IMPLEMENTATION OF FEDERAL PRIZE AND CITIZEN SCIENCE AUTHORITY: FISCAL YEARS 2021–2022

A Report by the

OFFICE OF SCIENCE AND TECHNOLOGY POLICY

In Response to the Requirements of the

America COMPETES Reauthorization Act of 2010 *and the*

Crowdsourcing and Citizen Science Act

April 2024

About the Office of Science and Technology Policy

The Office of Science and Technology Policy (OSTP) was established by the National Science and Technology Policy, Organization, and Priorities Act of 1976 to provide the President and others within the Executive Office of the President with advice on the scientific, engineering, and technological aspects of the economy, national security, homeland security, health, foreign relations, the environment, and the technological recovery and use of resources, among other topics. OSTP leads interagency science and technology policy coordination efforts, assists the Office of Management and Budget (OMB) with an annual review and analysis of federal research and development in budgets, and serves as a source of scientific and technological analysis and judgment for the President with respect to major policies, plans, and programs of the federal government. More information is available at http://www.whitehouse.gov/ostp.

About this Document

This document presents the eighth report on the use of prize competitions and challenges conducted by federal agencies to spur innovation, engage citizen solvers, address tough problems, and advance their core missions. It also presents the third report on crowdsourcing and citizen science activities conducted by federal agencies.

Copyright Information

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Abbreviations and Acronyms

AICA	American Innovation and Competitiveness Act
ASMFC	Atlantic State Marine Fisheries Commission
CCS	crowdsourcing and citizen science
CCS Act	Crowdsourcing and Citizen Science Act of 2017
COMPETES Act	America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act of 2010
DAC	direct air capture
DEIA	Diversity, Equity, Inclusion, and Accessibility
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DYFI	Did You Feel It? program
EFH	essential fish habitat
EPA	Environmental Protection Agency
FedCCS	Federal Crowdsourcing and Citizen Science Community of Practice
FEMA	Federal Emergency Management Agency
HBCU	Historically Black Colleges and Universities
HHS	Department of Health and Human Services
JET	Just Energy Transition
MMI	Modified Mercalli Intensity
MSI	Minority-Serving Institutions
NIH	National Institutes of Health
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OSTP	Office of Science and Technology Policy
PC&C	prize competition and challenge
PCAST	President's Council of Advisors on Science and Technology
REACH	Regional Education Assessment Crisis Habilitation
STEM	science, technology, engineering, and math
U.S.	United States
USAID	United States Agency for International Development
USGS	United States Geological Survey

Executive Summary

President Biden made it clear that the fruits of science and technology should be shared across America, and that Americans of all backgrounds should be drawn into the creation and the rewards of science and technology. Crowdsourcing and citizen science (CCS) refers to the voluntary participation of individuals or organizations throughout the scientific process.[1] CCS is an important part of delivering the benefits of science to everyone in America.

This report details the work of the federal agencies that have conducted prize competitions and challenges (PC&C) and CCS during the fiscal years (FY) 2021 and 2022. This report demonstrates that PC&C and CCS activities can advance many Biden-Harris Administration priorities such as centering civil rights, working towards freedom from discrimination, sustaining America's leadership position in science and technology, increasing economic competitiveness, and nurturing a healthy and vigorous democracy.

The America COMPETES Reauthorization Act of 2010 (COMPETES) granted broad authority to all federal agencies to conduct PC&C to spur innovation. COMPETES permitted federal agencies incentives to involve the American public, leveraging fresh perspectives and novel approaches to collectively solve complex, socially relevant problems. The American Innovation and Competitiveness Act (AICA; Public Law 114-329), which became law in January 2017, included the Crowdsourcing and Citizen Science Act. The Act gave federal agencies broad authority to use CCS to advance agency missions and facilitate broader public participation in the research and innovation process.

OSTP is legislatively required by Congress to submit a biennial report to the House of Representatives Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology on the activities carried out under these authorities. PC&C and CCS open opportunities for agencies to engage with the communities they serve.

