Adopting Innovation at the Forest Service: Communication, Pathways, and Foundations

Table of Contents

Executive Summary

The Forest Service is at a crossroads. Shifting climate risks are straining our nation's forests and rangelands in new ways, demanding unprecedented levels of responsiveness and adaptation from the Forest Service. Meeting urgent needs for climate-informed decision making—from the front lines of wildfires to the Washington Office—is essential to realizing the vision of the Forest Service to respond to the climate crisis. Given the scale and complexity of the task, adopting innovative data and digital tools is no longer an option but an imperative—to enable foresight, improve collaboration, and build real-time response capabilities.

To that end, the Forest Service needs to be poised to leverage the energy and diversity of innovators across the organization, and among leading partners in the public and private sectors. This report, authored by the Environmental Policy Innovation Center (EPIC), highlights the barriers we see to adopting innovative data and tools the Forest Service needs, and makes recommendations for how the agency can move toward a more connected and responsive model: one that centers—and takes advantage of—digital innovation. To identify barriers and make recommendations, we conducted over forty interviews with a wide cross-section of Forest Service personnel at the regional and national levels, and with technology providers, nonprofit partners, and collaborators outside the agency.

Based on our interviews, we see a Forest Service that is increasingly thinking about and experimenting with innovative data and tools on the ground—a trend that needs to be nurtured and accelerated. We also learned, however, that despite many efforts to scale and adopt innovative data and tools, precious few ultimately navigate the organizational thickets and unmarked trails that stand in the way of success. Hence, in this report we propose that the Forest Service institutionalize practices that can connect and accelerate emerging efforts to adopt new, innovative tools.

Our findings and recommendations are organized into three key focus areas:

Communication about technology

Pathways for technology to move from experimentation to adoption

Foundations for strategic and successful adoption of technology

Communication about technology is fundamental to identifying, building, and deploying high quality tools that are responsive to user needs. Pockets of conversations about technology are happening in and around the Forest Service—in internal forums and occasional events—but there are few open and proactive ways to communicate and build awareness about technology across deputy areas and forest, regional, and research units at the agency. The Forest Service needs better communication in order to bridge the cultural, structural, and language barriers that slow down or stop technology adoption.

! **Priority recommendation: add roles or teams that can act as "connective tissue" between Forest Service units** with a mission to communicate frequently and openly about technology to build awareness.

! **Other recommendations:** regular agency participation in open, externally facing forums for discussing technology; a system for ensuring that innovative ideas with merit can be communicated and acted on; and more proactive market research.

Pathways for experimenting with and scaling digital tools give would-be innovators inside and outside the Forest Service the clear sign posts they need to build tools that are useful to users. Staff across the Forest Service are finding ways to experiment—a practice that should be encouraged—but they aren't connected enough to enable collective learning about their benefits and drawbacks, or to make the case for adopting them on a broader scale. Technology providers and internal innovators often told us they have no idea how to engage effectively with the right parts of the Forest Service to deploy their tools at scale.

! **Priority recommendation: establish or enhance processes for evaluating tools at different stages (experimenting and scaling) based on clear performance criteria** to enable organizational learning, identify the most promising tools, and scale them.

! **Other recommendations:** establish clear entry points and guidance for technology providers to start engaging; develop a framework detailing the steps required to go from experiment to operations; and develop a strategy for using alternative ways to innovate, such as prize competitions.

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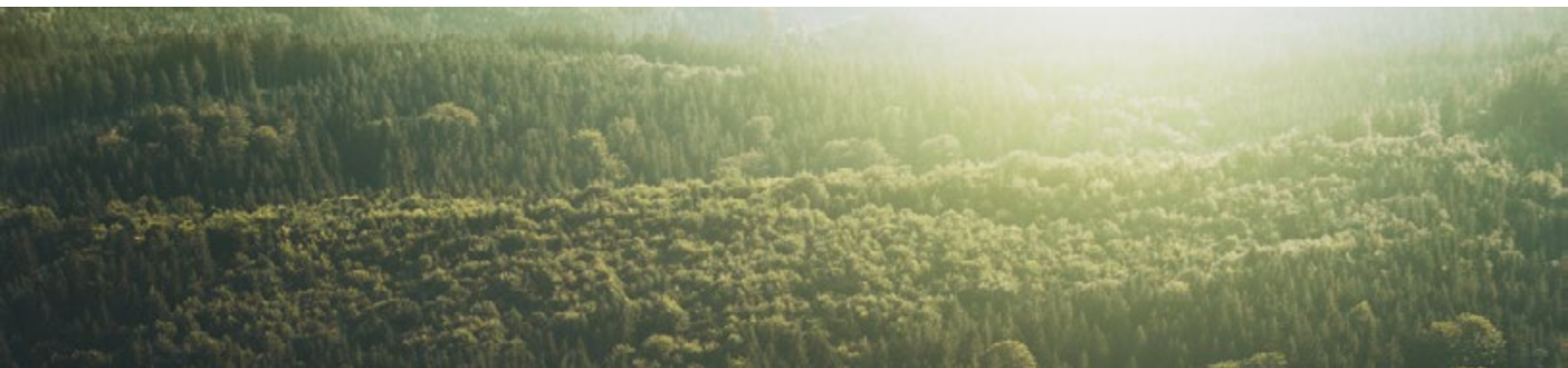
Foundations for making strategic and successful decisions about what tools to adopt need investment. This is essential to realize the Forest Service's vision for climate-informed forest management and move away from older systems that are consuming resources and leaving little for innovation. These foundations include a detailed understanding of user needs, integrated and accessible data, informed leadership and adequate staffing. We did not see evidence of decision-making consistently based on understanding of how users actually use tools, and that reflect modern practices for ensuring that the Forest Service gets the best out of its diverse but currently siloed data.

> **!** **Priority recommendation: develop the capacity to continuously assess the information and technology needs of lines of business** as the basis for evolving and prioritizing future investments at a scale that maintains a focus on users.

> **!** **Other recommendations:** facilitate sprints that improve data integration—that is make it useful to the whole organization rather than just those who collect it; invest in training for leadership to ask questions whether leading practices are being implemented; staff the agency with technical and other roles at a level consistent with the Forest Service ambitions to be a leader in climate-informed decision making also needs attention.


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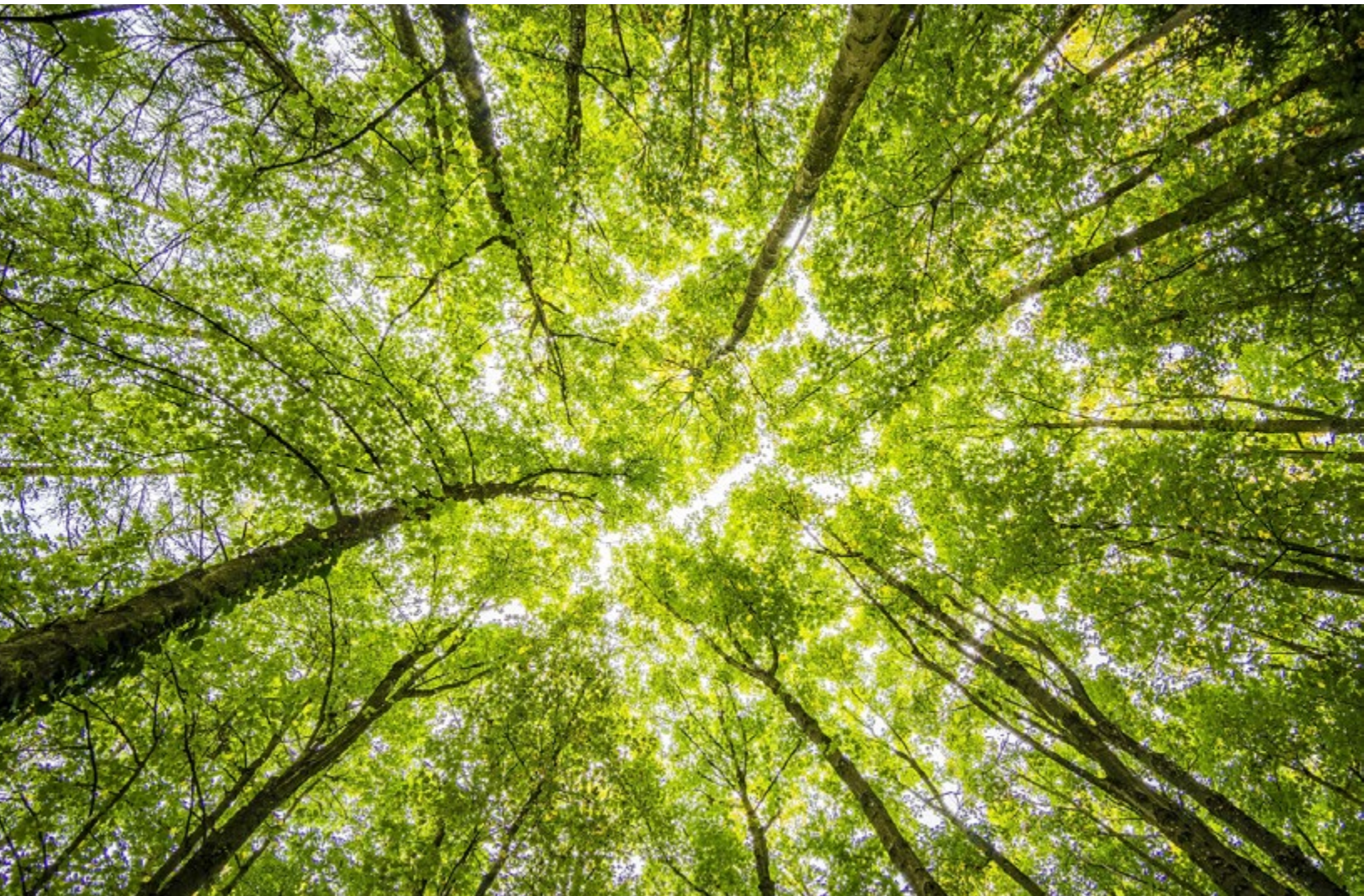
Introduction

Climate change poses significant and complex challenges to numerous federal agencies responsible for the health and well-being of our people, our wildlife, and the ecosystems and services we depend on. Increasing temperatures with more variable and extreme weather events are driving both quick-moving natural disasters and longer-term ecosystem change. To protect people and ecosystems, the Forest Service is urgently developing and implementing strategies to respond to climate change and the wildfire crisis effectively. From fuels and fire treatments, controlled burns, and reforestation, to post-fire recovery amidst more intense fire events—USFS needs sophisticated analytical tools designed to help carry out its mission in response to rapidly changing conditions.

Spurred by that imperative, the Environmental Policy Innovation Center (EPIC) conducted this Innovation Assessment. Our objective was to evaluate the Forest Service's systems, processes, culture, and organizational dynamics with an eye toward identifying the factors that influence the agency's ability to develop, procure, and use innovative technology for climate-informed management of the Nation's private and public forest lands. We define innovative technology as new data and analytical tools linked to the agency's mission. Specific goals of the assessment were to:

- Examine the Forest Service's current organizational capacity and barriers to developing, procuring, and adopting innovative tools and technologies for decision support.
- Focus on the Forest Service's efforts to manage national forests and grasslands in a changing climate, and in particular, on-going effects of the wildfire crisis.
- Make recommendations on how the Forest Service can improve its capacity to harness new and innovative technologies for decision support.

