirements,* RL30853 (Washington, D.C.: Sept. 2022).

[11]These sources of hazardous air pollutants include factories, refineries, and power plants. For a list of the hazardous air pollutant source categories, see https://www.epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-8.

[12]The Clean Air Act authorizes EPA to treat Tribes as states and delegate authority to the tribal government for implementing the act in certain circumstances. 42 U.S.C. § 7601(d). EPA has issued regulations governing treatment of Tribes as states for purposes of the Clean Air Act. *See* 40 C.F.R. pt. 49. Under the Clean Air Act, EPA can delegate authority for implementing and enforcing federal standards to states or local governments.

Air Quality Standards.[13] To determine compliance with these standards, tribal, state, territorial, and local governments operate air quality monitors that are part of a national monitoring system to measure air pollution levels. Figure 1 shows examples of monitoring sites and equipment.

Figure 1: Examples of Ambient Air Quality Monitoring Sites and Monitoring Equipment

National Core network (NCore) monitoring site operated by the Wyoming Department of Environmental Quality

Near-road monitoring site operated by the Rhode Island Department of Environmental Management

Equipment for monitoring criteria pollutants operated by the Colorado Department of Public Health and Environment

Canisters used to collect samples for measuring air toxics operated by the Wisconsin Department of Natural Resources

Particulate matter monitoring site atop a building at the Illinois State Fairgrounds operated by the Illinois Environmental Protection Agency

Source: GAO. | GAO-23-105618

[13]A State Implementation Plan is a collection of regulations and documents used by a state to implement, maintain, and enforce the National Ambient Air Quality Standards. In some states, such as California, local air pollution districts work with the state on the State Implementation Plan. EPA must issue a Federal Implementation Plan if a state fails to submit a plan or EPA disapproves the State Implementation Plan, unless the state corrects the plan's deficiency.

The National Ambient Air Quality Monitoring System

The national ambient air quality monitoring system provides standardized information essential for implementing the Clean Air Act and protecting public health. The system includes monitors located at over 4,000 fixed-location monitoring sites that use standardized methods to collect data on ambient levels of air pollutants regulated under the Clean Air Act.[14] This allows for the comparison of data across the country to provide a national perspective on various air quality issues.[15] Data collected through the national ambient air quality monitoring system are submitted to EPA by the various monitoring agencies that operate the air monitoring sites.

Under EPA regulations, the objectives of the national ambient air quality monitoring system are to (1) provide air pollution data to the public in a timely manner, (2) support compliance with ambient air quality standards and emissions strategy development, and (3) support air pollution research studies.[16] The national ambient air quality monitoring system provides information essential for assessing Clean Air Act compliance and provides information critical to helping air quality managers, researchers, and the public to understand and manage health risks from air pollution, as we described in our November 2020 report.[17] We found that the monitoring system provides some near real-time air quality information for ozone and particulate matter, which organizations and individuals can use to evaluate daily health risks and change behaviors accordingly.

We have also reported on emerging technologies—such as lower-cost sensors and satellite-based sensors with new capabilities—for obtaining

[14]For more information on the national ambient air quality monitoring system, see GAO-21-38.

[15]Certain state and local air toxics monitoring programs use common methods for producing data. However, since these are not required networks, the use of common methods across all state and local air toxics monitoring is not assured.

[16]40 C.F.R. pt. 58, appx. D, § 1.1.

[17]GAO-21-38. In addition, in 2022 we testified that air quality managers, researchers, and the public need more information to understand health risks from air pollution. See GAO, *Air Quality Information: Need Remains for Plan to Modernize Air Monitoring*, GAO-22-106136 (Washington, D.C.: July 13, 2022).

air quality information.[18] For example, in December 2020, we found that lower-cost sensors can be deployed virtually anywhere, including on fences, cars, and clothing.[19] Air quality managers, researchers, and the public increasingly use these emerging technologies to obtain air quality information. These sensors provide opportunities to improve research on the health effects of air pollution and expand monitoring. We also found that researchers have begun to use satellite-based sensors in studies of pollution over large areas, including areas that are difficult or impossible to monitor with traditional monitoring methods.

Legacy Federal IT Systems

In June 2019, we found that federal agencies have struggled with appropriately planning and budgeting for modernizing aging (also called legacy) IT systems; upgrading underlying infrastructure; and investing in high quality, lower-cost service delivery technology.[20] The report evaluated agencies' plans for modernizing their legacy systems to see if they included key elements identified in best practices: (1) milestones, (2) a description of the work necessary to complete the modernization, and (3) a plan for the disposition of the legacy system.

We found that the consequences of not updating legacy systems have contributed to the following four challenges for agencies:

- **Unmet mission needs.** Legacy systems may not be able to reliably meet agency mission needs because they are outdated or obsolete.
- **Staffing issues.** In order to operate and maintain legacy systems, staff may need experience with older technology and programming languages. Agencies have had difficulty finding employees with such knowledge and may have to pay a premium to hire specialized staff or contractors.
- **Security risks.** Legacy systems may operate with known security vulnerabilities that are either technically difficult or prohibitively

[18]See GAO-21-38; and GAO, *Science & Tech Spotlight: Air Quality Sensors*, GAO-21-189SP (Washington, D.C.: Dec. 2020).

[19]According to EPA, air sensor refers to a class of technology that has expanded on the market in recent years and has certain common traits, including being capable of directly reading a pollutant in the air, being smaller in size, and often being sold at a price that supports a wider number of monitoring locations than possible in the past.

[20]GAO, *Information Technology: Agencies Need to Develop Modernization Plans for Critical Legacy Systems,* GAO-19-471 (Washington, D.C.: June 11, 2019).

expensive to address. In some cases, vendors no longer provide support for hardware or software, creating security vulnerabilities and additional costs.

- **Increased costs.** The cost of operating and maintaining legacy systems increases over time. The issue of cost is linked to the three previously described consequences—either because the other issues directly raise costs or, as in the case of not meeting mission needs, the agency is not receiving a favorable return on investment. Further, in an era of constrained budgets, the high costs of maintaining legacy systems could limit agencies' ability to modernize and develop new or replacement systems.

EPA Processes for IT Management and Oversight

EPA's CIO has established internal processes for management and oversight of the agency's IT systems. These include the System Life Cycle Management (SLCM) and Capital Planning and Investment Control (CPIC) processes.

- **System Life Cycle Management Process.** EPA's SLCM policy and procedure establish the agency's approach for planning, developing, and managing IT systems. This process is intended to help scope and implement IT systems using effective management control practices. The SLCM procedure states that it is intended to ensure that EPA IT systems support EPA mission goals, are controllable and cost-effective, reduce risk, and comply with federal regulations.
- **Capital Planning and Investment Control Process.** EPA's CPIC policy and procedure state that they are intended to integrate the planning, acquisition, and management of IT systems into the budget decision-making process to improve the agency's asset management. EPA describes CPIC as a dynamic process in which the agency selects IT systems that it will invest in and then continually monitors and evaluates these systems to ensure that each one is well-managed, cost-effective, and supports the mission and strategic goals of the EPA.

According to EPA's CPIC procedure, CPIC reporting is intended to assist the EPA CIO with oversight and informed decision-making. EPA's goal through CPIC is to address the strategic needs of the agency, optimize scarce IT resources, identify gaps and inaccuracies in IT spending, and ensure that mission and business goals are achieved.

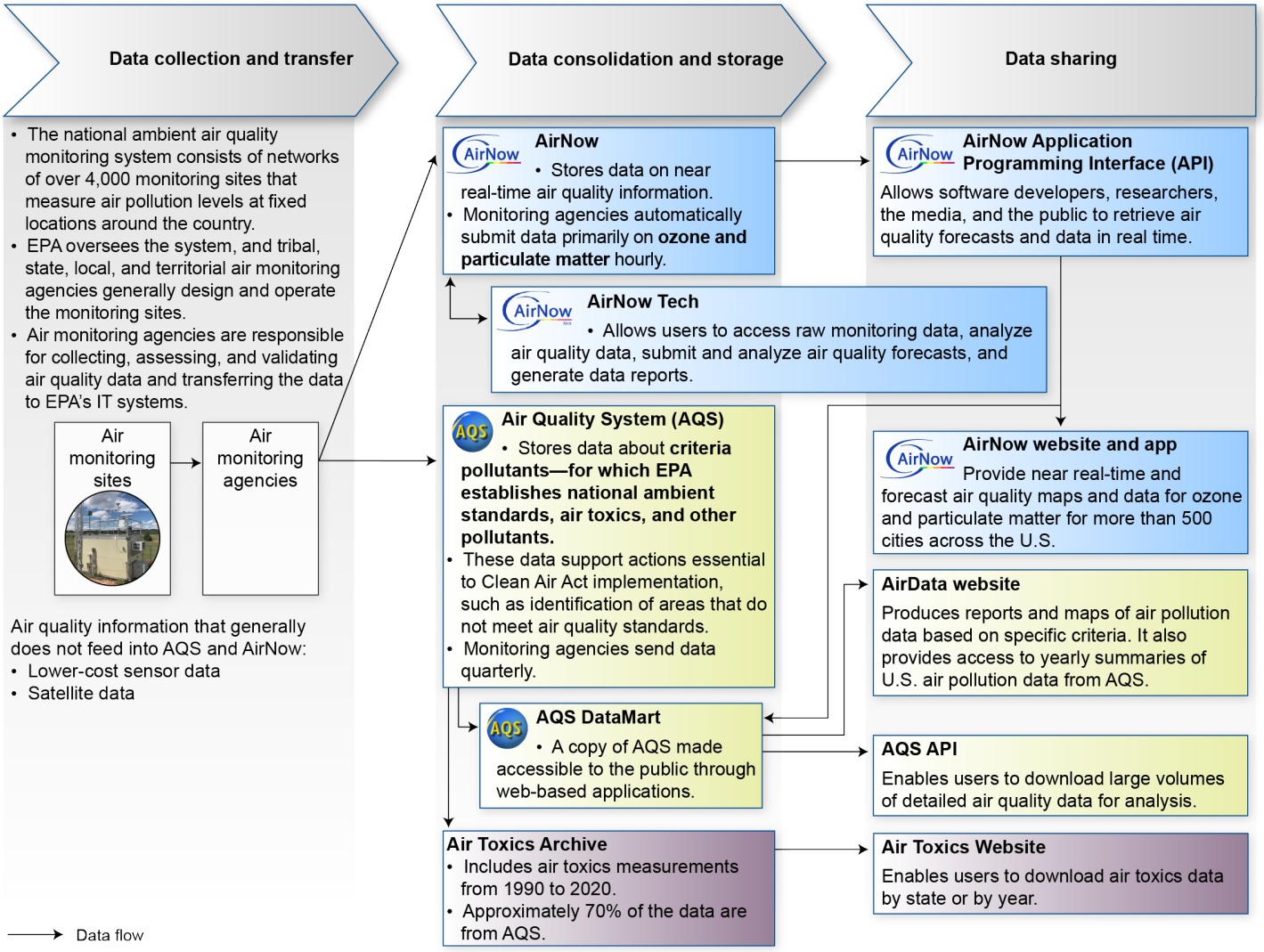
In addition, EPA has established a centralized review process under CPIC, known as the IT portfolio review, to evaluate the effectiveness of EPA's IT systems. Specifically, the Office of Mission Support meets annually with each EPA program and regional office to discuss their IT systems.[21] The overall purpose of the annual review meeting is to allow program and regional offices to report and discuss concerns, risks, or issues with IT systems in their area and provide an opportunity to elevate these issues to the CIO level, at which point they can potentially be addressed or mitigated.