The FY21–FY22 reporting period included the highest number of activities of any reporting period to date, representing the expanding use of PC&C and CCS methodologies across the public sector. The activity reports submitted by the federal agencies describe the benefits of the PC&C and CCS mechanisms, including community engagement, strengthening innovation, benefitting the public, and bolstering agency missions.

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[1] 15 U.S.C. § 3724

Introduction

The White House Office of Science and Technology Policy (OSTP) is pleased to issue this report, which details the work of the Federal agencies that have used funding authorities to conduct prize competitions and challenges (PC&C) and crowdsourcing and citizen science (CCS) activities in fiscal years 2021 and 2022. This report is part of the Biden-Harris Administration's commitment to effective and meaningful public engagement, as well as OSTP's role in developing evidence-based policy and policy that is reflective of the diversity of our nation. This report also responds to the mandates in *America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Reauthorization Act (COMPETES Act) of 2010*[2] *and the Crowdsourcing and Citizen Science Act (CCS Act) of 2017*[3] which require OSTP to inform Congress on the use of the authorities provided by those laws on a biennial basis.

The PC&C and CCS activities in this report demonstrate that engagement bolsters many Administration priorities such as centering civil rights, working towards freedom from discrimination, increasing economic competitiveness, and nurturing a healthy and vigorous democracy. For example, PC&C have been lauded as "tool[s] for incentivizing the achievement of scientific and technological innovation by offering monetary and nonmonetary benefits (e.g., recognition) to competition participants."[4] They have proven to be an important part of the systems of innovation for the federal government.[5] PC&C have the potential to greatly expand the circle of innovators, attracting and making space for different communities of problem solvers. Similarly, CCS as avenues of participation and engagement have expanded the reach, accessibility and capacity of the federal research ecosystem. As seen in the activities described in this report, CCS activities take many forms, from agencies working with volunteers to observe their environment to agencies working with and providing data for mutual benefit. The use of CCS makes it possible for federal agencies to access new and more data, especially related to the experiences and priorities of the communities and individuals they aim to serve. By increasing participation and engagement, these avenues of connection strengthen the rigor, relevance, and reach of science[6] while creating pathways for communities to engage in broader government processes.

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[2] 20 U.S.C. § 9801

[3] 15 U.S.C. § 3724

[4] U.S. Congressional Research Service. "Federal Prize Competitions" (R45271; April 6, 2020), by Marcy E. Gallo. https://crsreports.congress.gov/product/pdf/R/R45271/5
See also Burstein, Michael J., and Fiona E. Murray. "Innovation Prizes in Practice and Theory." Harvard Journal of Law & Technology, vol. 29, no. 2, Spring 2016, pp. 401-454.
In addition, see also Kevin C Desouza. "Challenge.gov: Using Competitions and Awards to Spur Innovation." IBM Center for The Business of Government.

[5] Liotard, Isabelle and Valerie Revest. "Contests as innovation policy instruments: Lessons from the US federal agencies' experience." *Technological Forecasting and Social Change* 127 (2018): 57-69.

[6] Balazs, Carolina L., and Rachel Morello-Frosch. "The three Rs: How community-based participatory research strengthens the rigor, relevance, and reach of science." *Environmental justice* 6.1 (2013): 9-16; Baker, Beth. "Frontiers of Citizen Science: Explosive growth in low-cost technologies engage the public in research." *Bioscience* 66.11 (2016): 921-927;
English, Paul B., Maxwell J. Richardson, and Catalina Garzón-Galvis. "From crowdsourcing to extreme citizen science: participatory research for environmental health." *Annual review of public health* 39 (2018): 335-350.