Given the urgency of the wildfire crisis and the need for climate-informed forest management, the Forest Service is redoubling its efforts to apply its own internal scientific research and analysis to decision-making, and is leveraging the capacity and expertise of a growing number of external technology providers for new technology and tool development. There is a strong, mutual desire on the part of the Forest Service and the external technology provider community (non-profit as well as for profit entities) to identify key barriers and marshal innovation in new ways that develop decision support tools at the speed and scale necessary to address the wildfire crisis and other urgent needs. This report focuses on the capacity of the Forest Service to adopt mission-driven innovations around data and tools—and hence, to better meet the needs of present and future generations.
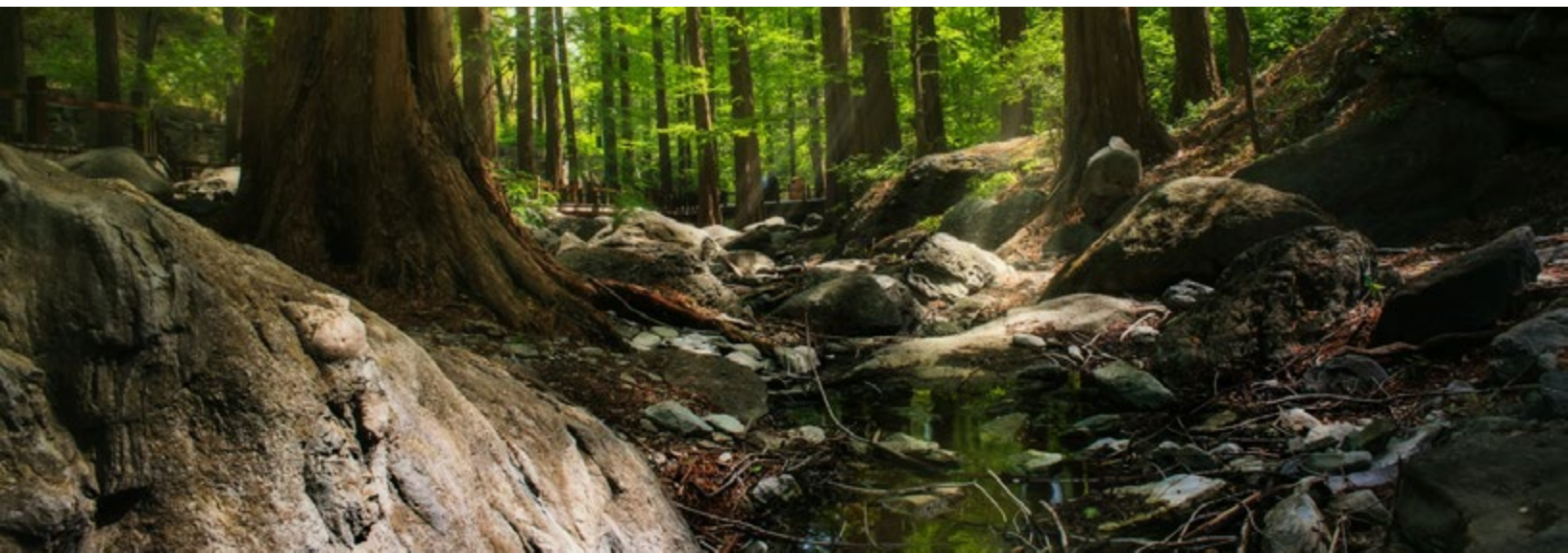
Background

This section provides background information in several areas to help guide the reader through this report, and to situate our findings and recommendations in relevant contexts. Specifically, this section provides information on:

- **The concept of innovation and technology** adopted in the report;
- **Practices of organizations** seeking to successfully adopt innovations;
- **Recent and ongoing activity at the Forest Service** concerning technology for climate-informed forest management and wildfire risk reduction; and
- **A vision for technology at the Forest Servic**e described by some of the interviewees engaged for this assessment.

Technology

To shed light on what these considerations mean in practice across the Forest Service, we find the following definitions of key concepts in this report (and distinctions between them) helpful:

- **Adopting Innovation:** Innovation has **many definitions**, but at its core, it is about *finding new ways to address familiar problems*. For the Forest Service and its partner organizations, "adopting" innovation means taking those new ideas and putting them into regular practice.
- **Data and Tools:** Data are recorded observations of the world, and tools are the software that make use of that data (by Forest Service staff, partner organizations, or the public) possible. *Innovative* data and tools apply new ways of collecting and using data linked to the work of the Forest Service. This report focuses on data and tools that contribute directly to mission-critical work—such as managing vegetation—as opposed to the broader suite of information technology tools (e.g., email) that all offices use in their daily operations.
- **Science and Technology:** Science is the systematic study of something through observation, experimentation, and the testing of theories against evidence obtained. Technology seeks to *apply* scientific knowledge to a defined task. Ideally, the links between science, technology, and innovation are strong—but they are not synonymous, and often involve different processes and skill sets, and emphasize different outcomes.

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The graphic below illustrates how these concepts relate. The blue box shows where this report is situated in the broader context of each process.

SCIENCE

TECHNOLOGY

Adopting Innovative Data and Tools

Basic Research → Applied Research → Development Prototype → Introduction Piloting Expertimenting → Growth Scaling Deploy → Maturity Maintain Update Operate

Studying combustion processes

Fire modeling in a specific forest

Creating software for fire prediciton with a user interface

Testing interface usability and fire prediction accuracy for prioritizing small scale actions

Evaluating, purchasing, and deploying software for fire prediction for use in multiple regions

Patch, add features, and optimize use of software for fire prediction

Developer inside or outside the Forest Service gets user input and adds features iteratively.

Innovative Organizations

What does it mean to be an innovative organization? There are dozens of frameworks to choose from on this topic, but for the purposes of this report, we have adopted the model described in the federal Innovation Adoption Community of Practice's guiding principles. Our motivation for selecting this framework was two-fold: the principles are focused on adoption—meaning they are action-oriented—as well as grounded in deep innovation experience across federal agencies. The following practices, based on that model, can help the Forest Service intentionally build an organization that is adept at moving from innovative ideas to innovative actions:

- **Build an innovative culture:** Openness to ideas from anywhere, a keen awareness of subcultures and priorities, a commitment to bridging cultural differences, and a consistent focus on the *users* of technology are all fundamental enablers of innovation.

- **Be agile and experiment:** Innovative organizations are willing to question the status quo, make intentional space for experimentation, learn from that experimentation, and work iteratively over the long haul.

- **Collaborate and harness diversity:** A diversity of backgrounds and thinking makes for better overall experience, products, and services.

- **Make data-informed decisions:** Decisions about how and whether to adopt innovations should be informed by diverse data that define and measure changes from the status quo.

- **Scale and communicate:** Cultivating the ability to right-size the problem, solution, and groups of key stakeholders—and communicating about these clearly and openly—is essential to moving from experimentation to adoption.

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Recent Forest Service Activity

This assessment also takes into account previous and ongoing work the Forest Service has engaged in with respect to climate change and wildfire risk reduction. The agency released its first National Roadmap for Responding to Climate Change in 2011. Since then, the Forest Service's understanding of climate impacts on ecosystem change, new wildfire regimes, and the disproportionate burdens of climate change on disadvantaged communities and Tribes has become more sophisticated. Establishment of the agency's Office of Sustainability and Climate (OSC) in 2015 reflected structural changes designed to support the development of climate change policies, guidance, and tools for agency use. At present, the need for new data and tools that can help foresters and other agency staff to "see into the future"—to help mitigate and adapt to the impacts of climate change—is increasing. In 2023, the Forest Service released the **Climate Risk Viewer** and established the Climate Data Working Group—but more work in this area is needed. Indeed, we see targeted, collaborative forums for continued learning, and tools for bolstering data-driven decision making across agency silos and geographies, as essential.

Moreover, in the past two years, USDA and other stakeholders have released several reports and other strategic documents that include guidance, information, and recommendations around technology and tool innovation—providing important context and guideposts for this Innovation Assessment. A brief outline of these key documents is as follows:

Jan. 2022

Forest Service released its 10-year strategy, "**Confronting the Wildfire Crisis**," which identified priority, high-risk firesheds for treatment to reduce wildfire risk. The strategy calls for treating at least 50 million acres of federal, state, Tribal, and private forest lands over the next decade.

Sept. 2022

Forest Service released its **Climate Adaptation Plan**, which highlights the need for improved data and data integration to support development of decision support tools that will help foresters manage forests in a warming climate.

June 2023

Forest Service released the first beta version of the **Climate Risk Viewer**, a spatial tool developed by the agency's Office of Sustainability and Climate to assess potential gaps between climate pressures and current forest management intent. Climate Risk Viewer is designed for regular enhancement and expansion, continually improving usability and its utility to forest managers.

June 2022

USDA released a Secretary's Memorandum, "**Climate Resilience and Carbon Stewardship of America's National Forests and Grasslands.**" The memo directed the Forest Service to carry out activities—including the development of policies, guidance, decision support tools, an updated fireshed risk map, among other directives—to address climate change vulnerabilities and risks to the Nation's forests.

Mar. 2023

The Nature Conservancy (TNC) and Aspen Institute released a jointly authored **Roadmap for Wildfire Resilience**, based on findings and recommendations developed through a series of stakeholder workshops. The Roadmap includes recommendations built around the theme of "technology and innovation."

Aug. 2023

Forest Service kicked off the first meeting of a new Climate Data Working Group, a cross-agency body designed to coordinate and align the development and provisioning of climate datasets and tools.

June 2023

Wildland Fire Mitigation and Management Commission, established by Congress in 2021, released "**On Fire**"—a report with recommendations that address every facet of the wildfire crisis. Chapter six of the report ("Integrating Modern Science and Technology") is the most relevant for the purposes of this report.

In particular, the TNC/Aspen Institute and Wildland Fire Mitigation and Management Commission reports each address innovative tools and technology in ways that occasionally overlap with this report. Where our findings and recommendations point to similar recommendations found in these and other reports or documents, we have echoed them. It is important to note, however, that the TNC/Aspen and Commission reports had much broader mandates than our own—and that they were carried out using varying methodologies.[1]

Since this report is about adopting innovative data and technology, it is also notable that data and tools are always subject to a variety of requirements supplied by policies and public laws. The Federal Information Technology Acquisition Reform Act (FITARA), for instance, is central to all agencies' management and acquisition of information technology (IT) tools. It contains an array of requirements that, among other things, move agencies toward incremental development of IT tools and regular reviews of their IT portfolios. Chief Information Officers (CIOs) play a crucial role in implementing these (and other) requirements, including those aimed at managing cybersecurity risks. In our view, many of the processes and personnel engaged in these activities must play an integral role in any effort to improve the adoption of innovative data and tools at the Forest Service. This report is not intended, however, to assess compliance with particular policies or laws, but rather to identify areas that can benefit from concerted attention and greater collaboration.

Finally, in Fiscal Year (FY) 2021, the Forest Service underwent a budget modernization process to improve oversight of its spending, including IT expenditures. As a result of this change, IT spending is now tracked and budgeted for in a centralized manner. The agency received $450 million in enacted appropriations for FY 2023 but, according to the FY 2024 Budget Justification, the cost data from this change revealed that program IT expenditures likely exceeded $571 million in 2023—and are hence estimated to be around $603 million for 2024. The Forest Service is currently addressing the gap between funding and expenditures by pulling money from other sources, such as various program funds and supplemental appropriations. And, as the agency has noted, this is an unsustainable way to fund IT over the long term, and such a scenario greatly affects the funding available for adopting innovative data and tools in particular.[2] Several interviewees expressed frustration with the Forest Service's IT budget constraints. If not managed carefully, this situation can lead to a feedback loop where innovators are consistently told "no" and either look for ways to adapt current processes or give up trying. We recognize that the agency is working under these constraints with no easy solutions. Ultimately, however, dedicated investments in modern data and tools will yield significant dividends to the Forest Service in its efforts to sustain the health, diversity, and productivity of the Nation's forests and rangelands for present and future generations.