EPA Primarily Uses Two Legacy IT Systems to Manage and Report Air Quality Data

EPA primarily uses two legacy IT systems—AQS and AirNow—to manage and report air quality data collected through the national ambient air quality monitoring system, as shown in figure 2. AQS is EPA's repository for ambient air quality data that EPA uses for regulatory purposes. AirNow receives near real-time data primarily on ozone and particulate matter that EPA reports to the public through a website and app.

[21]EPA has national program offices in headquarters and 10 regional offices, which are responsible for the execution of EPA programs. The national program offices in headquarters are the offices of the Administrator, Air and Radiation, Chemical Safety and Pollution Prevention, Enforcement and Compliance Assurance, Environmental Justice and External Civil Rights, International and Tribal Affairs, Land and Emergency Management, Research and Development, and Water. The 10 regional offices are Region 1 (Boston), Region 2 (New York City), Region 3 (Philadelphia), Region 4 (Atlanta), Region 5 (Chicago), Region 6 (Dallas), Region 7 (Kansas City), Region 8 (Denver), Region 9 (San Francisco), and Region 10 (Seattle).

Figure 2: Environmental Protection Agency (EPA) IT Systems for Air Quality Data



Source: GAO analysis of EPA information. | GAO-23-105618

EPA Uses AQS to Manage Data That Can Be Used for Regulatory Purposes

EPA began developing AQS in 1996 to manage ambient air quality data used for regulatory purposes, including assisting in identification of locations that do not meet air quality standards, according to EPA. It contains ambient air quality data collected by EPA and tribal, state, local,

and territorial air monitoring agencies. Approximately 128 tribal, state, local, and territorial air monitoring agencies submit data to AQS.[22] Monitoring agencies are required to report data to AQS quarterly, take quality assurance steps to verify and validate their data, and annually certify that the data they submit to AQS are complete and accurate to the best of their knowledge.[23] Monitoring agencies that provide data to AQS can also use AQS to produce standard predefined data reports, such as data completeness reports.

EPA uses AQS as its long-term repository of regulatory ambient air quality data, according to EPA documents. The earliest data are from 1957. Most of the data in AQS are for criteria pollutants and air toxics. AQS also contains descriptive information about each monitoring station and the data quality assurance information reported by monitoring agencies.

EPA makes data from AQS available to the public through its AirData website and the AQS Application Programming Interface (API), which serve distinct purposes.[24] AirData is intended to assist a wide range of people, from concerned citizens who want to know how many unhealthy air quality days occurred in their county last year to air quality analysts in the regulatory, academic, and health research communities who need raw data, according to EPA's AirData website. AirData can be used to produce reports and maps of air pollution data based on specific criteria. The website provides access to yearly summaries of U.S. air pollution data from AQS. It also has a tool that can be used to query daily air quality summary statistics for criteria pollutants by monitor.

In contrast, the AQS API enables users to download large volumes of detailed air quality data for analysis. Data from this API are available to anyone, but the API is targeted at application developers and data

[22]In addition, EPA, two other federal agencies, eight institutions or contractors, and 46 industrial entities also report data to AQS. Tim Hanley, Ambient Air Monitoring Group, EPA's Office of Air Quality Planning and Standards, "Ambient Air Monitoring and NAAQS Overview" (Slides presented at the Plenary Session National Ambient Air Monitoring Conference Pittsburgh, PA, Aug. 23, 2022).

[23]40 C.F.R. §§ 58.11(a), 58.15(a), 58.16(b).

[24]An API is a type of software interface that allows two or more software applications to communicate with each other. For the AirData website, see https://www.epa.gov/outdoor-air-quality-data. For the AQS API, see https://aqs.epa.gov/aqsweb/documents/data_api.html.

analysts who are familiar with the data and its interpretation, according to EPA's website.

The air toxics data submitted to AQS are also maintained in EPA's Air Toxics Archive. EPA developed the Air Toxics Archive in 2001 because there was no central repository to which ambient air toxics data could be reported, according to an official from the contractor that manages the archive.[25] At that time, there was no guidance or requirement that air toxics data be submitted to AQS. Thus, EPA made an effort to gather these data from various state and local agencies, provide quality assurance, and standardize the information for the development of the archive. Over time, according to the contractor, EPA began requiring that monitoring initiatives receiving EPA funding submit their data to AQS. Approximately 70 percent of the data in the archive are from AQS.[26] AQS also includes data from 23 other primary sources, such as state and local agencies. EPA makes data from the archive available to the public on its website.[27]

EPA Uses AirNow to Report Current Air Quality Data to the Public

EPA developed AirNow in the late 1990s to provide current, or near real-time, information about certain air pollution levels to the public, according to EPA officials. Organizations and individuals can use this information to evaluate daily health risks and change behaviors accordingly. AirNow has a smaller scope than AQS because it is primarily used to collect and report data about ozone and particulate matter, which are two of the six criteria pollutants.[28] According to EPA officials, AirNow is focused on

[25]The Air Toxics Archive is managed by a contractor, the Eastern Research Group, Inc. For more information on the Air Toxics Archive, see Regi Oommen et al., Eastern Research Group, Inc., *Compilation and Quality Assurance Summary Report for the 2020 Ambient Monitoring Archive for the Hazardous Air Pollutants* (Sept. 30, 2022).

[26]Oommen, *Compilation and Quality Assurance Summary Report for the 2020 Ambient Monitoring Archive for the Hazardous Air Pollutants.*

[27]For the Air Toxics Archive website, see https://www.epa.gov/amtic/amtic-ambient-monitoring-archive-haps.

[28]According to EPA officials, some monitoring agencies submit data to AirNow on pollutants other than ozone and particulate matter, such as nitrogen dioxide, sulfur dioxide, and carbon monoxide, but those data are available in AirNow-Tech and are not reported on the AirNow website or app.

ozone and particulate matter because those pollutants are more widespread than the other criteria pollutants.

Monitoring agencies provide data to AirNow hourly through an automated process, according to monitoring agency officials, and reporting data to AirNow is voluntary. Approximately 115 tribal, state, and local monitoring agencies submit data to AirNow.[29] AirNow is programmed to perform preliminary data quality assessments. However, unlike the data submitted to AQS, the data submitted to AirNow are not certified as complete and accurate. This is because AirNow data are not used for regulatory purposes and, instead, are used to provide the public with near real-time information.

EPA makes AirNow's data available to the public in near real-time through a website and app, as shown earlier in figure 2.[30] The website and app report the data using the Air Quality Index (AQI), a color-coded scale designed to communicate whether air quality is healthy or unhealthy, as shown in figure 3.[31] The website and app also report forecasts of air quality provided by monitoring agencies. In addition, EPA has an AirNow API that allows software developers, researchers, the media, and the public to retrieve air quality forecasts and data in real time.

[29]In addition, EPA, three other federal agencies, and 19 entities in Canada, Mexico, and other countries also report data to AirNow. See Hanley, "Ambient Air Monitoring and NAAQS Overview."

[30]For the AirNow website, see https://www.airnow.gov/. EPA also hosts the Fire and Smoke Map on its AirNow website and app, according to EPA officials. The Fire and Smoke Map is a collaborative effort between the U.S. Forest Service-led Interagency Wildland Fire Air Quality Response Program and EPA. The map relies on data provided from a number of sources, including AirNow, the Western Regional Climate Center, AirSis, and PurpleAir for monitoring and sensor data, and the National Oceanic and Atmospheric Administration Hazard Mapping System and the National Interagency Fire Center for fire and smoke plume information. For more information, see GAO, *Wildfire Smoke: Opportunities to Strengthen Federal Efforts to Manage Growing Risks,* GAO-23-104723 (Washington, D.C.: Mar. 13, 2023).

[31]EPA calculates the AirNow AQI based on monitoring data for ozone and particulate matter and reports it in color-coded categories based on the levels of health concern posed by the amount of air pollution over certain time periods. The categories include good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous.