Although this report often focuses on the implications for science and technology (S&T), the activities summarized in this report generally are bridges between the U.S. government and the communities served by the government. Proactive engagement with members of underserved communities to inform design of regulatory agendas and plans is central to the Biden-Harris Administration's initiatives and actions. For example, meaningful involvement of the public in decision-making is a foundational tenet of *Executive Order 14091, Further Advancing Racial Equity and Support for Underserved Communities Through the Federal Government* and *Executive Order 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All.*[7] Meaningful involvement necessitates fostering long-lasting relationships between federal agencies and communities. The PC&C and CCS activities demonstrate that the mandates of the COMPETES and CCS Acts have a lasting and active legacy. This report has evolved since the first version in FY13 as the use of the COMPETES and CCS authorities has expanded in scope and frequency. The FY19–20 report was the first to collect agency data through a dedicated online interface, which allowed for systematic analysis of the data submitted by agencies, including the increase in the use of the authorities and which agencies conduct the most PC&C and CCS activities. These insights improved the understanding of the federal landscape and demonstrated the potential types of analyses that could be provided by such data. This approach was used again in FY21–22, using survey questions which were reviewed and revised in consultation with federal agencies to allow for a more precise measurement of how the authorities support agencies' missions and the communities they work with.

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[7] Exec. Order No. 14091, 2023, https://www.whitehouse.gov/briefing-room/presidential-actions/2023/02/16/executive-order-on-further-advancing-racial-equity-and-support-for-underserved-communities-through-the-federal-government/;
Exec. Order No. 14096, 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/04/21/fact-sheet-president-biden-signs-executive-order-to-revitalize-our-nations-commitment-to-environmental-justice-for-all/

The Federal Landscape: Prize Competitions, Challenges, Citizen Science & Crowdsourcing

Overview

There is growing interest in how PC&C and CCS authorities are used by agencies, their role in allowing the broader public to participate in and benefit from innovation, and their role in expanding the public's engagement with and access to the federal government's science and technology efforts.[8] The growth in the number of activities reported here, relative to the previous report, tracks with a movement towards improving and expanding participation and engagement in not only government research and development, but also government processes more broadly. Recent developments such as the issuing of the Public Access Memo of 2022, recommendations by the President's Council of Advisors on Science and Technology (PCAST) for public engagement in the sciences in 2023, and the Office of Management and Budget's recent guidance on Participation and Engagement in Regulatory Processes are examples of this trend.[9] Supporting, enabling, and expanding the use of these authorities stands to benefit the whole of government, and more so, the federal science and technology ecosystem and civil society.

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[8] Bella Isaacs-Thomas. "How you can contribute to scientific discoveries from your couch." PBS NewsHour. https://www.pbs.org/newshour/science/not-all-scientists-wear-lab-coats-volunteers-are-fueling-research-nationwide

[9] See: "Memorandum on Ensuring Free, Immediate, and Equitable Access to Federally Funded Research," https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-access-Memo.pdf
See: "Letter to the President: Advancing Public Engagement with the Sciences," https://www.whitehouse.gov/wp-content/uploads/2023/08/PCAST_Science-Engagement-Letter_August2023.pdf
See: "Memorandum on Broadening Public Participation and Community Engagement in the Regulatory Process," https://www.whitehouse.gov/wp-content/uploads/2023/07/Broadening-Public-Participation-and-Community-Engagement-in-the-Regulatory-Process.pdf

Figure 1. Number of Reported PC&C Activities Conducted Since FY14 by Authority Type.

Reporting from agencies is voluntary; hence, this is not a comprehensive view of all PC&C activities across the federal government. Nevertheless, the growth in the PC&C activities is evident: the total number of active PC&C activities reported has increased from 97 in FY14 to 199 in FY22. More specifically, the number of prizes conducted under the authority of the COMPETES Act increased from 34 in FY14 to 84 in FY22 as seen in Figure 1.

Similarly, Figure 2 shows that the total dollar amount offered by the agencies in the PC&C prize purses has grown over the years. The agencies with the largest PC&C prize purses in FY2022 are United States Agency for International Development (USAID), Department of Health and Human Services (HHS), Department of Energy (DOE), and Department of Defense (DOD). The increase in the overall PC&C prize purse is mostly due to the increase in the prize purses of these four agencies.