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[1] TNC and the Aspen Institute convened stakeholder workshops, while the Wildland Fire Mitigation and Management Commission solicited public opinion and interviewed subject matter experts—ultimately relying on the expertise of Commission members.

[2] Although we do not explicitly address IT funding levels at the Forest Service in our recommendations, we believe that a combination of 1) using data to reduce underutilized IT and technical debt, and 2) increases in targeted funding, should create opportunities to pursue innovative data and tools moving forward.

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Scope & Methodology

The goal of this assessment is to understand the Forest Service's current capacity to use new and innovative technology—defined as new data and analytical tools—to achieve its mission objectives. While climate-informed forest management and wildfire risk reduction was the initial area of inquiry for this report, its findings and recommendations are likely applicable across multiple mission objectives. Given the relatively short time period of our analysis, this work should be considered exploratory in nature, and while not definitive, it is forward-looking and action-oriented. As a next step, the Forest Service and its partners build out action plans to operationalize these recommendations with more specific details and proposals.

To develop findings and recommendations, EPIC's team conducted more than forty confidential interviews across four key stakeholder groups to identify barriers and opportunities related to adopting innovative technology, current and future applications of that technology, and opportunities for improving the process of adoption at the USFS.

Our interviewees included:

Forest Service employees

We spoke to employees at the regional and Washington Office levels within the National Forest System, Research & Development (R&D), Business Operations, and State, Private, and Tribal Forestry Deputy areas, as well as staff within R&D Research Stations and Labs.

Other federal agency personnel

We spoke to employees at other federal agencies to explore comparative examples of how they approach innovative data and technology.

Technology companies

We spoke to employees of private companies involved in past or current technology development projects with the Forest Service, specifically those with a focus on wildfire risk reduction.

Non-governmental organizations (NGOs)

We spoke to employees of nonprofit organizations involved in past or current technology development projects with the Forest Service, including those that have had extensive experience engaging with the agency on a variety of projects.

The project team included staff and consultants from EPIC's Technology Program, Forest Service liaisons who helped guide the research process and secure interviews, and other consultants working on related projects with the Forest Service. The research team also reviewed recent related strategic and programmatic documents (listed above) as well as other federal agencies' structures, policies, and procedures to inform our findings and recommendations.

One important caveat: while the Forest Service is clearly a significant actor in addressing the wildfire crisis, it does not operate in a vacuum. In all aspects of wildfire management, the Forest Service partners with other federal agencies (e.g., BLM, USGS, NRCS, DOE), state agencies, Tribes, local jurisdictions, utility providers, and other wildfire actors in the Western U.S. And while the scope of this project did not allow for inclusion of many of these Forest Service partners in our analysis, it is vital for the Forest Service to communicate directly with partners as it works to improve its data systems and procure/develop new decision support tools. Moreover, many of the external technology providers interviewed for this project are collaborating with key partners alongside their work with the Forest Service. In our view, to the extent that the Forest Service and its wildfire crisis partners can leverage each other's efforts and interests in this arena, the more likely it is that a coordinated, innovative technology and tools approach will pay real dividends. We see a more efficient, and harmonized, response to the wildfire crisis as a strategic north star for the agency.

Vision for Forest Service Data and Technology

The Forest Service is at a crossroads with respect to technology. Everyone we spoke to believes that new approaches to data and technology have a significant role to play in the evolution of the Forest Service. We asked interviewees to provide their vision for the Forest Service's relationship with technology in five year's time, and received 20 responses from a diverse group inside and outside of the agency.

At one level, these vision statements illustrate a broad consensus on aspirations for how the Forest Service leverages data and technology. Statements included these descriptions:

Technology that is...	Data that are...
Agile, adaptable, configurable, responsive, scalable, flexible, varied	Consolidated, centralized, corporate, governed, integrated, connected, standardized
Integrated, centralized, enterprise-wide, managed	Seamlessly shared, discoverable, accessible, public
Useful, effective, deployed, used, safe, understood, easily navigable, intuitive	Usable, reusable, repeatable
Efficient, automated, funded, sustainable, planned, strategic	Contemporary, meaningful, high-quality

At another level, the vision statements we heard illustrate several divergent approaches to how the Forest Service could better leverage data and technology—approaches that reflect an array of cultures, structures, and metrics of success in and around the agency. For instance, these different visions emphasized things like:

- Seeking out and piloting new technologies to increase the pace and scale of work
- Partnering beyond the agency and government to yield best-in-class solutions
- Looking inwards, taking the time to understand the systems that already exist, and investing in them
- Becoming a leader in technology rather than a consumer of rapidly changing technology
- Becoming competitive with private industry in terms of technology
- Upgrading or replacing archaic systems

At first glance, these may seem like incompatible visions for the future at the Forest Service. In reality, however, the organization must strike a balance between these competing visions. In our view, truly becoming a leader in the adoption of innovative technology requires a willingness to take advantage of many sources of innovation—and to synthesize or reconcile varying approaches in ways that make mission success more likely.

Findings

Lack of Communication and Connection

The Forest Service is a large agency, with approximately 30,000 employees working on National Forests and state and private forestry across the continental U.S. and its Territories. With such a dispersed staff and structure, communication becomes critical to mission delivery and to the development and adoption of technology and tools.

> **The Forest Service has an unprecedented opportunity to meet the challenges presented by the wildfire crisis and a rapidly changing climate.**

We found that communication about technology at the Forest Service is certainly happening—but often in ways that remain siloed within particular offices, regions, and districts/forests.

Examples include:

Mainly internally-facing forums

Cross-cutting communication usually takes the form of internal forums organized around a particular type of technology (e.g., geospatial or remote sensing), or around a particular tool or data system (e.g., FACTS). There are also communities of practice across the Forest Service, organized by the Washington Office and inclusive of regions and other units of the agency. We also encountered a few examples of technology focused summits, such as the 2021 Rangeland Technology Summit, for rangeland managers to discover technologies ready for their use. We did not find many avenues for Forest Service staff to consistently gain exposure to the latest tools to maintain awareness of new developments.

Limited "connective tissue" roles

We found plenty of Forest Service personnel working on innovative tools, but little evidence of coordinated activity across units—including efforts to disseminate technology development and use activities, evaluate pilots (and early stage tech tools) for further development and scaling, and learnings about use cases for tools. The Forest Service has a small number of distributed staff whose job it is to connect tool developers to programmatic personnel who are either developing or testing new technologies and tools; but more of these positions are sorely needed. This organizational "connective tissue" can serve as a critical bridge between IT staff, internal tool developers, external tech providers, and Forest Service tool users, and help build awareness of potential and successful uses of technology.

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The same conversation again

We heard from technology providers that they had to have the same conversations multiple times—with different parts of the Forest Service—indicating that communication rarely translated to broader awareness of tools across the agency. Smaller technology providers also said that they simply don't have the capacity to perform the labor-intensive work of identifying and briefing people separately across the entire Forest Service. A more proactive approach to engaging with technology providers could go a long way toward addressing these hurdles.

Language barriers

Language barriers are common in organizations when it comes to discussing tools and technology, and the Forest Service is no exception. We heard about the different ways that "technology" is implicitly or explicitly defined throughout the Forest Service and how those definitions result in a reduced ability or willingness to collaborate. For example, we heard that inconsistent definitions of "Information Technology" (IT) were a key factor in determining (or failing to determine) the pathway for potential tools. Others emphasized a need to distinguish between "technology" and "science" given their frequent conflation, and since each activity requires different skills and emphasizes different outcomes.

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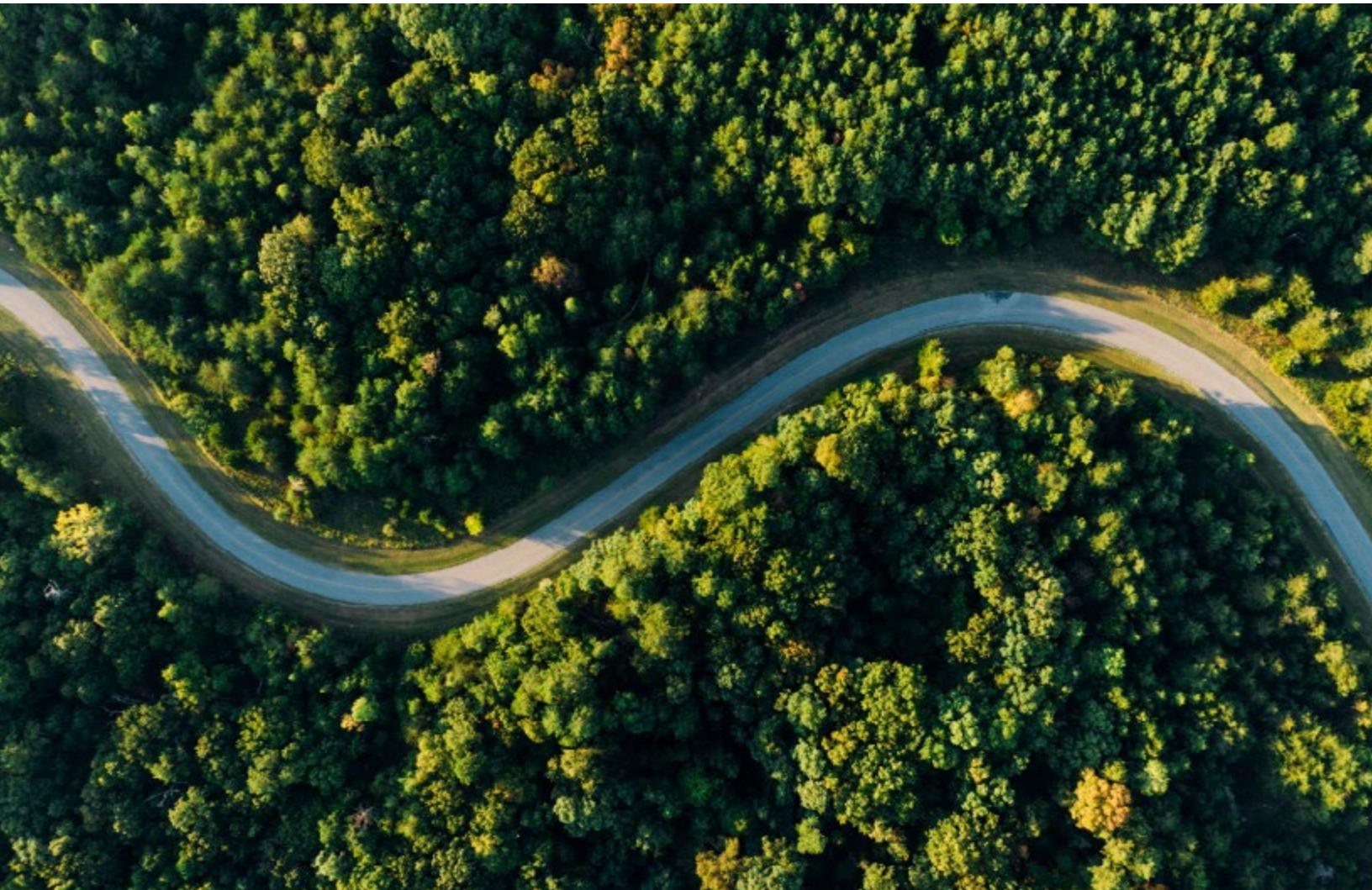
Missing Pathways

Any large organization like the Forest Service needs the right mix of people and processes to develop, procure, and scale innovative tools and technology. Throughout our research and interviews, we found examples of successful internal tool development and collaborations with private sector tech providers. However, we also found constraints that limit successful internal development and which frustrate external tech providers. These include:

No "front door" for partners

There are no defined entry points to the Forest Service for external technology providers seeking to partner with the agency. Nearly every tech provider, and a majority of the Forest Service employees we interviewed, said that they were unsure of how external entities could engage effectively with the agency. Conversations between tech providers and Forest Service personnel are not coordinated and there appears to be no one at the agency communicating comprehensively about partner efforts across offices and units. We even heard about multiple groups evaluating the same tool, for example, with no awareness of the others' simultaneous efforts.