Figure 3: AirNow Website, Showing Near Real-Time Air Quality Information on January 31, 2023

Source: Environmental Protection Agency (AirNow.gov). | GAO-23-105618

EPA makes the raw data from AirNow available through its AirNow-Tech website.[32] AirNow-Tech allows users to access raw monitoring data, analyze current and past air quality events and episodes, submit and analyze air quality forecasts, generate data reports, and create Geographic Information System-based maps with air quality and meteorological conditions. AirNow-Tech is primarily used by the federal, tribal, state, and local air quality organizations that provide data and forecasts to the AirNow system, as well as researchers and other air data users, according to EPA's AirNow-Tech website.

[32]For the AirNow-Tech website, see https://airnowtech.org/.

The Age and Design of EPA's Legacy IT Systems for Air Quality Data Present Maintenance and Usability Challenges, According to EPA and Stakeholders

Due to their age and design, AQS and AirNow can be difficult to maintain, access, and use, according to our analysis of EPA and stakeholder views. EPA and stakeholders also said that maintaining multiple systems to manage air quality data can result in inefficient use of resources for EPA and monitoring agencies. Based on our analysis of EPA and stakeholder views, we identified four categories of challenges: (1) challenges presented by AQS, (2) challenges presented by AirNow, (3) challenges resulting from the use of multiple systems to manage data, and (4) challenges presented by agencies' limited capacity to address existing issues.

AQS's Age Presents Maintenance and Usability Challenges

AQS presents a number of challenges for EPA, monitoring agencies, and other users, according to our analysis of EPA and stakeholder views, as described in the following sections.

AQS's age and reliance on outdated software make AQS difficult to update and maintain. AQS is an aging system that relies on outdated software, which makes it increasingly difficult and costly to maintain.[33] This, in turn, can present technological and staffing challenges for both EPA and monitoring agencies, according to EPA officials and stakeholders. For example, EPA officials said that it was challenging to find and retain technological staff with the experience or knowledge needed to work with AQS, since software developers knowledgeable in the older software used by AQS are becoming increasingly rare. According to EPA officials, as of January 2023, there was one person at EPA who had been working on AQS for more than a year. In addition, AQS has accumulated extensive amounts of code over time, which has

[33]AQS uses an Oracle database and Oracle Forms and Reports. According to EPA officials, Oracle announced that Oracle Reports will be de-supported in September 2023, and EPA is working with a contractor to transition to a different software for AQS reports.

made the system increasingly susceptible to bugs when EPA officials attempt to make changes to the system, according to EPA officials.

As we found in 2019, operating and maintaining legacy systems such as AQS can also become more expensive over time.[34] For example, according to EPA officials, EPA pays license fees for legacy data storage, which is more costly than cloud-based storage. As the amount of data in AQS increases, the cost of storing these data increases as well. According to EPA officials, the quantity of air quality data stored in AQS has grown significantly since AQS's early usage, as a result of historical data accumulation, evolving regulations, and the shift to digital data transmission. According to EPA, the number of sample measurements in AQS for 2020 is roughly double the number of sample measurements for 1996, when EPA began developing AQS.[35] Further potential increases in data, such as from increases in continuous monitoring across a wider range of pollutants, would create substantially more data to manage.

AQS's outdated software also makes it difficult to keep the system up to date with monitoring information and regulatory and security updates, according to our analysis of EPA and stakeholder views. In particular, EPA officials said that they must devote much of their time to fixing existing problems in order to keep AQS functional for users, allowing little time to update the system with regulatory and other changes. According to monitoring agency officials, it can take years for AQS to reflect regulatory requirements or national guidance for monitoring.

Submitting data to AQS can be complicated and resource intensive. Submitting data to AQS can involve complications and delays, according to EPA officials and stakeholders. For example, monitoring agency officials cited challenges when processing large amounts of data in AQS—such as entering data in batches—which can cause AQS to run slowly or crash. In addition, officials said that AQS can freeze midway through data submission without a corresponding error message, requiring monitoring agencies to both determine the source of the error and then take steps to resubmit the data. In other cases, AQS issues error reports that are difficult to interpret, according to monitoring agency

[34]GAO-19-471.

[35]There are approximately 56 million sample measurements in AQS for 1996 and approximately 118 million sample measurements in AQS for 2020. EPA makes these data available at https://aqs.epa.gov/aqsweb/documents/about_aqs_data.html, accessed on Mar. 27, 2023.

officials. This causes delays as agencies seek the appropriate steps to resolve the issue, such as by attempting different troubleshooting measures or submitting a support request to EPA.

Further, monitoring agency officials said that saving changes in AQS—such as adding new air quality monitors, certifying data, or updating information—can be slow and inefficient. For example, EPA and monitoring officials said that it can be difficult to update certain information about air quality monitors in AQS. According to EPA officials, information must be updated according to strict rules—and entered in a particular order—to be considered valid by AQS. In addition, AQS does not have mechanisms—such as informative error messages—to help users avoid and correct any mistakes, according to EPA and monitoring agency officials. Furthermore, fields designated for required information are supposed to be identified to the user through the use of bold text, but in some cases those fields have not yet been updated in AQS, according to an EPA official, so users may not be aware that filling those fields is required by the system.

Accessing and analyzing data through AQS is complicated and cumbersome. AQS's outdated software can complicate efforts to access and analyze air quality data. EPA officials told us that when AQS was developed in the 1990s, its interface was not designed for use by those without specific programming expertise in AQS's coding structure and use of terminology. As a result, monitoring agency officials and other users said that it often can be difficult to perform basic searches in AQS without such expertise. In some cases, AQS search results are inconsistently formatted or difficult to interpret, according to monitoring agency officials.

Monitoring agency officials said that generating reports from AQS can be time-consuming, requiring additional staff hours and taking time away from other responsibilities. For example, monitoring agency officials reported that AQS's interface is often "down," making AQS inaccessible to users. A monitoring agency official cited one such instance in which a monitoring agency could not access AQS data and, therefore, could not respond to a time-sensitive request from a local government official. Problems accessing AQS data can create more work for state and local staff, who must respond to public inquiries and devise workaround solutions to find the data they need, according to monitoring agency officials. EPA officials said that EPA has received few documented reports of AQS outages through its existing IT support channels and that problems with AQS accessibility are not necessarily related to AQS itself.

In response to issues in accessing and analyzing AQS data, a number of states have developed their own independent data systems to facilitate access to AQS data in a way that better meets their needs. Similarly, representatives from a public health organization said that they hired an outside contractor to develop a separate, more easily understandable database from AQS data to support a major research effort, since AQS itself is too difficult to use without specific expertise.

AirNow's Functionality Has Some Limitations

According to our analysis of EPA and stakeholder views, AirNow provides a user-friendly means for the general public to access current air quality data. AirNow is designed for—and accessible to—a wide range of users, including air quality agencies, researchers, public health organizations, and the general public. According to monitoring officials and other stakeholders, AirNow has a user-friendly interface, offering local air quality information in near real-time, as well as air quality forecasts, interactive maps, and other tools.

However, AirNow has some limitations to its functionality, according to our analysis of EPA and stakeholder views. For example, EPA officials said that extracting large amounts of data—such as multiyear datasets—from AirNow can be difficult and may involve workaround solutions requiring considerable time and effort.[36] Stakeholders also said that some of AirNow's capabilities—for example, its tools for running queries or data visualizations—were limited or outdated. In addition, the AirNow-Tech feature for accessing raw data from the system is built on a platform that is not compatible with mobile devices.

Working with Multiple Systems Presents Additional Challenges for EPA and Users

Using multiple systems (i.e., AQS, AirNow, and the Air Toxics Archive) to manage air quality data can present additional challenges, according to our analysis of EPA and stakeholder views, which, they said, has led to inefficient use of resources and potential confusion for data users, as described in the following sections.

[36]EPA officials told us that it is possible to extract large amounts of data through the AirNow API, but programming expertise and effort is required.

Multiple systems for air quality data results in inefficient use of resources. Maintaining and using multiple systems to manage air quality data results in inefficient use of resources for EPA and monitoring agencies, according to our analysis of EPA and stakeholder views. For example, maintaining and using multiple systems increases the amount of training resources required because EPA and monitoring agency officials must learn and maintain a working knowledge of two systems instead of one. In addition, monitoring agency officials must report data separately to both AQS and AirNow, and users attempting to access or analyze data from either system must be familiar with the capabilities and required steps in each system and independently request EPA assistance when issues occur. According to EPA and monitoring agency officials, EPA-provided training in AQS has become less thorough and less frequent over time.

EPA officials told us that AQS and AirNow maintain much of the same data, but these data are stored in slightly different ways between them. As a result, according to these officials, when data are needed from both systems, they must devote a large amount of time determining how to crosswalk the data between the systems. Moreover, the officials said that the use of multiple systems—each with its own legacy components and software—creates additional costs for EPA to operate, update, troubleshoot, and maintain the systems. For example, EPA officials said that having two systems rather than one results in the need for more training and documentation (e.g., on how to use the data systems).

Multiple systems from which to access data can be confusing for users. According to our analysis of EPA and stakeholder views, having multiple systems from which to access data can be confusing for users. EPA officials said that, in some cases, AQS and AirNow may appear to provide different "answers" to the same question from a user's perspective. Some of these inconsistencies can be attributed to the differing quality assurance standards across systems.[37] For example, air

[37]A 2017 EPA Inspector General report evaluated data in both AQS and AirNow and found approximately 75 percent agreement between the two systems. According to this report, there are a number of reasons for the differences. For example, monitoring agencies may eventually determine through AQS quality assurance checks that certain data reported in real time to AirNow are invalid and, therefore, not report the data to AQS. Environmental Protection Agency, Office of Inspector General, *Management Alert: Certain State, Local and Tribal Data Processing Practices Could Impact Suitability of Data for 8-Hour Ozone Air Quality Determinations*, Report No. 17-P-0106 (Washington, D.C.: Feb. 6, 2017).

monitoring data submitted to AirNow may be corrected prior to being submitted to AQS because data submitted to AQS undergo additional quality assurance checks.[38]

Similarly, AQS and the Air Toxics Archive may contain different information for the same pollutants. Monitoring agencies are able to upload air toxics data directly into AQS, and these data subsequently serve as the primary source of data for EPA's Air Toxics Archive. However, when data are added to the archive, additional quality assurance procedures are performed to correct and identify any faulty records, according to the consulting firm that manages the archive.[39] EPA makes corrected data from the archive publicly available on its website, but those corrections are not subsequently carried back to AQS. In addition, some data users may be unaware of the archive or of the potential for discrepancies between the two databases. If uncorrected air toxics data are retrieved from AQS, the resulting data analyses could potentially provide inaccurate results.