Figure 2. Prize Amounts of PC&C Reported since FY14.
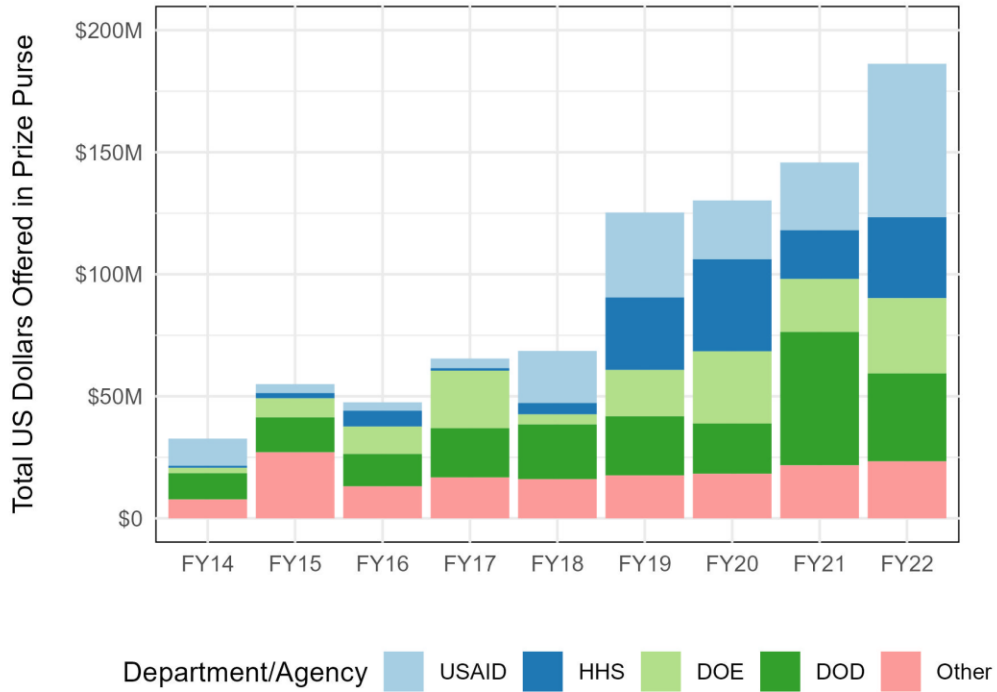
The number of reported CCS activities has fluctuated over the years. This is partially due to changes in agency reporting behavior. Although nine federal agencies reported their activities during FY17–20, only seven responded during FY21-22. While the overall number of reported CCS activities is slightly lower for FY21 and FY22 (77 and 80 activities, respectively) compared to the number of reported CCS activities in FY20 (85 activities), there are two fewer agencies reporting in FY21–22. The number of activities per agency is the highest for FY21–22, because there are over 11 activities per agency in FY21-22, but only an average of 9.5 activities per agency in FY20–22.
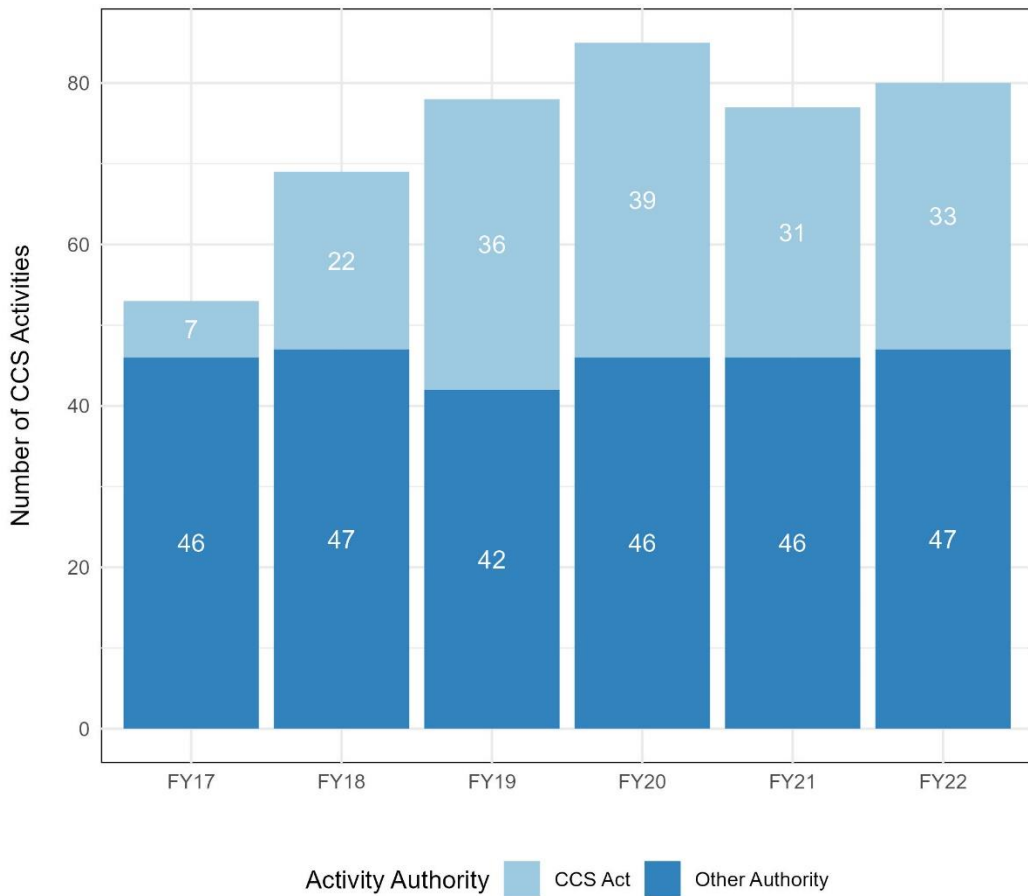
Figure 3. Number of CCS Activities Conducted Since FY17 by Authority Type.