No "how-to-manual" for partners

We found no published guidance or framework (e.g., cybersecurity requirements, data standards, etc.) for external entities looking to work with the Forest Service. As a result, external tech providers may not understand internal Forest Service constraints, requirements, and processes, which in turn limits the ability of external partners to efficiently develop tools and technologies for agency use. We also heard directly from technology providers who were not made aware of Forest Service standards well into their partnership with the agency— illustrating a lack of a well-defined and socialized framework for how to move from a prototype to an operational tool.

Inconsistent ways to sift and scale tools

Whether a technology tool is developed internally by Forest Service personnel, collaboratively between the Forest Service and an external tech provider, or procured from an external tech provider—we could not find any consistent method for evaluating and scaling tools. For instance, we heard about useful internal tools that did not receive needed investment and which did not scale as a result. We also heard concerns that tools with demonstrated quality advantages were simply ignored. Additionally, we did not encounter any framework for developing and applying consistent criteria or metrics to evaluate the *utility and effectiveness* of new tools, and which might help scale those showing promise. Regardless of provenance, the ultimate fate of innovative tools should be based on consistent criteria and metrics that help mitigate internal vs. external biases, and which ensure that utility and effectiveness are always primary considerations for agency leaders.

Uneven Foundations

New tools can live or die based on the foundations that they are building on—including existing systems and data, an understanding of current and future needs, and the skillsets of the workforce. We found a number of building blocks that urgently need attention to help the Forest Service meet its evolving needs for climate risk and other information. These include:

Technical debt is holding back innovation

Our interviews suggest that the Forest Service has significant technical debt—deferred work updating software with current standards to maintain functionality—that consumes a significant (and if left unchecked, increasing) amount of the current budget. Like many federal agencies, the Forest Service faces IT budget constraints, limiting its ability to invest in the development and procurement of innovative tools and technologies. We also heard about concerns that IT specialists are not consistently involved early enough in the process to help move mission-oriented tools toward more modern solutions that minimize potential technical debt.

Tools that are responsive to active user needs

Tools need to be developed and sustained with a set of specific users in mind to ensure that they are useful and utilized. According to our interviews, there are thousands of applications available to Forest Service staff—but metrics about their use are either in development or are not widely available. Several interviewees told us that they need a better understanding of the data and tools relevant to their programs to help them comprehend patterns and make decisions. The existing "guides" we reviewed on such topics tended to be long lists of available tools lacking curation based on intended users. Interviewees also emphasized that existing ways of assessing needs for information (and the tools necessary to meet those needs) are not sufficiently connecting lines of business across the Forest Service.

Lots of data, limited use

The Forest Service collects and uses data everywhere throughout the agency and owns some of the world's best datasets. However, the organization's decentralized structure and aging digital infrastructure means that data is widely dispersed and no single inventory of databases exists. We heard from interviewees that sharing data can often mean inefficient work-arounds like mailing a physical harddrive. Further, differences in how data are collected and stored—for example, data on the same species in different forests—make it difficult to incorporate data into a single tool, or roll that information up to the national level. Internal and external tool developers also told us they encounter challenges when attempting to integrate Forest Service data into their own tools.

Need for supportive and tech savvy leadership

We heard about leaders across the Forest Service that are increasingly supportive of staff pursuing innovative technology projects. The importance of this leadership support cannot be overstated. At the same time, we also heard that the comfort level of leadership with the language of data and technology varies considerably across the agency—leading to situations where staff with technical skill sets feel they spend a disproportionate amount of time answering questions from leadership rather than actually evaluating tools or supporting users in deploying them. In the extreme case, this results in defaulting to the same basic, outdated approaches that no technologist would recommend.

Staff bottleneck

The right skill sets and personnel play a major role in enabling all aspects of adopting innovative technology. Our interviews surfaced some roles focused on building the collaborations necessary to adopt new technologies—including, for instance, a small team working to bring R&D tools to an operational status. However, we also heard about important skill gaps, such as vacant liaison positions between branches and inadequate access to GIS skill sets despite mission-related needs. Ultimately, effective staffing will determine how fast people can give and get the answers or help they need—and we see this as a significant factor in whether innovators can (or want) to work with the Forest Service, especially among innovative startups.
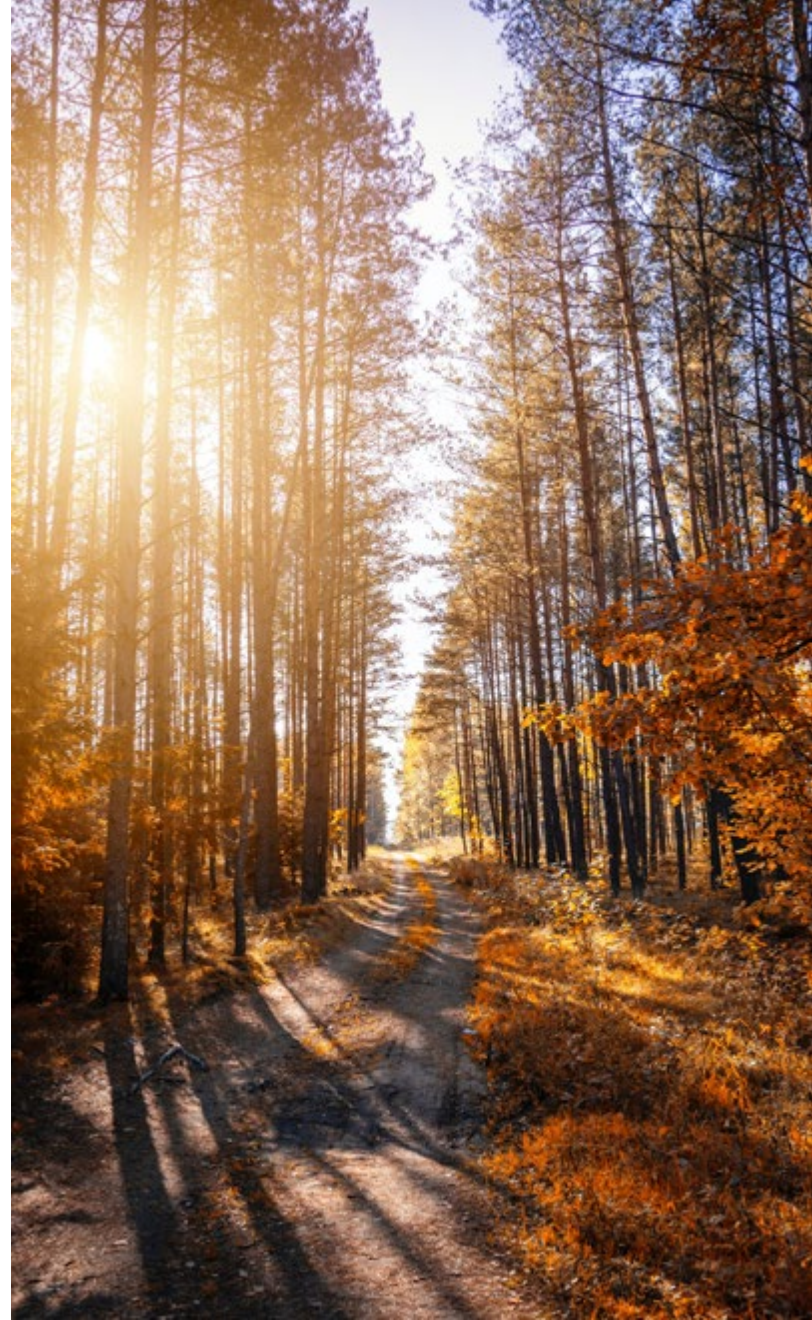
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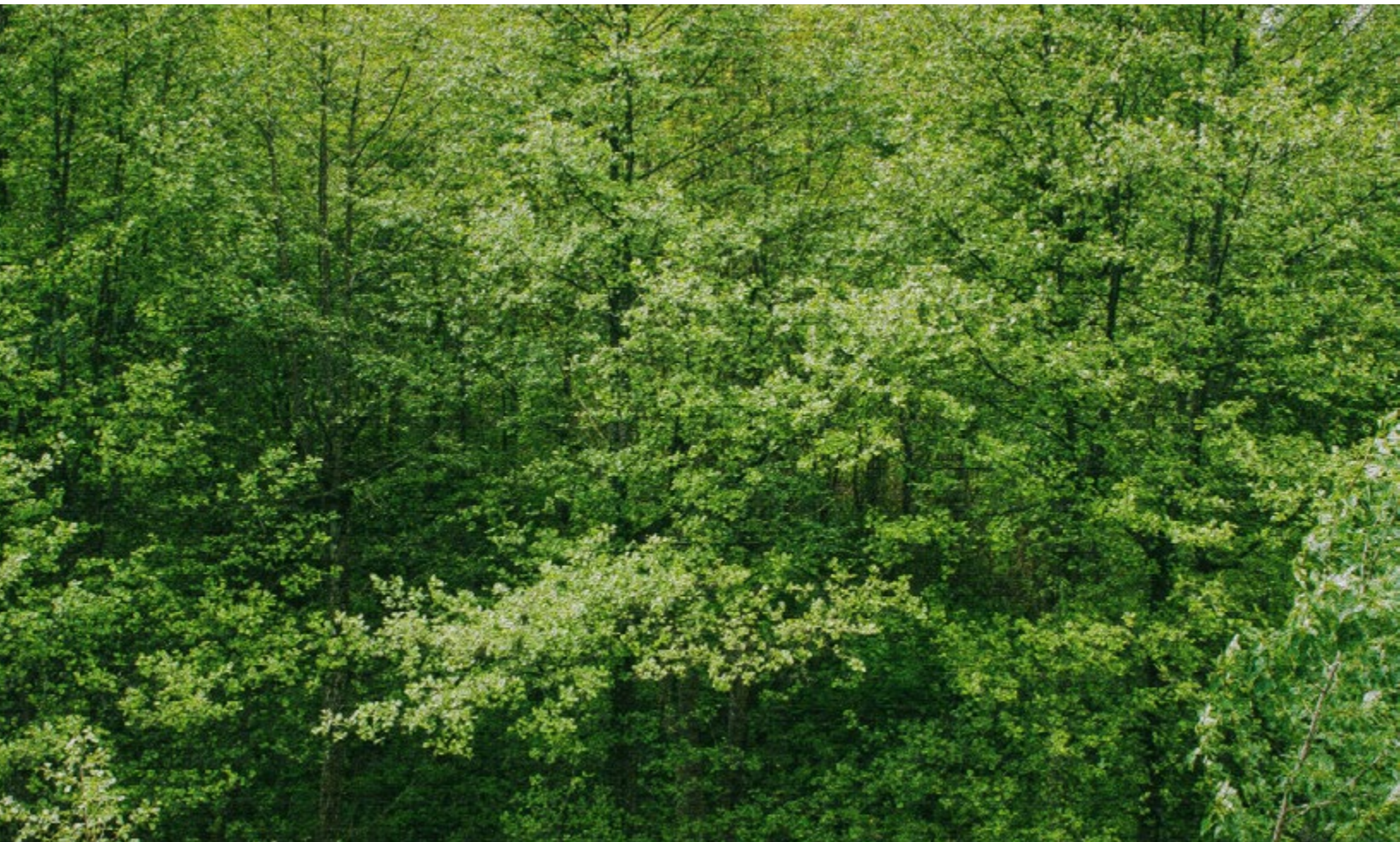
Agency Culture and Structure

The Forest Service has a nearly 120-year history and approximately 30,000 employees. The agency's current structure—aspects of which are siloed, decentralized, and institutionally complex—is the product of countless incremental decisions made over the course of those 120 years. Given its mission's scope and the nature of its work across geographies, aspects of that structure have both served the agency well and inhibited its effectiveness. For similar reasons, the agency's culture is unique among federal agencies: as the product of many historical factors and long-standing organizational characteristics, the Forest Service's culture is broadly resistant to change, no matter who leads the organization.