Limited Capacity May Exacerbate the Challenges Presented by AQS and AirNow, According to EPA and Stakeholders

The limited capacity (i.e., people and resources) of EPA and monitoring agencies may exacerbate the challenges presented by AQS and AirNow, according to our analysis of EPA and stakeholder views. EPA has faced challenges finding and retaining IT and other staff with the knowledge necessary to support its legacy air quality data systems, according to EPA officials. Furthermore, according to EPA officials, the agency does not have sufficient staff to keep system documentation (e.g., on how to use the data systems) up to date, and this can make it difficult for users to resolve problems they may be experiencing when using the systems. In addition, monitoring agencies at the tribal, state, or local level often do not have the staff, expertise, or funding to effectively learn, navigate, and

[38]AirNow data receive preliminary data quality assessments, but they are not subjected to the full validation used to officially submit and certify data in AQS. AQS data are used for regulatory purposes, such as determining attainment of the National Ambient Air Quality Standards, while AirNow data are used to report near real-time air quality data to the public.

[39]EPA has contracted with the Eastern Research Group, Inc., to collect, measure, and interpret air toxics data for the National Monitoring Program.

troubleshoot AQS and AirNow, according to EPA and monitoring agency officials.

EPA officials said that resource constraints have made it difficult for them to keep AQS and AirNow updated with regulatory and monitoring changes while also addressing more immediate technological issues.[40] For example, in 2016 EPA finalized revisions to its regulation governing the use of air quality monitoring data influenced by exceptional events, such as wildfires, but, as of March 2023, EPA had not updated AQS to reflect the revised regulation.[41] According to EPA officials, the work to make these updates has not been funded because of competing priorities, as well as a 3-year delay in obtaining a replacement contract for AQS technical support after the existing contract had expired.[42] Moreover, EPA officials said that past requests for additional funding to improve or update AQS were not approved and, as a result, funding over the last 15 to 20 years has been largely devoted to keeping the system functional.

In addition, monitoring agency officials said that it can be difficult and time-consuming to obtain direct technical assistance from EPA, leading to delays and problems with data submission, access, and analysis. In the past, monitoring agency officials with AQS-related questions were able to contact an EPA IT service desk. EPA now asks monitoring agency officials to direct such questions to an AQS contact at their EPA regional office, who then connects them with EPA's air office if the issue is unable to be resolved. Monitoring agency officials said that this support structure made it time-consuming to resolve issues that could not be resolved at the regional level. EPA officials said that these changes were made to try

[40]From fiscal years 2017 through 2021, EPA obligated on average approximately $955,000 each year for the operation and maintenance of AQS and on average approximately $991,000 each year for the operation and maintenance of AirNow.

[41]Under the Clean Air Act, an "exceptional event" is an event that affects air quality, is not reasonably controllable or preventable, is caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the EPA Administrator through a process established by regulation to be an exceptional event but does not include stagnation of air masses or meteorological inversions, a meteorological event involving high temperatures or lack of precipitation, or air pollution relating to source noncompliance. 42 U.S.C. § 7619(b)(1). When exceptional events influence monitoring data and cause exceedances or violations of the National Ambient Air Quality Standards, monitoring agencies can request, and EPA can agree, to exclude these data from the dataset used for certain regulatory decisions.

[42]EPA had retained a contract with an outside service provider for AQS that covered five to 12 full-time programmers to update AQS to keep it current with regulatory changes, but this contract ended in 2016, according to an EPA official. The replacement contract for AQS support was not finalized until 3 years later.

and be more efficient by addressing issues at the lowest level that they could be resolved. They said that they would review this support structure to see if it was working as intended.

EPA Is Considering Replacing Its Legacy IT Systems for Air Quality Data with a Single System to Address Challenges but Has Not Secured Management Approval

EPA is considering replacing AQS and AirNow with a new, single IT system to address legacy system challenges. However, the agency has not clearly identified AQS and AirNow as candidates for replacement through its IT management and oversight processes that are intended to ensure that systems effectively support the agency's mission and strategic goals. Furthermore, EPA has not documented a business case to secure management approval for a new system.

EPA Is Considering Replacing AQS and AirNow with a New System Intended to Address Legacy System Challenges

According to EPA officials, the agency began to explore updates to AQS and AirNow because they were becoming less effective in supporting the agency's air quality mission.[43] In addition, EPA's acting CIO listed AQS as one of EPA's top three mission-critical systems in need of modernization in a 2017 memorandum written in response to a request from Members of Congress regarding legacy systems.[44] EPA's progress to update or modernize AQS and AirNow, however, has been limited partly due to competing priorities and resource limitations, according to EPA officials. For example, EPA's air office sought to update AQS in 2018. The update did not occur, however, because the staff in EPA's air office did not receive management approval for funding, according to EPA officials.

[43]Interest in modernizing EPA's systems—in particular AQS—has been long-standing. For example, according to EPA officials, AQS users in the mid-2000s wanted a more modern interface (i.e., software display screens through which users provide data to, or request data from, the system) similar to those of other IT systems becoming available at the time.

[44]EPA officials told us that they do not know why the acting CIO—who has since retired—listed AQS as a system in need of modernization in the 2017 memorandum and that they could not identify anyone who recalled the basis for the listing.

Management did not approve the funding request because the agency viewed the proposed update as a lower priority compared with other projects, according to EPA officials.

In 2019, EPA's air office began considering replacing AQS and AirNow with a new, single system and held two brainstorming sessions, referred to as "Lean Management System" or "Lean" events, between 2019 and 2022 to discuss it. According to EPA officials, the first Lean event explored the idea for a new, single system by focusing on how EPA should receive and store ambient air data in the future. EPA officials also told us that participants comprising staff from EPA and staff from monitoring agencies concluded that a single repository for air quality data is a viable option.[45]

The second Lean event, held through meetings spanning late 2021 and early 2022, continued to explore the idea for a new, single system by focusing on data dissemination, data users, and data partners, according to EPA officials. EPA officials also told us that the second Lean event included participants from EPA's air office, two EPA regions, and contractors that support both AQS and AirNow and that the event participants concluded that a new, single system for air quality data would be possible and suitable for data dissemination.

Officials in EPA's air office told us that the concept that emerged from the Lean discussions—replacing AQS and AirNow with a new, single system—could address most of the challenges identified by our analysis of EPA and stakeholder views. Specifically, EPA expects that it could address AQS's maintenance and usability challenges, AirNow's limited functionality, and the challenges resulting from the use of multiple data systems by streamlining system and data management, being user-friendly, and providing flexibility. For example:

- **Streamlining system and data management.** EPA officials expect that a new, single system would streamline data management by consolidating ambient air quality data in a single system. EPA officials told us that they intend for the new system to use an open-source database—meaning that it would not require a fee-based software

[45]EPA officials told us that, based on their recollection, the event participants included eight staff from EPA's air office, one staff member from an EPA region, and two state-level monitoring agency officials.

license—based in the cloud.[46] According to EPA officials, reliance on an open-source database would avoid some of the costs that EPA pays for AQS, such as license fees and software support.

EPA officials told us that they expect that it would be easier for the agency to maintain one IT system for air quality data rather than two systems and that it would likewise streamline training needs by focusing efforts on one system rather than two. For example, according to EPA officials, this would make training roles and responsibilities easier for EPA and for users of the system.

EPA officials also expect that a single system would benefit stakeholders outside the agency. For example, they expect that using a single system would ease the reporting burden for monitoring agencies by allowing them to submit data to one system rather than submitting the same data to AQS and AirNow. The new, single system could also improve the availability of air quality data to regulators, including tribal, state, and local agencies, as well as the general public, according to EPA officials. For example, according to agency information, the system, as conceptualized, would provide real-time air quality information—allowing members of the public to plan daily activities based on air quality conditions—while also providing high-quality data to the regulatory and scientific communities.[47]

- **Being user-friendly.** EPA officials told us that they also anticipate that the new, single system would simplify data uploads, make it easier to obtain data from the system, and provide clear and meaningful information to data users. In particular, EPA expects that the new system would have a modern user interface that would minimize the effort and amount of training required to perform these tasks.
- **Providing flexibility.** According to EPA officials, the new, single system would fulfill the same data use objectives of the current legacy systems, such as the real-time aspect of AirNow data and the

[46]Internet-based computing services are commonly referred to as cloud services. According to OMB, cloud services offer agencies a number of benefits, including reduced IT procurement and operating costs and increased efficiency and effectiveness in delivering services. See GAO, *Cloud Computing Security: Agencies Increased Their Use of the Federal Authorization Program, but Improved Oversight and Implementation Are Needed*, GAO-20-126 (Washington, D.C.: Dec. 12, 2019).

[47]Environmental Protection Agency, "Vision and Concept for a Unified Ambient Air Quality Data System" (presented at the National Ambient Air Monitoring Conference, Pittsburgh, PA, Aug. 2022).

regulatory purposes for AQS data. EPA officials stated that they also expect that the new system would be able to accept data from emerging technologies for obtaining air quality information, such as lower-cost sensors. In addition, EPA officials stated that a cloud-based design would increase the system's capacity to accept data during busy times, for example, near the deadlines for data submissions by monitoring agencies.