PC&C and CCS as engagement methodologies on a continuum

PC&C and CCS are engagement approaches with distinct requirements and considerations. They have different purposes and outcomes, and each can serve as an avenue to stimulate innovation and partnership. They help expand public participation in the U.S. government, specifically within the S&T ecosystem. To better understand the impact of PC&C and CCS

approaches, it is necessary to understand their differences and how they are in a continuum of engagement and implementation possibilities. This understanding is particularly important given Biden-Harris Administration efforts that aim to increase public participation and engagement.[10]

PC&C and CCS can be framed in the context of a larger continuum, or spectrum, of engagement methodologies.[11] Based on academic and grey literature, a continuum of engagement can help illustrate how different methodologies serve distinct goals (to reach out to, to consult, and to involve diverse communities).[12] The spectrum provides a visual representation of different engagement approaches, and demonstrates how to further expand the relationship of the federal government with the American public.

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[10] See: "Memorandum on Ensuring Free, Immediate, and Equitable Access to Federally Funded Research," https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-access-Memo.pdf
See: "Letter to the President: Advancing Public Engagement with the Sciences," https://www.whitehouse.gov/wp-content/uploads/2023/08/PCAST_Science-Engagement-Letter_August2023.pdf
See: "Memorandum on Broadening Public Participation and Community Engagement in the Regulatory Process," https://www.whitehouse.gov/wp-content/uploads/2023/07/Broadening-Public-Participation-and-Community-Engagement-in-the-Regulatory-Process.pdf

[11] Center for the Advancement of Informal Science Education (2009). "Many Experts, Many Audiences: Public Engagement with Science and Informal Science Education." https://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1011&context=eth_fac;
Hood NE, Brewer T, Jackson R, Wewers ME. Survey of community engagement in NIH-funded research. Clin Transl Sci. 2010 Feb;3(1):19-22. doi: 10.1111/j.1752-8062.2010.00179.x. PMID: 20443949; PMCID: PMC3691361;
Selker, Harry P., and Consuelo H. Wilkins. "From Community Engagement, to Community-Engaged Research, to Broadly Engaged Team Science." Journal of Clinical and Translational Science, vol. 1, no. 1, 2017, pp. 5–6., doi:10.1017/cts.2017.1.