In our interviews and research, it also became clear that the Forest Service's culture and structure pervade and color every aspect of the agency's work—including its efforts to develop and incorporate innovative tools and technology. For instance, its decentralized structure, coupled with the common notion that the agency is a series of "federated states" with varying degrees of autonomy, has generated both benefits and challenges over time. We found that leaders and personnel across many of these "federated states" feel empowered to innovate by identifying, evaluating, and procuring tools and technology that are appropriate for their particular situations. At the same time, the absence of coordination around those processes hampers the agency's ability to gain efficiencies, integrate data and tools, and scale effective tools within individual units.

We cannot emphasize enough the ways in which the Forest Service's decentralized structure underpins many of our findings. Under the current structure (see Appendix below), Regional Foresters and Research Station directors report directly to the Forest Service Chief in a line-staff model. In the Washington Office, four Deputy Chiefs plus the Chief Financial Officer also report to the Chief. This lack of direct supervisory connections between Washington Office Deputy Areas and the Regions and Forests present inherent (and unnecessary) challenges to coordinating the development, evaluation, and scaling of innovative tools and technology. Even in the Washington Office, the Research and Development (R&D), State and Private Forestry, and National Forest System Deputy Areas—which are critical to innovative tool development and dissemination—each have different focus areas, success metrics, and key stakeholder groups. These differences lead to disparate approaches to innovative tools and technology.

Similarly, we found myriad examples of how the agency's culture impacts this work. Below are several examples we think worth highlighting:

Significant pockets of distrust of private, for-profit technology providers among Forest Service personnel.	While this is not uncommon among federal agencies, there are examples of organizations such as NASA or the Department of Defense where a longer history and culture of collaboration with external technology providers make distrust less of a hurdle for for-profit entities.
Differing perspectives on the role of Forest Service R&D scientists.	Some interviewees stated that R&D should more explicitly serve the needs of the National Forest System while others noted R&D's long-standing culture of independence and academic motivations.
Cultural undercurrent of distrust between Forest Service personnel at the Forest and District levels and the Washington Office.	The sentiment that "no one knows how to manage my forest better than me" complicates efforts to coordinate scaling and dissemination of innovative tools and technology.

While agency structure and culture influenced all aspects of our findings in this report, making explicit recommendations about those topics would require additional research and engagement with the agency that is beyond the scope of this project. We recognize, however, that substantive changes to both of these fundamental aspects of the Forest Service may well have a galvanizing effect on the agency's ability to integrate innovative tools and technologies, and we see this as an important area for future inquiry.

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Recommendations

We developed recommendations across each of our findings categories, detailing the areas we think are most important for the agency to address as it works to improve the uptake of innovative tools and technology. Organized across categories *(i.e., Communication, Pathways, and Foundations)*, we also listed what we see as the most urgent recommendations first within each area, although we certainly see all recommendations as important.

Communication: *Enabling open and proactive communication*

- **Priority Recommendation:** Add roles or teams that can act as "connective tissue" between Forest Service units.

- Participate in or establish forums for open dialogue about technology.

- Build an open system for soliciting and evaluating innovative ideas to improve operations from Forest Service staff.

- Move toward more proactive market research of emerging and alternative technologies.

Pathways: *Building, testing, and scaling promising tools collaboratively*

- **Priority Recommendation:** Establish or enhance processes for evaluating tools at different stages (experimenting and scaling) based on clear performance criteria.

- Establish clear entry points for external entities and a framework for transitioning innovative tools through the pilot stage to operational status.

- Create guidance and a team of liaisons for external entities looking to engage with the Forest Service on IT and data.

- Develop and implement a strategy for open collaboration on data and tool development.

Foundations: *Investing in technology enablers*

- **Priority Recommendation:** Develop the capacity to continuously assess the information and technology needs of lines of business.

- Establish a baseline goal for the speed of technology evaluation, staff accordingly, and track results.

- Dedicate funding and capacity for data integration sprints.

- Provide training to upper management on how to ask the right questions about data and tech to institutionalize leading practices.

Note that for each recommendation below we include the following:
- **Key considerations:** Context about the recommendation and how it could be implemented.
- **Internal momentum:** Existing roles, offices, or efforts inside the Forest Service that align with the recommendation and show where there is already momentum that could be leveraged or built upon.
- **Comparative examples:** Roles, offices, or efforts outside the Forest Service that could serve as a model or source of new ideas for implementing the recommendation.

Communication

These recommendations are aimed at creating open and proactive communication channels to bridge structural, cultural, and language barriers that hamper tool development and slow down adoption.

Add roles or teams that can act as "connective tissue" between Forest Service units.

Key considerations **!** Priority Recommendation

> Bridging those often disparate cultures, priorities, and language barriers in and around the Forest Service necessitates dedicated positions and/or teams for translating and moving information between different Forest Service units—both "horizontally" (i.e., across Deputy Areas, for example) as well as "vertically" within the Agency (e.g., across districts, forests, and regions). It may also be necessary to map out the key structures, cultures, and languages that need to be bridged to do this effectively. This organizational "connective tissue" would help ensure that relevant stakeholders across the Forest Service are aware of complementary and/or duplicative efforts elsewhere in the agency. The positions would also help to elevate success stories, best practices, and lessons learned from experimentation with new technology or tools across units. The more these roles or teams are empowered and encouraged to talk to any stakeholders, the better.

Internal momentum:
- There are positions focused on IT within lines of business such as the Deputy Director for Fire and Aviation Management.
- The National Partnerships Office has a team that works on technology across the Forest Service.
- The Forest Service established a Wildfire Crisis Strategy (WCS) Landscape Team in late summer of 2023 to develop an action plan for R&D engagement with the 21 WCS Landscapes. Under consideration is the establishment of a Landscape Science Support Team that would focus on trying to deliver existing functionality, information, datasets, and tools developed in R&D to the 21 Landscapes.
- In R&D, there are positions that serve as liaisons to the CIO's office and the Science Partners program aims to connect scientists with managers to help align research with existing needs.

Comparative examples:
- NOAA created the [Electronic Monitoring Coordinator](#) position to be a resource to those inside and outside of government in understanding various perspectives on the use of key technology, electronic monitoring of fish on vessels, and to help work more collaboratively with industry.
- The Natural Resources Conservation Service (NRCS) has a national innovation leadership role and serves as a connector between those with innovative ideas and other parts of the agency that can help act on those ideas.

Participate in or establish forum(s) for open dialogue about technology between the Forest Service, other federal agencies, technology providers, and nonprofits.

Key considerations

Forums focused on data and technology can be important vehicles through which to generate new ideas, leverage best practices and lessons learned from other organizations, and foster new partnerships and collaborations that can accelerate the implementation of new technology at the Forest Service. The greater the diversity of thought in these venues, the more likely the Forest Service is to emerge with truly innovative ideas—which is why we recommend forums with cross-sector participation. Given the dispersed nature of technology at the Forest Service, it is important that the opportunity to participate in these forums is inclusive of most, if not all, Forest Service units. At present, Forest Service leaders and staff already participate in some technology forums. A full evaluation of these could help the Forest Service determine if it is useful to establish one or several additional forums focused on technology. It may also be more effective to focus each forum on a specific line of business (for example, wildfire risk reduction) in order to bring users with common mission objectives together to co-create agendas centered on the information and technology needs of the Forest Service and its partners.

Internal momentum:

- The Forest Service Rangeland Technology Summit in 2021 was aimed at increasing the understanding of potentially useful decision support tools for capacity-constrained rangeland managers. During the Summit, over 35 data/tool providers presented their applications to over 100 NFS and BLM range managers and received real-time feedback from Forest Service staff on usefulness, applicability, and the user experience (UX).

- The Forest Service has several internal communities of practice and user groups that could serve as forums for discussing innovative technology, some of which might also be used for open dialogue across sectors. For example:
    - Geospatial Forums hosted by Geospatial Technology and Applications Center (GTAC)
    - The CIO Forum (hosted by the CIOs Office)
    - Regional Inventory and Monitoring Coordinators' Community of Practice

Comparative examples:

- The International Council for the Exploration of the Sea (ICES) is an intergovernmental marine science organization meeting societal needs for impartial evidence on sustainable use of our seas and oceans. A NOAA representative chairs the Council's **Working Group on Technology Integration for Fishery-Dependent Data (WGTIFD)**, which examines electronic technologies and applications developed to support fisheries-dependent data collection—both onshore and at sea—including electronic reporting (ER), electronic monitoring (EM), positional data systems, and observer data collection.

- **EPA air sensor performance target workshops**. When miniaturized, lower-cost air monitoring sensors entered the market, EPA held workshops and webinars to solicit individual stakeholder views, including those of technology providers, related to non-regulatory uses and performance targets for air sensors—and has since expanded efforts to evaluate these technologies for use in various applications

- The **Red Sky Summit** is a gathering of wildfire thought leaders who share a common objective: to develop and scale innovative, technology-based solutions to our wildfire crisis. Attendees include a diverse set of fire experts, foresters, practitioners, technology entrepreneurs, utility and insurance executives, philanthropists, non-profit leaders, researchers, and elected officials.

Key considerations

Building a culture of open innovation requires the cultivation of trust between collaborators and organizations inside and outside of the Forest Service, as well as the expectation that new ideas will be given fair consideration and the potential for action. A system for soliciting innovative ideas within the agency, whether for decision support tools or other changes, will help surface, elevate, and spread ideas throughout the Forest Service faster and more consistently. Importantly, such a system would also help connect ideas and innovators with the capacity for taking action on them across various parts of the agency (CIO Office, R&D, etc.), and could also provide some form of recognition as added motivation. This could also be an opportunity to involve those with innovative mindsets in improving the agency by establishing a pool of volunteer raters or evaluators of ideas throughout the Forest Service. The system's success will depend on broad awareness across the agency (it is impossible to "over communicate" about its existence as a resource), as well as having adequate resources and teams to demonstrate traction around the best ideas. No one wants to submit their ideas into a blackhole!

Internal momentum:
- The Forest Service Chief Data Officer's (CDO) office has a data issue log that could be utilized to track data gaps and innovative ideas to fill them.

Comparative examples:
- The Natural Resources Conservation Service (NRCS) implemented a single system for suggesting and acting on innovative ideas that is open to all NRCS staff. The system allows for submissions in three categories:
    1. ideas that have not been acted on
    2. ideas that are being explored or piloted
    3. resources that are ready for broader use.

  Once submitted, each idea is considered and voted on by volunteer innovators drawn from all over the agency. Ideas with the most interest are reviewed, and, if selected, have co-leads assigned to them to help implement within the agency.

- **GSA 10x** is an initiative to crowdsource ideas from federal employees and turn them into real products that improve the public's experience with the federal government.

Key considerations

As the Forest Service improves communication and collaboration with the private sector, there will be a need to proactively understand the landscape of tools and technologies that may have broader use cases (e.g., those that incorporate generative artificial intelligence (AI). An early awareness of a new approach allows the Forest Service to be proactive in hiring specialists and setting up a new evaluation team. Furthermore, it could allow the agency to solicit information more systematically about new products, understand the state-of-the-art, and avoid bias toward legacy solutions. Continuous market research for decision support tools should be connected to—and grounded in—an information needs assessment, and make use of the science and technology expertise within different parts of the Forest Service.