EPA officials told us about their expectations for how a new system would address challenges, but work remains underway to identify the specifications of a new system, the estimated cost, and the time it will take to build it. Following the conclusion of the Lean events in 2022, EPA's air office used an IT contract, according to agency officials, for a "requirements analysis," which would evaluate the features of a new system replacing AQS and AirNow. Officials in EPA's air office stated that they plan to use the requirements analysis, once finished, to inform the request for management approval for funding to develop the new system.[48] The contractor's work on the requirements analysis remained underway and was nearly complete as of June 2023, according to EPA officials.

In addition, in 2022, EPA's air office consolidated staff management of AQS and AirNow into one team unit, according to EPA officials. Agency officials told us that previously, two different groups in EPA's air office managed AQS and AirNow. According to EPA, centralizing the systems' management supports collaboration among the staff that would be responsible for managing the data in a new, single system that would replace AQS and AirNow.

EPA Has Not Clearly Identified AQS and AirNow as Candidates for Replacement through Its IT Management and Oversight Processes

Despite listing AQS as a system in need of modernization in 2017 and recent efforts to explore replacing AQS and AirNow, EPA has not clearly identified these systems as candidates for replacement through its recent IT management and oversight processes. Under EPA's Capital Planning and Investment Control (CPIC) process—the agency's budget planning

[48]EPA officials told us that the agency's air office also plans to seek input from other stakeholders, including EPA users of AirNow and AQS, EPA regional offices, and monitoring agencies, and modify the requirements analysis to include these perspectives, as relevant.

and reporting process for IT systems—mature systems, such as AQS and AirNow, are to be evaluated prior to making decisions about modernization. Specifically, EPA's CPIC process directs staff to ascertain a mature system's continued effectiveness in supporting mission requirements, evaluate the cost of continued maintenance support, assess potential technology opportunities, and consider replacement or retirement options. This includes discussing the system's effectiveness at EPA's annual IT portfolio review, which provides program and regional offices an opportunity to elevate IT issues—such as any challenges or risks—to EPA's CIO and other Office of Mission Support officials.

Officials from the Office of Mission Support told us that they were unaware of the air office's consideration to replace AQS and AirNow, based on how the air office had categorized those systems in the annual portfolio review. According to EPA officials, during the annual portfolio review, EPA program offices classify their IT systems in categories to inform discussion about the future direction of the systems. The classification categories, according to EPA officials, are invest, tolerate, migrate, or eliminate.[49] In particular, EPA's air office classified AQS as "invest" and AirNow as "tolerate" for the 2022 portfolio review, according to EPA officials.

According to EPA officials, "invest" serves as the strongest indicator for continued support of a system, and "tolerate" applies to systems that cannot be eliminated because they provide a certain degree of utility or because there is no adequate alternative. Office of Mission Support officials told us that they view systems classified as "invest" as operational, whereas a classification like "eliminate" would prompt the Office of Mission Support to ask questions about the system and any

[49]EPA officials provided the following written descriptions for each category: "(1) Invest: Applications represent good business processes running on good applications and good platforms. Modernize the application because it has a high business value (e.g., application with high usage but supported by outdated technology); (2) Tolerate: Applications represent an existing valid business process that cannot be eliminated. These applications will be tolerated; they will continue to run, and IT will continue to maintain them. Tolerate the application, as it serves its purpose (e.g., a certain degree of utility in good technical condition) or because there is no adequate alternative; (3) Migrate: Applications represent valid business processes that are needed, but the apps that automate them may be old, unsupported, or operating on end-of-life infrastructure. These applications require an investment to migrate functionality to a different application; and (4) Eliminate: Applications represent a business process that isn't valuable anymore. They may be old and/or unsupported, allowing IT to sunset the application and free up resources. Eliminating applications is easier said than done, as business leaders still using the apps must be consulted first."

modernization plans during the portfolio review. It is not clear, however, why “invest” would not prompt similar questions, given that EPA’s description of “invest” includes the possibility of modernization. Officials from the Office of Mission Support stated that plans to sunset an existing system—such as AQS or AirNow—and replace it with a new one should be classified as “migrate” rather than “invest” or “tolerate.” Officials from the Office of Mission Support told us that the planning process may not be far enough along to trigger that change.

Officials from EPA’s air office said that prior portfolio reviews have discussed the decreased effectiveness of AQS and AirNow in supporting the mission as well as the desire to restructure AQS, but they have not classified either system as “migrate.” Officials from EPA’s air office told us that they classified AQS as “invest” because, absent a replacement system, they need to support the system for the air quality information. They also stated that in future portfolio reviews they would consider whether to change it to a different category allowing for continued investment, such as “tolerate.”

Leading practices identified by our prior work state that organizations should develop criteria for identifying IT investments that may be ready for replacement and that the analysis to identify such systems should be based on performance factors.[50] In addition, guidance from OMB directs agencies to review, properly plan for, and actively manage their IT systems.[51]

Moreover, the OMB guidance states that criteria are to be established and monitored to determine the condition of the asset and how well it is performing. The OMB guidance provides examples of factors for consideration, such as whether the IT system continues to support the mission, whether it has deteriorated beyond economical repair, and whether the impacts of the IT system on program performance measures justify the cost to operate and maintain the system.

According to EPA’s CPIC, CPIC describes the steps that agency staff should follow to implement OMB guidance. In particular, EPA’s CPIC directs staff to ascertain the continued effectiveness of mature systems in

[50]GAO-04-394G.

[51]OMB, *Capital Programming Guide, Supplement to Office of Management and Budget Circular A-11, Planning, Budgeting, and Acquisition of Capital Assets* (Washington, D.C.: 2022).

supporting mission requirements and consider replacement or retirement options, but it does not specify factors for identifying systems that may be ready for replacement or retirement. EPA officials in the Office of Mission Support stated that the agency's internal processes for management and oversight of IT systems—for example, EPA's CPIC policy and procedures—provide guidance for the assessment of the effectiveness of mature systems.[52] EPA's guidance specifies who should conduct the evaluation and when it should occur, but it does not identify specific factors for staff to consider when making decisions about replacement or retirement of an IT system. The classifications that EPA uses at the annual IT portfolio review also do not identify such factors. Identifying factors for staff to consider when evaluating IT systems that may be ready for replacement could help ensure that the IT management practice—including the annual portfolio review—captures information that is used for making timely decisions about modernization needs and the future direction of those systems.

In addition, OMB's guidance states that agencies should conduct periodic reviews of operational systems to determine whether they should be retained, modified, replaced, or retired.[53] For example, OMB guidance states that the operational analysis, which primarily involves tracking and identifying the operational cost and performance of the IT system, should trigger considerations of how the IT system's objectives could be better met, how costs could be reduced, and whether the agency should continue performing a particular function. Officials from EPA's air office told us that they have not documented an operational analysis for AQS or AirNow. OMB's guidance provides flexibility to agencies in how they implement the operational analysis and other key principles—for example, implementing a less detailed process for IT systems with a smaller dollar value. However, documenting an operational analysis could show whether there is a need to replace AQS and AirNow and ensure

[52]EPA's CPIC directs staff to assess performance and identify areas to improve decision-making, specifically to focus on "Whether the IT investment met its performance, cost, and schedule objectives; If the investment continues to be effective in supporting mission requirements, accounting for the cost of continued maintenance support; and If retirement or replacement of the investment should be considered." Environmental Protection Agency, *Capital Planning and Investment Control Procedures*, CIO 2120-P-02.4 (July 7, 2005).

[53]OMB, *Capital Programming Guide*.

that EPA has relevant information for making decisions regarding these systems.

EPA Has Not Documented a Business Case to Secure Management Approval for a New System Replacing AQS and AirNow

OMB guidance directs EPA and other federal agencies to establish a decision-making process for the investment planning and control of each information system that covers the life of each system.[54] According to EPA's System Life Cycle Management (SLCM) process, after an IT system is identified as needing a significant change to address deficiencies, and prior to deciding to fund such an endeavor, agency staff need to document a business case for the modernization project or development of a new system.[55] Specifically, SLCM requires agency staff to determine if a new IT system is required to fulfill an agency need, such as management of air quality information, and to document a business case that explains the mission and budget justification for a new system.[56]

EPA's air office has not documented a business case that defines the mission and budget justification for a new IT system to replace AQS and AirNow, which is necessary to secure management approval for modernizing IT systems or developing a new one. According to EPA officials, EPA's air office therefore has not secured management approval or funding to implement a new IT system for air quality data.

[54]The guidance states that the decision-making process should encompass planning, budgeting, procurement, management, and assessment of the IT system. OMB, *Managing Information as a Strategic Resource*, OMB Circular A-130 (July 2016).

[55]EPA's SLCM procedure establishes a structured approach, comprised of six phases, for agency efforts to obtain, use, maintain, and dispose of IT systems.

[56]According to EPA's SLCM procedure, the business case is to document the mission and budget justification to pursue new system development or modernization, and it may include an analysis of alternatives. EPA's SLCM procedure clarifies that the business case should describe current processes, possibly using activity and data models; associates current costs and performance with the models; and identify gaps between current and desired outcomes. To determine if there is a need for a new system, SLCM directs agency staff to check if there are any similar existing systems or applications instead of investing in a new system and to consult with senior information officials—who are responsible for IT management—in other EPA offices to discuss and refine the business need, among other things.

Officials from EPA's air office stated that they are working on the tasks needed to develop the business case for the new system. Specifically, the agency is working to document the vision for the new system, including the scope, time frame, and estimated cost. Officials from EPA's air office stated that they will use this information as part of their business case to request management approval for funding to develop the new system.