[12] Kania et al. (2022). "Centering Equity in Collective Impact." Stanford Social Innovation Review; Vetter, A., Faircloth, B. S., Hewitt, K. K., Gonzalez, L. M., He, Y., & Rock, M. L. (2022). Equity and Social Justice in Research Practice Partnerships in the United States. *Review of Educational Research*, *92*(5), 829-866. https://doi.org/10.3102/00346543211070048

Continuum of Engagement

Reach Out	Consult	Involve	Collaborate	Share Leadership

Example: Science Communication & Translation
Communication flows from the agency to individuals and communities with the goal of informing them.
Outcome: Establishes communication channels

Example: Public listening sessions, Crowdsourcing, Citizen Science
Agency requests data or knowledge from the community and is clear on how it will be used and how results will be communicated/sent back.
Outcomes: Develops a connection, education, awareness

Example: Community Review Panels, or Patient Engagement Councils, Citizen Science, Prize Competitions, Challenges, Community Patient-Centered Outcomes
Data, communication, ideas, knowledge flow from community to agency and communication flows back to the public. Agency seeks more cooperation with and involvement from the community
Outcome: Visible partnership that provides multiple avenues of engagement and increased agency and value to community voice

Example: Cooperative Agreement Funding Models
The agency seeks and nurtures a continued collaboration, support, funding, training, data, communication, ideas, knowledge flow both ways.
Outcome: Evolving partnership that builds and centers trust and provides increasing agency to community partner

Example: Funding Community Engagement Cores that fund community-university research, Community holds decision and design power at some point of the process, there are strong partnership structures and agencies makes intentional space for community leadership.
Outcome: More equitable access to Federal resources and leveraging knowledge and for policies that improve local outcomes
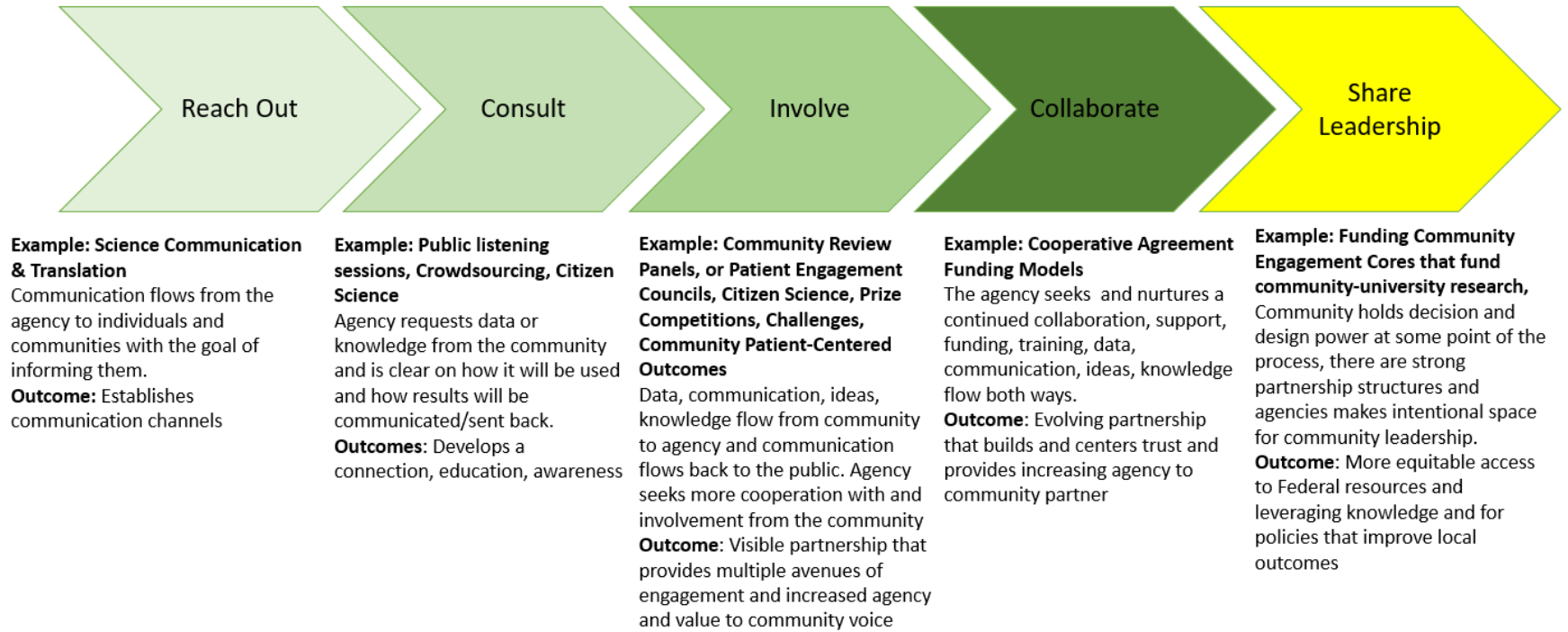
Figure 4. Continuum of Engagement.