Internal momentum:
- The USDA Science Council has an **Emerging Technologies Team** designed to "facilitate and accelerate the exploration, adaptation, and adoption of new and emerging technologies for advanced assessments of agricultural production." Technologies include those that help users understand the variability of production at multiple spatial and temporal scales, and the analysis software needed to integrate new sources and types of data with ongoing and legacy data.

Comparative examples:
- The Department of Homeland Security's (DHS's) Procurement Innovation Lab is piloting the use of **AI to assist with better market research** by "improving the ability of the acquisition workforce at DHS to rapidly access relevant records" from their central repository of contractor past performance assessment records.
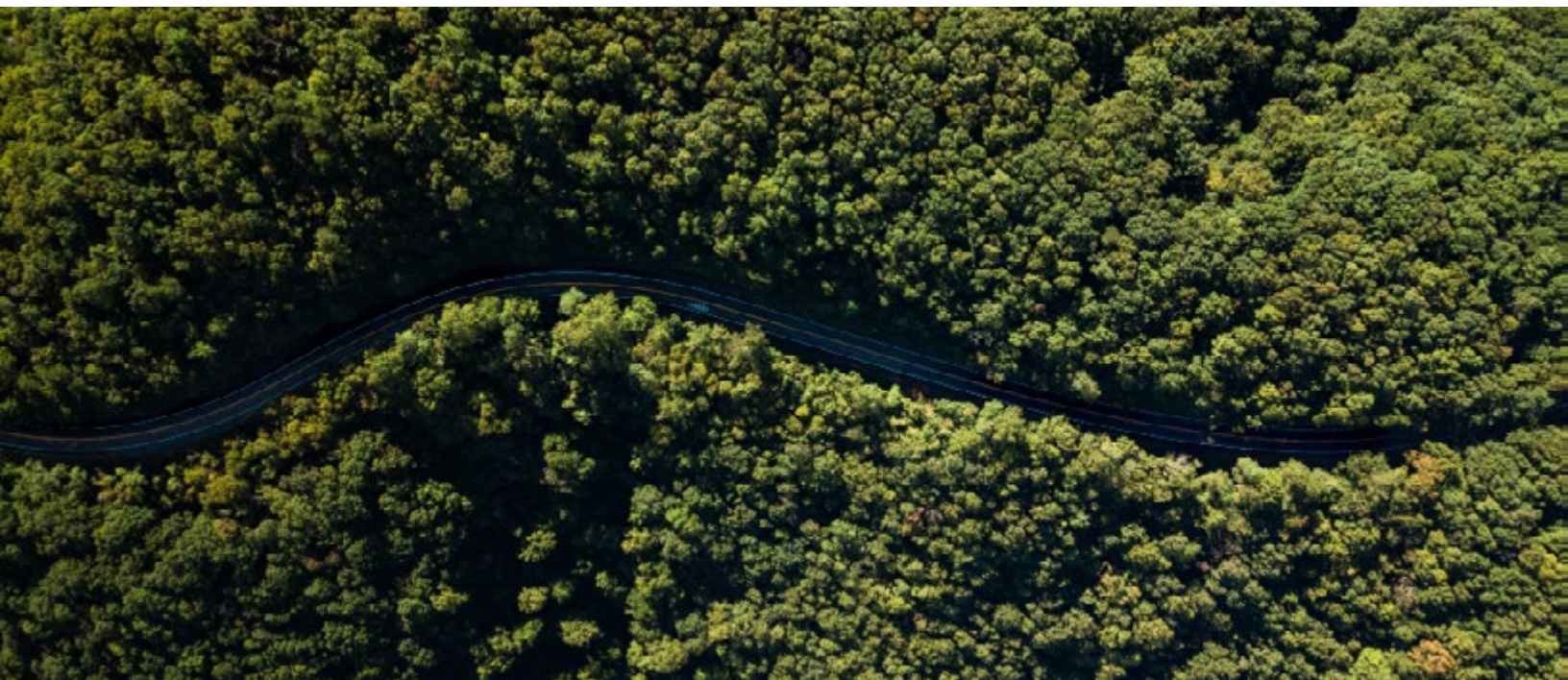
Pathways

These recommendations are specifically aimed at connecting efforts to experiment with tools and scale the best ones by giving a wide-range of innovators the information they need to succeed.

Establish or enhance processes for evaluating tools at different stages (experimenting to scaling) based on clear performance criteria.

Key considerations   **!**   Priority Recommendation

The Forest Service should establish a set of repeatable, inclusive, and transparent processes for evaluating tools. In the early stages, when the Forest Service is first exposed to a new tool and the features are still being built out, the process should allow for experimentation at smaller scales with a wide variety of tools and low barriers to entry for those both inside and outside the organization. Although several parts of the Forest Service may be testing the tools, the tests should operate under a framework that emphasizes organizational learning and comparability so that the results systematically advance the Forest Service's understanding of their benefits and drawbacks. Tools and technologies that show promise in the early stages should be evaluated in a subsequent stage based on an expanded set of criteria that includes performance at scale and the ability to comply with requirements for IT and data standards, among others.
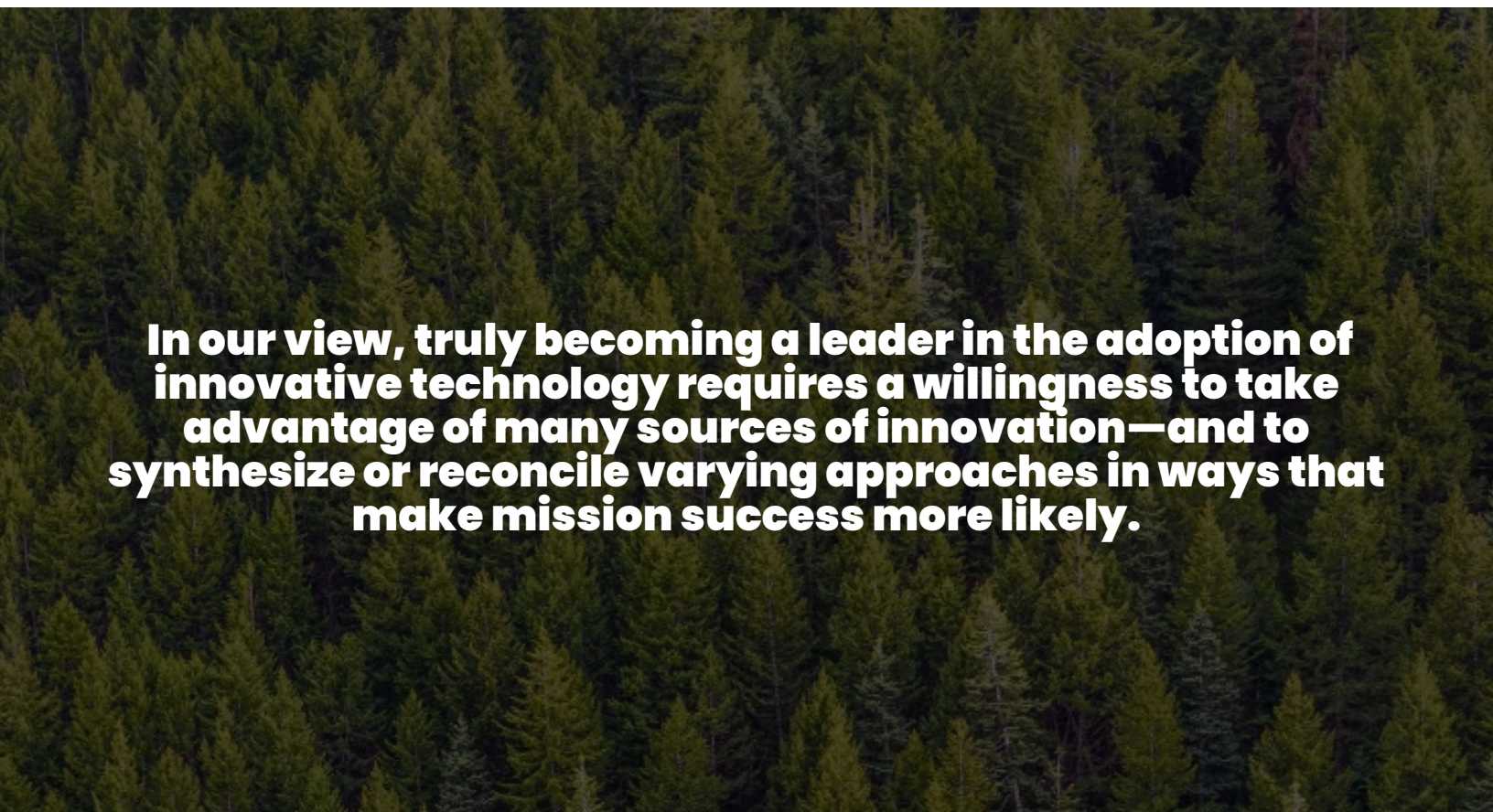
Any evaluation process should be based on a set of transparent evaluation criteria that go beyond one dimension of a tool (i.e., data quality, transparency, scientific defensibility) to equip the agency to compare the tradeoffs of the new technology with the status quo. A wide range of metrics, including usability and design criteria with input from actual users, should be considered in tandem. No single office or expert should have the power to define the performance criteria without input from other parts of the agency—which risks making it too easy to "say no" or overemphasize certain aspects of a particular technology. Performance criteria should be the same for tools developed internally or externally. Additionally, a consistent process could be developed but implemented for different business lines (e.g., fire, invasive species management, vegetation management), as well as by different constellations of staff. It should include representatives from a broad cross-section of Forest Service units that both understand and manage technology (e.g., the CIO or CDO offices), specialists versed in applicable science (e.g. scientists in R&D), and those that understand technology user needs in the field (e.g., national program leads, staff in the forests and regions). This will be a standing need for the Forest Service and should not be considered a "one and done" exercise, as needs and tools will continue to evolve in the future.

Internal momentum:

- Multiple teams (at least one from FAM and one in Region 5) are evaluating wildfire mitigation decision support tools. Looking at similarities and differences between those evaluations could help structure a future process.
- The Information Resource (IR) Architecture Standards Board (ASB) is responsible for approving IR standards for data, applications, technology, protocols, and information management.

Comparative examples:

- OpenET is a non-profit organization that works across sectors to provide access to the best available information on evapotranspiration (ET). This effort brought together government and academic experts to evaluate a variety of models producing ET estimates in an open and transparent way. This helps build trust and acknowledges that there may be different models that are better suited to particular use cases, rather than a single model. Note that this could be part of an evaluation process for a suite of tools since it evaluates models. It also demonstrates the use of clear performance criteria for the models.

- Although it is not focused on digital tools, the General Services Administration (GSA's) Green Proving Ground is an example of a continuous technology evaluation process and capability. Some of its key features include collaboration with researchers in federal labs to evaluate technology using performance metrics and then issuing an accessible summary of the evaluation to facilitate wide-spread organizational learning.

> **In our view, truly becoming a leader in the adoption of innovative technology requires a willingness to take advantage of many sources of innovation—and to synthesize or reconcile varying approaches in ways that make mission success more likely.**

Establish clear entry points for external entities to work with the Forest Service, and a framework for transitioning innovative tools through to operational status.

Key considerations

Too often, potential data and technology partners for the Forest Service, especially new ones, have no idea where to start. Partnerships between the Forest Service and external entities developing innovative tools could be facilitated and enhanced by establishing explicit entry points (i.e., people or offices) for external entities to engage with the agency. Once the Forest Service is aware of a new tool, it is unclear who needs to know and offer input at what point, and to what end. A framework describing the series of steps (including any evaluation processes) for moving tools from the entry points to operational status should be documented for both internally and externally developed tools. This framework should include designating who within the agency is responsible for each step, including who will manage the tools once deployed (typically trained product managers). In developing the frameworks, the agency should consider leveraging industry standard terminology or frameworks (e.g. Technology Readiness Levels). Establishing those clear entry points and pathways would reduce the time and effort required for both external entities and agency staff to form partnerships, avoid duplication, and increase the capacity of the agency to evaluate new potential tools.