Documenting its business case for a new system replacing AQS and AirNow could better position EPA to prioritize this effort and commit the resources necessary to address legacy system challenges. A business case that documents the justification for a new system, including a realistic, multiyear cost estimate, could ensure that EPA has the best available information to make decisions about whether to replace AQS and AirNow.

Moreover, documenting the business case for a new system could help the agency prioritize resources for related air quality projects. For example, according to EPA officials, the agency expects to consider ways to respond to our November 2020 report's recommendations related to national ambient air monitoring while it determines how to spend air quality monitoring appropriations from the Inflation Reduction Act of 2022.[57] Information from the business case for a new, single system for air quality information (e.g., the timeline, staffing levels, and expected costs) could allow EPA to use resources (e.g., staff and funds for IT system development) more effectively, thereby ensuring successful implementation of multiple priorities.

[57]In November 2020, we recommended that EPA establish an asset management framework for the monitoring system and develop an air quality monitoring modernization plan that aligns with leading practices. GAO-21-38. According to EPA officials, the agency has been working with its tribal, state, and local partners to implement our recommendations to manage and modernize the air quality monitoring system. EPA officials stated that the agency has used appropriations from the American Rescue Plan Act of 2021 and the Inflation Reduction Act of 2022 to support implementation of these recommendations. For example, EPA used appropriations from these acts to award $53.4 million to grant recipients for projects to enhance air quality monitoring in 37 states. EPA also announced the distribution of nearly $22.5 million in American Rescue Plan Act of 2021 appropriations to tribal, state, and local air agencies for enhanced monitoring of criteria pollutants. For more information on funding from the Inflation Reduction Act of 2022, see GAO, *Oversight of Agency Spending: Implementing GAO Recommendations Could Help Address Previously Identified Challenges at Commerce, DOE, and EPA*, GAO-23-106726 (Washington, D.C.: Mar. 29, 2023). For more information on funding from the American Rescue Plan Act of 2021, see GAO, *American Rescue Plan Act: Implementation of Economic Development, Environment, and Wildlife Provisions*, GAO-23-105795 (Washington, D.C.: Apr. 26, 2023).

Conclusions

EPA depends on IT systems to manage and report air quality data that play a critical role in government efforts to reduce air pollution and related public health risks. However, according to our analysis of EPA and stakeholder views, these systems present maintenance and usability challenges. In addition, in 2017, EPA's acting CIO listed AQS as one of the agency's top three systems in need of modernization. EPA is considering replacing AQS and AirNow with a new, single system to address challenges, but EPA has not clearly identified the two legacy systems as candidates for replacement through the agency's IT management and oversight processes. Furthermore, its oversight and management processes do not specify factors to consider when evaluating systems that may be ready for replacement or retirement. Identifying such factors could ensure that the agency captures information that is critical for making timely and thoughtful decisions about its modernization needs and the future direction of its IT systems.

EPA officials said that they are gathering information in support of replacing AQS and AirNow, but the agency has not documented an operational analysis of the legacy systems' performance or a business case for developing a new system. An operational analysis that documents whether there is a need to replace AQS or AirNow could inform a business case for a new system. A business case that presents a mission and budget justification for a new system would better position EPA to make decisions about whether to prioritize and commit the resources to replace AQS and AirNow. For example, the estimates of timeline, staffing levels, and costs in the business case for a new system could allow EPA to allocate staff and funding resources more effectively, thereby ensuring successful implementation of multiple priorities. This information could also support strategic use of EPA's recent appropriations, such as those from the Inflation Reduction Act of 2022.

Recommendations for Executive Action

We are making the following three recommendations to EPA:

The Assistant Administrator of EPA's Office of Mission Support should identify factors for evaluating whether EPA's IT systems may be ready for replacement or retirement. (Recommendation 1)

The Assistant Administrator of EPA's Office of Air and Radiation should consider documenting an operational analysis for AQS and AirNow. (Recommendation 2)

The Assistant Administrator of EPA's Office of Air and Radiation should develop and document a business case for a new IT system for air quality data based on considerations for how such a system could address the challenges currently posed by AQS and AirNow. The business case should consider an analysis of alternatives, if appropriate. (Recommendation 3)

Agency Comments and Our Evaluation

We provided a draft of this report to EPA for review and comment. In its written comments, reproduced in appendix II and summarized below, EPA agreed with the second and third recommendations and disagreed with the first recommendation. EPA stated that its Office of Air and Radiation (air office) appreciates the principles outlined in the recommendations and looks forward to reporting more progress as it begins to create a new single architecture to replace AQS and AirNow next fiscal year. In addition, the agency said that the recommendations will be very useful as it develops its new systems. EPA informed us that it had no technical comments on this report.

EPA stated that its air office agrees with the second recommendation to consider documenting an operational analysis for AQS and AirNow. EPA stated that it has recently completed a "requirements analysis" activity for developing a new combined air quality data system that will replace AQS and AirNow. EPA said that the analysis provides important input from users of both systems and expects it to factor into the development of an operational analysis. Developing and documenting an operational analysis for AQS and AirNow would address the recommendation.

In addition, EPA stated that its air office agrees with the third recommendation to develop and document a business case for a new IT system for air quality data. EPA stated that, as funds become available, its air office will investigate alternatives for developing a new combined air quality data system and plans to outline the business case for possible technology options. This action, if implemented effectively, would address the recommendation. In its letter, EPA asked GAO to provide more information on methods and formats for business cases and operational

analyses, and our report includes references to relevant EPA and OMB information on this topic.[58]

EPA stated that its Office of Mission Support disagrees with the first recommendation to this office to identify factors for evaluating whether EPA's IT systems may be ready for replacement or retirement. EPA stated that the criteria and decision to replace or retire IT systems is delegated to the senior official responsible for IT management in each EPA program office. EPA said that the Office of Mission Support delegated this role so program offices could maintain flexibility to manage and implement their programmatic priorities. We recognize the importance of maintaining flexibility for program office priorities. However, EPA's Capital Planning and Investment Control Policy states that the Chief Information Officer (CIO)—within the Office of Mission Support—is responsible for providing guidance and tools to senior managers for program oversight. Further, OMB guidance states that the CIO is responsible for defining process and policies in sufficient detail to address information resources appropriately, including agencywide policies and procedures for conducting reviews to evaluate IT resources.[59] Therefore, we continue to believe that the recommendation is best directed to the Office of Mission Support.

EPA also described some of its IT management efforts, including its System Life Cycle Management Directives, its Enterprise Architecture Directives, and IT portfolio reviews, as indicative of its work to manage the retirement and replacement of IT systems. We recognize the importance of these efforts for IT management; however, the efforts EPA

[58]In addition to information cited in this report, operational analyses are discussed in GAO, *Information Technology: Cost and Schedule Performance of Selected IRS Investments*, GAO-22-104387 (Washington, D.C.: Oct. 19, 2021); and *Information Technology: Agencies Need to Strengthen Oversight of Billions of Dollars in Operations and Maintenance Investments*, GAO-13-87 (Washington, D.C.: Oct. 16, 2012). Business cases are discussed in GAO, *Defense Acquisitions: Improved Business Case Is Needed for Future Combat System's Successful Outcome*, GAO-06-367 (Washington, D.C.: Mar. 14, 2006), and business cases for major investments are discussed in OMB, *Preparation, Submission, and Execution of the Budget*, OMB Circular A-11 (Washington, D.C.: 2022).

[59]Specifically, OMB Circular A-130 states that, in support of agency missions and business needs, and in coordination with program managers, agencies shall require that the CIO, in coordination with appropriate governance boards, defines processes and policies in sufficient detail to address information resources appropriately. At a minimum, these processes and policies shall require, among other things, that there are agencywide policies and procedures for conducting IT investment reviews, operational analyses, or other applicable performance reviews to evaluate IT resources, including projects in development and ongoing activities. OMB, *Managing Information as a Strategic Resource*.

described occur once a decision has been made to consider an IT system for retirement or replacement. Furthermore, none of the efforts cited identify factors to consider when evaluating whether an IT system may be ready for retirement or replacement. Moreover, none of these efforts resulted in AQS being clearly identified as a candidate for replacement through recent EPA IT management and oversight processes, despite recent efforts to explore replacing AQS and AirNow and the acting CIO listing it as one of EPA's top three systems in need of modernization in 2017. Therefore, we continue to believe that implementing the recommendation could better assist the EPA CIO with oversight and informed decision-making by capturing information that is critical for making timely and thoughtful decisions about EPA modernization needs.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees and the EPA Administrator. In addition, the report is available at no charge on the GAO website at https://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or gomezj@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 contributions to this report are listed in appendix III.

Sincerely yours,

J. Alfredo Gómez
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

This report examines (1) how the Environmental Protection Agency (EPA) uses IT systems to manage air quality data, (2) any challenges that EPA's IT systems for air quality data present for EPA and other data providers and users, and (3) the extent to which EPA has addressed challenges presented by its IT systems for air quality data.[1]

To examine how EPA uses IT systems to manage air quality data, we reviewed documents that describe EPA's IT systems for air quality data and interviewed EPA officials. For example, we reviewed EPA presentations on its IT systems for air quality data and manuals and guidance for the systems to understand the architecture of the systems, the nature of the data stored, quality assurance standards, procedures for data submission and data queries, and other considerations relevant to EPA's management of the data. We interviewed EPA officials from the Office of Air Quality Planning and Standards—a group within the Office of Air and Radiation (EPA's air office)—that is responsible for management of these systems. We also interviewed an official from the Eastern Research Group, Inc., a consulting firm that EPA has contracted with to manage the Air Toxics Archive. We also attended the National Tribal Forum on Air Quality in May 2022 and the National Ambient Air Monitoring Conference in August 2022, both of which included training or discussions on EPA's IT systems for air quality data.