The organizing principle of this spectrum is that involvement, engagement, and co-ownership of the processes and products of government science, technology, and innovation can increase across the continuum. The examples in Figure 4 point to what the continuum can look like across the federal scientific ecosystem—and across the government. Increased engagement and co-ownership are key to people seeing themselves and their needs reflected in the products and practices of government and its science ecosystem.

However, increased involvement, engagement, and co-ownership of processes and products require an investment and institutionalization of engagement methodologies to remove barriers to public participation in government work. Understanding how these methods differ and where they overlap, particularly in the federal context, is the first step to making such investments. In this year's survey, agencies were asked how their use of PC&C and CCS activities aligned to the agency's mission, uncovering a key distinction between the two. All responses were assessed for quality and detail, as well as suitability for deeper analysis of high-level trends.[13] Overall, there was considerable variation in the length, content, and depth of the responses; this is congruent with the variation in the objectives of each activity as well as in the missions across agencies. Certain agency missions—those with greater focus on inclusion, outreach, and diversity—are more aligned with conducting PC&C and CCS activities.[14]

An important difference between PC&C and CCS is that agencies reported using the results (data, research outcomes, etc.) of the PC&C activities to advance agency missions while for CCS activities, the agencies reported using the actual activities themselves to advance the agency mission.

For instance, agencies often used the results of PC&C to:
- Gain or improve knowledge and research capabilities,
- Improve facility operation, and
- Improve the performance of the work they are already engaged in.

Consider the following agency submission that describes how the Environmental Justice Student Video Challenge aligned with and advanced the Environmental Protection Agency's (EPA) mission. It is also an example of agencies working across the continuum of engagement, involving students and communities in local environmental justice issues and planting seeds of potential collaboration.

EPA: Environmental Justice Student Video Challenge

> ***EPA's mission is to protect human health and the environment,*** *and EPA's goal is to provide an environment where* ***all people enjoy the same degree of protection from environmental and health hazards*** *and* ***equal access to the decision-making process*** *to maintain a healthy environment in which to live, learn, and work. The* ***results from this challenge aim to enhance community capacity*** *including*

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[13] Because of the variation in responses and the variation in agency missions, responses were selected from 11 agencies (out of 19) that provided more detailed responses. This resulted in an analysis of 32 prize competition activity responses and 47 CCS activity responses. These higher-quality responses were selected and analyzed first for the relationship between PC&C or CCS activity and the agency and then for overarching trends on how activities can contribute to agency missions.