Internal momentum:

- The National Partnerships Office is revamping its website to let partners know it is open for business and to make it more intuitive.

- R&D programs and researchers partnered with OSC (housed within NFS), which provided resources to build tools using R&D data/science and transition them to operations.

- R&D is currently developing a framework document with an initial intent to transition fire applications to CIO operations, but the larger goal is to develop a framework that could work to transition all tools and applications developed by R&D to CIO-managed operational environments.

- By leveraging the existing partnership with the National Forest Foundation, NFF recently issued an RFP for wildfire crisis decision support tools that will allow several forests to gain access to tools quickly in order to begin evaluating them alongside current tools and processes.

Comparative examples:

- The VA Pathfinder program features a website that acts a digital point of entry for those that have innovative ideas, products, or services to help the Veterans Administration (VA) carry out its mission. Often, agencies have separate websites for solutions that need further development and those that are market ready; this portal helps navigate some of those distinctions that may be unclear.

- Federal agency technology transfer programs have liaisons—oriented towards licensing technologies from federal labs—that could serve as a model for engaging with the private sector. For example, the Federal Laboratory Consortium operates a Collaboration Concierge that provides immediate, personalized assistance and referrals to connect entrepreneurs with federal technologists.

- The StatVentures program at the Census Bureau uses challenges as a point of entry for scouting technologies and systematically honing in on those that are most useful to the agency.

Create guidance and a team of liaisons for external entities looking to engage with the Forest Service on tools and data.

Key considerations

The Forest Service should develop guidance on tools and data for external entities to use in building their tools and engagement strategies. This guidance would make the framework described in the previous recommendation widely available and tailored to an external audience. It should include essential information on baseline cybersecurity and data standards to help external entities understand basic requirements prior to tool and technology development, and thus help avoid surprises later on. Beyond that guidance, the Forest Service should consider creating a team that would help external entities navigate this process and ensure that external tools are being evaluated fairly according to the established criteria.

Internal momentum:
- The National Partnerships Office has a team focused on technology that has worked with some initial partners interested in working with the Forest Service on digital tools.

Comparative examples:
- Climate Tech VC created a "Founders Guide to the DOE" that pulls together a variety of relevant material from the Department of Energy, and explains how it maps onto the process of developing and ultimately deploying new technology. It makes use of clear infographics to help understand how the DOE interacts with technology holistically.
- The Department of Homeland Security (DHS) has clearly identified industry liaisons on its website.
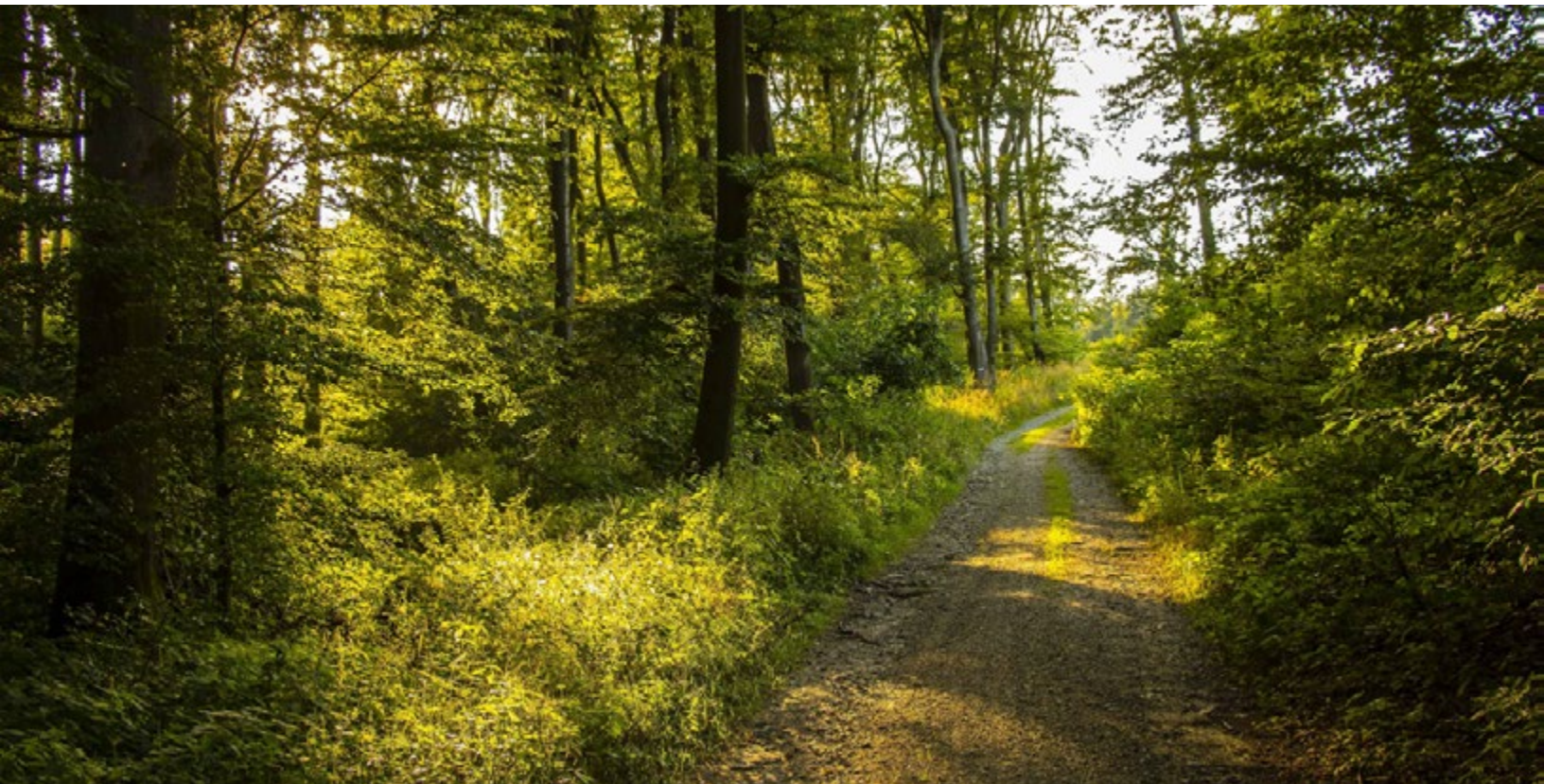
Develop and implement a strategy for open collaboration on data and tool development.

As the Forest Service's capacity to adopt innovation grows and its technology needs become clearer, the agency will need to shape "outside" innovation. An open innovation strategy on this score—one that takes advantage of a wide variety of flexible mechanisms for partnering—is an important tool for engaging a broader set of new partners; especially organizations with technical capabilities that are not yet invested in the Forest Service's mission. These mechanisms might include competitive RFPs administered by partners, facilitating technology sprints, and using prize competitions (e.g., the America Competes Act) to catalyze the development of innovative, mission-aligned tools and technologies by external entities. This approach could be particularly useful for helping the Forest Service meet the needs of stakeholders at the state level and across local communities.

Internal momentum:

- The **Forest Innovation Platform** aims to improve data access and analysis, and bring together a community of organizations and individuals to have informed discussions on the role of data and technology innovation—particularly when it comes to helping develop shared knowledge around how climate change affects our forests, building more resilient ecosystems, and identifying pathways toward climate change adaptation and mitigation.

- **Women in Data 2023 Climate Sustainability Datathon**. In 2023, USDA partnered with the nonprofit Women in Data and the World Meteorological Organization for the Climate Sustainability Datathon—which focused on applying data and data science to make recommendations linked to climate sustainability. The Climate Risk Viewer (CRV) was one of three focus areas, and was even used by one of the top teams to prioritize climate adaptation activities.

- The **iTree suite of tools** were developed through a public-private partnership between the Forest Service and the private sector to meet community needs for science-based information about trees.

Comparative examples:

- The **Center of Excellence for Collaborative Innovation** works with innovators across NASA and the federal government to generate ideas and solve important problems. Using strategies such as Prizes, federal Challenges, and crowdsourcing, the Center partners with global communities.

- **The Opportunity Project** in the U.S. Census Bureau facilitates 12-week product development cycles—called "sprints"—focused on helping companies, non-profits, and universities build products with federal open data that help solve national challenges. The Census gives teams access to subject matter and data experts to accelerate their progress.

- Pacific Gas and Electric Company (PG&E) has an **open pitch and award system** that brings in outside innovators to help address the utilities' innovation challenges, including those related to wildfires.

Foundations

These recommendations are aimed at bolstering foundations for strategic decision making about tool adoption based on a better understanding of user needs, the ability to use more of the Forest Service's data, and equipping leadership and staff with the right skill sets.

Develop the capacity to continuously assess the information and technology needs of lines of business.

Key considerations | ! Priority Recommendation

Establishing the capacity to continuously assess information and technology needs would be valuable for building awareness of current uses and identifying priority gaps for action related to particular mission objectives. Clarity about the existing flow of information and the future information needs of decision-makers should form the foundation for understanding these technology needs. This is particularly important given the emergence of new data needs related to climate risk. Hence, as a further step, a technology needs assessment could help leaders understand how technology might be deployed to meet those information needs. In any case, a technology assessment should not merely be a list of technology requirements, but rather a framework for understanding technology solutions in practically meeting *user needs*. Such an assessment would not only be helpful for evaluating new alternatives, but also understanding which existing systems are most (or least) valuable to the organization, and help reduce technical debt. As part of that process, usage and other performance metrics for existing applications should be shared more widely to build trust and awareness of the status quo.

Both information and technology assessments would be most effective if implemented for major lines of business (e.g., carbon stewardship) and aligned with other strategic planning activities (e.g., business rules, data architecture and strategy, wildfire crisis strategy, etc.). Different elements of the agency, such as R&D scientists, may have a need for a wider variety of specialized applications. A collaborative process for understanding program outcomes and information needs for specific lines of business should take into account these specialized user groups and also incorporate human centered design (HCD) principles. At minimum, the process should include representatives from centralized offices with key roles related to technology (e.g., the CIO and CDO offices, Human Resources, and Budget & Finance), R&D, the Forest Service National Partnerships Office, the National Forest System (NFS), and State, Private, and Tribal forestry.

Internal momentum:

- The Forest Service CIO's office has an effort underway to enhance metrics for the use of existing Forest Service tools and applications.

- The Forest Service CDO's office has started three pilot efforts to create business knowledge blueprints for major lines of business.

Comparative examples:

- PG&E developed a **broad needs assessment** and then held an "innovation day" to discuss the assessment with tech providers.

- GovLab developed a methodology to conduct an **open data demand assessment**, which aims at identifying, prioritizing, segmenting, and engaging with actual and future demands for open data in a systematic way to ensure that data investments are more targeted. This methodology could be adapted to understand data demand across the Forest Service or among its broader set of partners.

Establish a goal for the speed of tool evaluation, staff accordingly, and track results.

Key considerations

All of the recommendations above depend on the Forest Service's ability to hire and train the right people with the right skill sets, especially **technical talent**. The Forest Service may discover bottlenecks in the expertise required to act on these recommendations (e.g., IT specialists, GIS specialists, product managers) and should invest in focused, accelerated hiring to meet these workforce planning needs. If the Forest Service wants to be a nimble organization, it needs to be able to evaluate new technology at the pace of technological change and mission urgency, and successfully build the pipelines to source the talent it needs. Talent also matters for the agency's efficacy when working with outside partners: technology providers work best when they have speedy and iterative feedback to design their products and services—multi-month delays in getting answers about a feature or security standard could make or break a provider's—especially a small startup's—ability to remain viable or stay focused on Forest Service work.