To examine any challenges that EPA's IT systems for air quality data present for EPA and other data providers and users, we conducted a series of interviews with officials from EPA's Office of Air Quality Planning and Standards and officials from six stakeholder organizations. These stakeholders are the consulting firm that manages the Air Toxics Archive; two nongovernmental organizations focused on air quality issues—the Health Effects Institute and the American Lung Association; and three associations that represent tribal, state, local, or territorial monitoring agencies—the Association of Air Pollution Control Agencies, the National Association of Clean Air Agencies, and the National Tribal Air Association. Members of each association—that is, officials of tribal, state, or local monitoring agencies—also participated in these interviews.

[1]The scope of this report focuses on IT systems for ambient air quality data.

In addition, the National Tribal Air Association included officials from a support center for air monitoring in our interview. The center supports tribal environmental professionals by providing technical training and assistance in obtaining and analyzing air quality data. We attribute information from these interviews with associations to "monitoring agency officials" throughout this report. The views of these monitoring agency officials are not representative of the views of all monitoring agency officials.

To identify these stakeholders, we reviewed documents about the operation and use of EPA's IT systems for air quality data that describe users of the systems, as well as our prior report about the national ambient air quality monitoring system.[2] We also conducted searches to identify nongovernmental organizations that represent a range of views of the general public, community groups, and institutions and that have familiarity with EPA's IT systems for air quality data. Specifically, we conducted a literature search; reviewed material from conferences and presentations, such as EPA's National Ambient Air Monitoring Conference; and searched EPA's docket for public comments about IT systems for air quality data.[3]

We selected and interviewed the six stakeholder organizations based on their experience in either providing data to EPA's IT systems for air quality data or in obtaining and using data from these systems. We conducted semistructured interviews that discussed their experience with the IT systems, any challenges related to providing data to the IT systems, and any challenges related to using data from the IT systems. Data providers are primarily tribal, state, or local agencies, though EPA also operates some monitors and provides data to the systems. Data users include regulators; analysts and researchers; and the general public, including community groups or institutions, such as schools.

We refined the list of stakeholders based on their knowledge about how these systems support Clean Air Act implementation or air quality research, as well as their knowledge of how the general public may use the data and systems. It is particularly difficult to identify the complete

[2]GAO, *Air Pollution: Opportunities to Better Sustain and Modernize the National Air Quality Monitoring System*, GAO-21-38 (Washington, D.C.: Nov. 12, 2020).

[3]We searched Regulations.gov, which serves as EPA's electronic public docket system. EPA's docket is a collection of documents made available for public viewing. These documents may include public comments received by EPA as part of a rulemaking process or another agency action.

population of data users, given the diversity and wide-ranging scale of data users, which include researchers at universities and analysts at advocacy groups, as well as members of the general public. We, therefore, identified and interviewed stakeholders who are familiar with the systems because they routinely provide or use air quality data. The views of these stakeholders are nongeneralizable to all data providers and users.

We analyzed stakeholder views to identify challenges that EPA's IT systems for air quality data present for data providers and users. In particular, based on the interviews with stakeholders, one analyst developed a list of detailed challenges and grouped similar items into broader themes that are logical and distinguishable from one another. A second analyst independently reviewed the list of challenges and the assignment of challenges to themes. We reconciled differences in the two analysts' conclusions through refining the descriptions of the themes to ensure accuracy or categorizing a challenge in a different theme, when appropriate. We included themes in the report that were reported by multiple stakeholders or are supported by compelling examples.

To examine the extent to which EPA has addressed challenges presented by its IT systems for ambient air quality data, we reviewed relevant documents and interviewed EPA officials to understand the steps that EPA has taken to address these challenges. For example, we reviewed EPA presentations on developing a new system and EPA policies and procedures for managing IT systems. We interviewed officials from EPA's Office of Air Quality Planning and Standards and Office of Mission Support, which is the office that manages EPA's IT policy and investment portfolio agencywide.

We compared the steps that EPA has taken to consider developing a new IT system that could address the challenges presented by its IT systems for ambient air quality data with its System Life Cycle Management (SLCM) and Capital Planning and Investment Control (CPIC) policies and procedures. SLCM establishes the agency's approach for planning, developing, and managing IT systems, and EPA's CIPC policies and procedures are intended to integrate the planning, acquisition, and management of IT systems into the agency's budget decision-making process. We also compared these policies and procedures with Office of Management and Budget guidance on maintaining IT systems and leading practices that we identified in our Information Technology

Investment Management Framework.[4] The framework identifies processes that are critical for the successful management of IT investments and can be used to evaluate and assess how well an agency selects and manages IT.

We conducted this performance audit from December 2021 to September 2023 in accordance with generally accepted government auditing standards. Those standards require 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.

[4]GAO, *Information Technology Investment Management: A Framework for Assessing and Improving Process Maturity,* GAO-04-394G (Washington, D.C.: Mar. 2004); and Office of Management and Budget, *Managing Information as a Strategic Resource*, OMB Circular A-130 (July 2016).

Appendix II: Comments from the Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

July 27, 2023

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

Dear Mr. Gomez:

Thank you for the opportunity to review and comment on GAO's draft report, "*EPA Needs to Develop a Business Case for Replacing Legacy Air Quality Data Systems*" (GAO-23-105618) ("Draft Report").

The purpose of this letter is to provide the Environmental Protection Agency's (EPA) response to the Draft Report's findings, conclusions, and recommendations.

Summary

The report, GAO-23-105618, examined two legacy EPA Information Techology (IT) systems, AirNow and the Air Quality System (AQS). Both systems are used to manage air quality data collected by state, local, and tribal agencies. While AirNow uses the data to inform the public, AQS collects the data for regulatory use in evaluating attainment of the National Ambient Air Quality Standards (NAAQS).

Both systems have been in operation for considerable time and could benefit from redevelopment or replacement. EPA appreciates the work done by the GAO team to interview system stakeholders, talk with the Office of Mission Support and the AirNow and AQS teams, and to synthesize that information into the report.

EPA's Office of Air and Radiation (OAR) has taken steps to examine both systems for potential replacement and appreciates the principles outlined in GAO's recommendations. We look forward to reporting more progress as we begin in earnest to create a new single ambient architecture to replace AirNow and AQS next fiscal year.

Response to GAO Recommendations

EPA's Office of Mission Support (OMS) and Office of Air and Radiation (OAR) reviewed the recommendations and are issuing this letter jointly. OMS respectfully disagrees with Recommendation One, as explained below. OAR agrees with Recommendations Two and Three, also explained further in this letter.

Recommendation 1: The Assistant Administrator of EPA's Office of Mission Support should identify factors for evaluating whether EPA's IT systems may be ready for replacement or retirement.

EPA Response to Recommendation 1:

The Office of Mission Support within EPA respectfully disagrees with recommendation (1) identify factors for evaluating IT systems that may be ready for replacement. The criteria/decision to replace or retire systems is delegated to the Senior Information Officials (SIOs) per CIO policy: CIO 2102 (formerly 2101), Senior Information Officials. More specifically, one of the primary duties of the SIO is to "ensure establishment and implementation of effective processes and procedures within their organization for compliance with Agency information and information technology policies, procedures, operations and standards; statutes; and Executive Branch directives."

Due to the complex nature of programs' mission needs and funding levels, the agency delegated this role to the SIOs so programs could maintain the necessary flexibility and authority to manage and implement their programmatic priorities.

In February of 2021 EPA's updated System Life Cycle Management (SLCM) Directives were published to aid the Agency on how to make specific system management decisions such as if a system should be replaced or if a new system is needed. This includes but is not limited to the following guidance:

- Checking the Registry of EPA Applications, Models and Data Warehouses (READ), the availability of shared services, and Federal and EPA Code Repositories to identify any similar existing systems or applications instead of investing in a new system.
- Consulting with other SIOs to discuss and refine the business need and identify enterprise impacts.
- Identifying a Project Sponsor who understands the Agency's IT strategy, mission and program and funding/resource requirements.
- Documenting the vision for the application including the scope, timeframe, and an assessment of the cost/resource requirements.
- Identifying security and privacy implications and other shared services and federal cooperation needed.

Likewise in January 2023, EPA's updated Enterprise Architecture (EA) Directives were published. The EA Directives describe EPA's approach for establishing the principles, policies, procedures, and new technical infrastructure standards to manage EPA's EA program. The updated EA Directives require program offices to work with OMS in the development of their plans to replace or retire information systems.

This approach provides EPA with an individualized method to meet individual mission area needs, balancing program autonomy and authority with overall EPA level guidance, structure, and continuity needed for broader IT administration.

As part of the annual IT Portfolio Review with OAR, OAR's SIO detailed its internal procedure for reviewing proposed plans for new or significantly modified IT applications through its Information Technology/Information Management (IT/IM) Council.

Recommendation 2: The Assistant Administrator of EPA's Office of Air and Radiation should consider documenting an operational analysis for AQS and AirNow.

EPA Response to Recommendation 2:

EPA/OAR agrees with this recommendation. EPA has requested from GAO more information on operational analyses and best practices for developing them. EPA has recently completed a "requirements analysis" activity for developing a new combined ambient system that will replace AirNow and AQS. That analysis, while providing important input from users of both systems, is likely not the same as an operational analysis. However, it will no doubt factor into an operational analysis that can be developed as EPA moves to design a single ambient and emissions data system.

Recommendation 3: The Assistant Administrator of EPA's Office of Air and Radiation should develop and document a business case for a new IT system for air quality data based on considerations for how such a system could address the challenges currently posed by AQS and AirNow. The business case should consider an analysis of alternatives, if appropriate.

EPA Response to Recommendation 3:

EPA/OAR agrees with this recommendation. As funds become available, OAR will investigate alternatives for developing a new combined ambient and emissions system. EPA/OAR plans to leverage the Gartner Group to help clearly articulate the possible technology suites, as well as outline the business case for each.