Internal momentum:

- *None identified to date.*

Comparative examples:

- The Department of Homeland Security **launched a sprint to hire 50 artificial intelligence experts** to form a new AI Corps modeled after the U.S. Digital Service, building teams that will help better leverage this new technology responsibly across strategic areas of the homeland security enterprise.

Dedicate funding and capacity to data integration sprints.

Key considerations

Decision support tools and other information systems are only as useful as the data that flow through them—and helping data "flow" will yield major benefits for the Forest Service. Data across the Forest Service are often stored locally, and while it may not be realistic to centralize all data at all times, it's clear that investment is needed to discover, integrate, and store the most useful datasets. Relying on scientists and foresters—who are already overburdened or lack formal training in data management is a recipe for slow (or no) progress. Short, targeted efforts to integrate data sets could be performed by a contractor or internal team, and they should place an emphasis on performing a useful service for the data owner and demonstrating a return on investment. These types of projects are often overlooked in the broader IT spending conversation, but we see them as absolutely essential to realizing the value of investments in new tools. The arrival of broadly capable AI raises the urgency of acting on this recommendation because the technology's performance is fundamentally based on the data used to train it. Without data from across the Forest Service it will be impossible for the agency to leverage AI effectively.

Internal momentum:
- The Forest Service Enterprise Data Warehouse is an example of how data can be integrated and used throughout the agency even if it currently has a limited scope.
- The proposed R&D Data, Modeling, and Applications Support Hub (D*M*A*S*H*) concept would allow the Forest Service to explore and extend its science delivery capabilities. It would include conducting a review of existing, state-of-the-art data hubs around the country (and globe), and adopt/adapt the approaches that best meet the needs of the agency and FAIR Data Principles.
- In 2023, the Forest Service established a cross-agency Climate Data Working Group, chartered to coordinate and align the development and provisioning of climate datasets and tools. The target audience for this work is primarily Forest Service staff, but also includes external stakeholders.

Comparative examples:
- The Fisheries Information Service has an annual competitive RFP process that supports initiatives that improve the quality and effectiveness of collecting, reporting, and managing fisheries-dependent data. Through coordinated funding of regional priorities, FIS promotes the sharing of intellectual and financial resources, while helping to reduce redundancy.
- The USGS has a Science Analytics and Synthesis branch that is co-equal to other branches, and which includes a team of scientists, information technologists, and librarians who work together with USGS Centers, Programs, Regions, and partners (i.e., universities, non-profits, other federal agencies, and communities of practice). The branch supports foundational data needs in part through a competitive RFP process.
- Instead of operating as a system of 37 different interconnected modules, submodules, and web applications, the US Fish and Wildlife Service ECOSPHERE system was developed using a data first architecture. This architecture will enable ECOSPHERE users to query from all available data in a "data lake" without having to login to different modules.

Provide leadership training or coaching on how to ask the right questions about data and tools to institutionalize leading practices.

Key considerations

Agency leaders—even those that don't touch data and technology in their day-to-day—still play a crucial enabling role in the adoption of innovation. The types of questions asked by leadership about programs and projects often have major implications for technology "downstream"—but it's not always obvious or easy to engage in productive discussions about data and technology. It's worth underscoring this point: leaders do not need to be trained in data science or technology development, but there is a need for leadership to understand the building blocks necessary to enable functional technology; in other words, technology that actually serves Forest Service staff and stakeholders, rather than legacy systems that take time and resources away from them. A small investment in leadership training or coaching in this area (i.e., framing key questions about data or technology) may go a long way toward adopting better technology—and might even free up data and tech experts to more effectively support users and address the accute need for training throughout the agency.

Internal momentum:
- None identified to date.

Comparative examples:
- GovLab Academy: GovLab offers customized training options to build the capacity of the public sector to adopt new technological innovations for governing, including coaching, workshops, and courses. A key part of their training approach is problem definition and how to ask the right questions.
- ACT-IAC: The Partners Program offers senior leaders in government and industry a challenging curriculum to help prepare them for executive leadership opportunities such as Senior Executive Service (SES) or C-level roles, while leveraging improved partnerships between and within industry and government.
- Digital IT Acquisition Professional Training Program (DITAP): the United States Digital Service (USDS) and the Office of Federal Procurement Policy (OFPP) collaborated to develop a specialized and immersive training and development program called the Digital IT Acquisition Program (DITAP), which is targeted towards agency program managers, among others.

Conclusion

The findings and recommendations in this report are wide-ranging, spanning diverse challenges across the Forest Service's many organizations and activities. Their common thread, however, is simple: the agency has an unprecedented opportunity to meet the challenges presented by the wildfire crisis and a rapidly changing climate. Given the agency's mission, and the scale and complexity of that task, adopting innovative data and digital tools is no longer an option but a requirement. That effort will necessitate a *connected* and *responsive* approach to adopting innovation in ways that take advantage of the agency's decentralized structure—enabling genuine experimentation—while also giving each tool a fair chance for evaluation and scaling. It will also require Forest Service leadership to actively institutionalize practices that keep numerous and distinct efforts, people, and groups connected to each other's needs, and working together to realize the agency's vision for climate informed decision making. That collaboration should include an array of innovators drawn from across the organization, as well as leading partners in the public and private sectors. Lastly, although there will surely be bumps along the road—tools that don't pan out, or differing opinions on which efforts to prioritize—by centering improved communication, pathways, and foundations for adopting the tools it needs, the Forest Service can position itself as a leader among those working to address the climate crisis, and thereby better execute its mission.

Environmental Policy Innovation Center
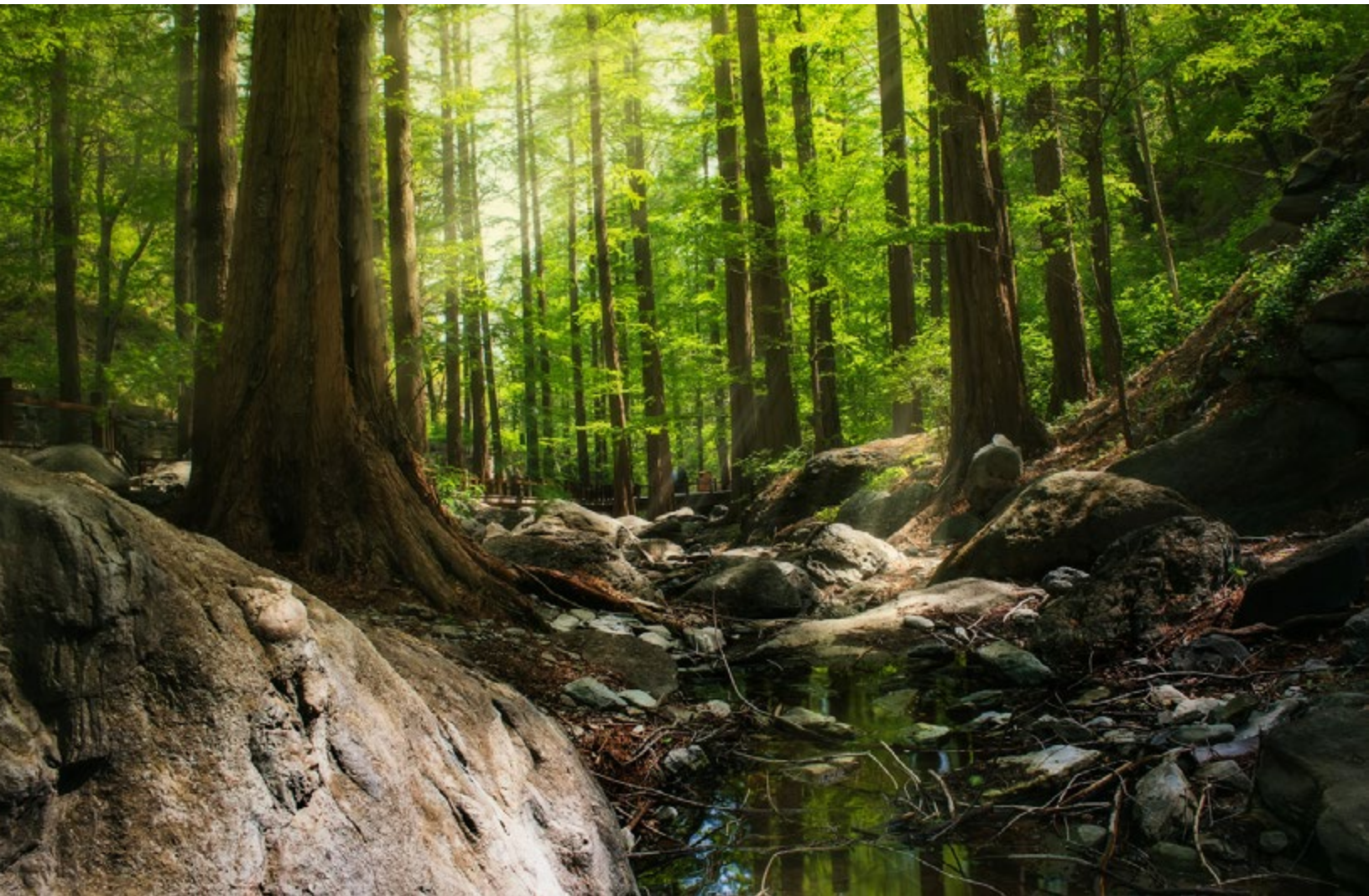
Appendix

U.S. Forest Service Organizational Chart (as of March 2023)

Chief — Civil Rights

Associate Chief

International Programs — Chief of Staff — Legislative Affairs

Law Enforcement and Investigations — Strategic Planning Budget and Accountability — Office of Communications

Work Enviornment and Performance — Intergovernmental Relations

Deputy Chief Business Operations
- Chief Information Office
- Enterprise Program
- Office of Regulatory and Management Services
- Office of Safety and Occupational Health
- Job Corps Program
- Human Resources Management
- Office of Grants and Agreement
- Homeland Security
- Office of Procurement and Property Services

Deputy Chief National Forest System
- Engineering Technology, Geospatial Services
- Lands and Realty Management
- Wilderness and Wild and Scenic Rivers
- Recreation, Heritage and Volunteer Resources
- Biological and Physical Resources
- Forest Management, Range Management, and Vegetation Ecology
- Office of Sustainability and Climate
- Minerals and Geology Management
- Ecosystem Management Coordination
- National Partnership Office

Chief Financial Officer
- Budget & Finance
- Financial Management Systems
- Financial Policy
- Audits & Assurance
- Financial Reporting and Reconciliation

Deputy Chief Research and Development
- Inventory, Monitoring, and Assessment Research
- Knowledge Management and Communications
- Landscape Restoration and Ecosystem Service Research
- Sustainable Forest Mgmt. Research
- International Institute of Tropical Forestry

Deputy Chief State, Private, and Tribal Forestry
- Fire and Aviation Management
- Cooperative Forestry
- Conservation Education
- Forest Health Protection
- Office of Tribal Relations
- Gray Towers

Research Stations
- Southern Research Station
- Rocky Mountain Research Station
- Northern Research Station and Forest Products Lab
- Pacific Northwest Research Station
- Pacific Southwest Research Station

Regions
- Northern Region, R-01
- Rocky Mountain Region, R-O2
- Southwestern Region, R-03
- Intermountain Region, R-04
- Pacific-Southwest Region, R-05
- Pacific-Northwest Region, R-06
- Southern Region, R-08
- Eastern Region, R-09
- Alaska Region, R-10