EPA appreciates GAO's assessment of the issues and the input offered on replacing legacy air quality data systems. As funding allows, EPA will continue to pursue creating a new system to replace the aging systems that house both ambient and emissions data. EPA respectfully requests further information on GAO's recommendation for a business case and an operational analysis. Specifically, links to any industry-standard methods and formats for those documents would be helpful.

As EPA develops new systems for these important functions, the recommendations made by GAO will be very useful. We look forward to more information on industry standard procedures and formats for implementing the advice in Recommendations 2 and 3.

As stated above, EPA's Office of Mission Support (OMS) and Office of Air and Radiation (OAR) reviewed the recommendations and are issuing this letter jointly. OMS respectfully disagrees with Recommendation One. OAR agrees with Recommendations Two and Three. We appreciate the opportunity to review the draft report.

If you have any questions regarding this final response, please contact Ashley Thompson, OAR Audit Liaison, at thompson.ashley.m@epa.gov or 202-564-3633, or Afreeka Wilson, OMS Audit Liaison, at wilson.afreeka@epa.gov or 202-564-0867.

Sincerely,

JOSEPH GOFFMAN
Digitally signed by JOSEPH GOFFMAN
Date: 2023.07.27 08:45:12 -04'00'

Joseph Goffman
Principal Deputy Assistant Administrator
Office of Air and Radiation

VAUGHN NOGA
Digitally signed by VAUGHN NOGA
Date: 2023.07.27 10:01:08 -04'00'

Vaughn Noga, Chief Information Officer
Deputy Assistant Administrator for
Environmental Information
Office of Mission Support

cc: Betsy Shaw
Ashley Thompson
Tiffany Purifoy
Peter Tsirigotis
Robin Dunkins
Anna Wood
Phil Dickerson
Monique Crews
Gary Farley
Holly Fenderson
Daniel Coogan
Marilyn Armstrong
OMS_Audit_Coordination
EPA-GAO-Liaison-Team
Brittany Wilson

Accessible Text for Appendix II: Comments from the Environmental Protection Agency

July 27, 2023

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

Dear Mr. Gomez:

Thank you for the opportunity to review and comment on GAO's draft report, "EPA Needs to Develop a Business Case for Replacing Legacy Air Quality Data Systems" (GAO-23-105618) ("Draft Report").

The purpose of this letter is to provide the Environmental Protection Agency's (EPA) response to the Draft Report's findings, conclusions, and recommendations.

Summary

The report, GAO-23-105618, examined two legacy EPA Information Techology (IT) systems, AirNow and the Air Quality System (AQS). Both systems are used to manage air quality data collected by state, local, and tribal agencies. While AirNow uses the data to inform the public, AQS collects the data for regulatory use in evaluating attainment of the National Ambient Air Quality Standards (NAAQS).

Both systems have been in operation for considerable time and could benefit from redevelopment or replacement. EPA appreciates the work done by the GAO team to interview system stakeholders, talk with the Office of Mission Support and the AirNow and AQS teams, and to synthesize that information into the report.

EPA's Office of Air and Radiation (OAR) has taken steps to examine both systems for potential replacement and appreciates the principles outlined in GAO's recommendations. We look forward to reporting more progress as we begin in earnest to create a new single ambient architecture to replace AirNow and AQS next fiscal year.

Response to GAO Recommendations

EPA's Office of Mission Support (OMS) and Office of Air and Radiation (OAR) reviewed the recommendations and are issuing this letter jointly. OMS respectfully disagrees with Recommendation One, as explained below. OAR agrees with Recommendations Two and Three, also explained further in this letter.

Recommendation 1: The Assistant Administrator of EPA's Office of Mission Support should identify factors for evaluating whether EPA's IT systems may be ready for replacement or retirement.

EPA Response to Recommendation 1:

The Office of Mission Support within EPA respectfully disagrees with recommendation (1) identify factors for evaluating IT systems that may be ready for replacement. The criteria/decision to replace or retire systems is delegated to the Senior Information Officials (SIOs) per CIO policy: CIO 2102 (formerly 2101), Senior Information Officials. More specifically, one of the primary duties of the SIO is to "ensure establishment and implementation of effective processes and procedures within their organization for compliance with Agency information and information technology policies, procedures, operations and standards; statutes; and Executive Branch directives."

Due to the complex nature of programs' mission needs and funding levels, the agency delegated this role to the SIOs so programs could maintain the necessary flexibility and authority to manage and implement their programmatic priorities.

In February of 2021 EPA's updated System Life Cycle Management (SLCM) Directives were published to aid the Agency on how to make specific system management decisions such as if a system should be replaced or if a new system is needed. This includes but is not limited to the following guidance:

Checking the Registry of EPA Applications, Models and Data Warehouses (READ), the availability of shared services, and Federal and EPA Code Repositories to identify any similar existing systems or applications instead of investing in a new system.

Consulting with other SIOs to discuss and refine the business need and identify enterprise impacts.

Identifying a Project Sponsor who understands the Agency's IT strategy, mission and program and funding/resource requirements.

Documenting the vision for the application including the scope, timeframe, and an assessment of the cost/resource requirements.

Identifying security and privacy implications and other shared services and federal cooperation needed.

Likewise in January 2023, EPA's updated Enterprise Architecture (EA) Directives were published. The EA Directives describe EPA's approach for establishing the principles, policies, procedures, and new technical infrastructure standards to manage EPA's EA program. The updated EA Directives require program offices to work with OMS in the development of their plans to replace or retire information systems.

This approach provides EPA with an individualized method to meet individual mission area needs, balancing program autonomy and authority with overall EPA level guidance, structure, and continuity needed for broader IT administration.

As part of the annual IT Portfolio Review with OAR, OAR's SIO detailed its internal procedure for reviewing proposed plans for new or significantly modified IT applications through its Information Technology/Information Management (IT/IM) Council.

Recommendation 2: The Assistant Administrator of EPA's Office of Air and Radiation should consider documenting an operational analysis for AQS and AirNow.

EPA Response to Recommendation 2:

EPA/OAR agrees with this recommendation. EPA has requested from GAO more information on operational analyses and best practices for developing them. EPA has recently completed a "requirements analysis" activity for developing a new combined ambient system that will replace AirNow and AQS. That analysis, while providing important input from users of both systems, is likely not the same as an operational analysis. However, it will no doubt factor into an operational analysis that can be developed as EPA moves to design a single ambient and emissions data system.

Recommendation 3: The Assistant Administrator of EPA's Office of Air and Radiation should develop and document a business case for a new IT system for air quality data based on considerations for how such a system could address the challenges currently posed by AQS and AirNow. The business case should consider an analysis of alternatives, if appropriate.

EPA Response to Recommendation 3:

EPA/OAR agrees with this recommendation. As funds become available, OAR will investigate alternatives for developing a new combined ambient and emissions

system. EPA/OAR plans to leverage the Gartner Group to help clearly articulate the possible technology suites, as well as outline the business case for each.

EPA appreciates GAO's assessment of the issues and the input offered on replacing legacy air quality data systems. As funding allows, EPA will continue to pursue creating a new system to replace the aging systems that house both ambient and emissions data. EPA respectfully requests further information on GAO's recommendation for a business case and an operational analysis. Specifically, links to any industry-standard methods and formats for those documents would be helpful.

As EPA develops new systems for these important functions, the recommendations made by GAO will be very useful. We look forward to more information on industry standard procedures and formats for implementing the advice in Recommendations 2 and 3.

As stated above, EPA's Office of Mission Support (OMS) and Office of Air and Radiation (OAR) reviewed the recommendations and are issuing this letter jointly. OMS respectfully disagrees with Recommendation One. OAR agrees with Recommendations Two and Three. We appreciate the opportunity to review the draft report.

If you have any questions regarding this final response, please contact Ashley Thompson, OAR Audit Liaison, at thompson.ashley.m@epa.gov or 202-564-3633, or Afreeka Wilson, OMS Audit Liaison, at wilson.afreeka@epa.gov or 202-564-0867.

Sincerely,

Joseph Goffman, Principal Deputy Assistant Administrator
Office of Air and Radiation

Vaughn Noga, Chief Information Officer
Deputy Assistant Administrator for Environmental Information
Office of Mission Support

cc: Betsy Shaw
Ashley Thompson
Tiffany Purifoy
Peter Tsirigotis
Robin Dunkins
Anna Wood
Phil Dickerson
Monique Crews
Gary Farley

Holly Fenderson
Daniel Coogan
Marilyn Armstrong
OMS_Audit_Coordination
EPA-GAO-Liaison-Team
Brittany Wilson

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov

Staff Acknowledgments

In addition to the individual named above, Chad M. Gorman (Assistant Director), Marya Link (Analyst in Charge), Mark Braza, Gwen Kirby, Jessica Lemke, Kate Shouse, Jeanette Soares, Jessica Steele, and Sara Sullivan made key contributions to this report.

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through our website. Each weekday afternoon, GAO posts on its website newly released reports, testimony, and correspondence. You can also subscribe to GAO's email updates to receive notification of newly posted products.

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, https://www.gao.gov/ordering.htm.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

Connect with GAO

Connect with GAO on Facebook, Flickr, Twitter, and YouTube.
Subscribe to our RSS Feeds or Email Updates. Listen to our Podcasts.
Visit GAO on the web at https://www.gao.gov.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact FraudNet:

Website: https://www.gao.gov/about/what-gao-does/fraudnet

Automated answering system: (800) 424-5454 or (202) 512-7700

Congressional Relations

A. Nicole Clowers, Managing Director, ClowersA@gao.gov, (202) 512-4400, U.S. Government Accountability Office, 441 G Street NW, Room 7125, Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, DC 20548

Strategic Planning and External Liaison

Stephen J. Sanford, Managing Director, spel@gao.gov, (202) 512-4707
U.S. Government Accountability Office, 441 G Street NW, Room 7814,
Washington, DC 20548