[14] For example, part of NOAA's mission is "to share … knowledge and information with others," which aligns especially well with citizen science activities. https://www.nesdis.noaa.gov/about/our-mission#:~:text=The%20National%20Oceanic%20and%20Atmospheric,as%20the%20Nation's%20authoritative%20environmental

increased knowledge about local environmental justice (EJ) issues and proposed strategies to address the EJ issues. It is the hope that this information will help communities to position themselves to better address the identified EJ issue thus **helping to protect their health and environment.**

On the other hand, agencies that use crowdsourcing and citizen science (CCS) reported using these activities to advance agency missions. These agencies indicated an alignment between activities and the mission of citizen science and crowdsourcing itself. Traditionally, CCS aims to encourage public engagement, participation, and collaboration in science activities. This was cited by some agency responses as a goal rather than connecting with the agency's mission, which in some cases did not include a public-facing outreach component. For instance, agencies used CCS to:

- Increase access to data or knowledge through education and outreach,
- Encourage public understanding of science, and
- Bring in citizen scientists to data collection efforts.

Moreover, agencies with a scientific or a research mission cited CCS activity as part of their research itself. Agencies that cited inclusion, access, and sharing of knowledge as part of their mission reported using CCS activities to expand inclusion and broaden participation in agency activities.

Below is a submission from the National Institutes of Health (NIH) describing the alignment between the agency mission and a research program that, through deep relationship building and consultation, is a comprehensive and representative group of communities across the nation.

NIH: "All of Us" Research Program

> *The mission of the NIH is to seek fundamental knowledge about the nature of living systems, and apply that knowledge to enhance health, lengthen life, and reduce illness. By establishing a* **diverse longitudinal cohort of one million or more people in the United States, All of Us will provide a valuable resource with health and lifestyle data from different communities and populations**. *This is designed to be one of the largest, most diverse and broadly accessible datasets of its kind ever assembled, to create opportunities for biomedical researchers to answer previously unanswerable scientific questions.*

Another submission noted is the National Oceanic and Atmospheric Administration's (NOAA) Cooperative Shark Tagging Program which is an example of sustained cooperation between recreational anglers, the commercial fishing industry, and NOAA Fisheries. The program's volunteers have contributed to conservation, management, and scientific understanding of Atlantic sharks since the program's inception in 1962. Not only does this align with the mission and goals of the agency, it expands its reach and capacity in ways that would otherwise be impossible.

NOAA: Cooperative Shark Tagging Program

> *The Cooperative Shark Tagging Program is the oldest citizen science program of NOAA Fisheries and has allowed us* **to collect large amounts of data we would not have had access to without extraordinary research costs** *due to the highly migratory nature of shark species crossing domestic and international boundaries. This program provides* **updates to essential fish habitat (EFH) designations** *for managed shark species and* **provided the data that formed the basis for the original EFH designations**. *Data from this program have also been used to define*

stock structure, document longevity, and validate age and growth in several shark species, all information essential for stock assessment and effective management to prevent overfishing and ensure sustainable fisheries under the Magnuson-Stevens Fishery Conservation and Management Act.

The results of PC&C activities contributed to furthering agency missions, whereas the engagement process of CCS activities contributed to agency missions more. All activities contribute to an agency mission in some way. Agencies with strong objectives on research, standards, inclusion, outreach, and diversity are able to leverage PC&C and CCS activities the most to advance their agency missions.

Benefits of PC&C and CCS

PC&C and CCS engage the public and broaden participation

PC&C and CCS benefit government agencies and the public in a variety of ways. Prize competition participants often receive a monetary prize as well as exposure and recognition, while still retaining the intellectual property rights to the innovation for the competition. Additionally, prizes and challenges have a reduced administrative burden compared to other funding mechanisms, and thus provide a more straightforward pathway to building relationships between the public and government agencies.

CCS have a long history in serving diverse communities, particularly those facing environmental harms and health disparities.[15] CCS have long been used by communities to focus agencies' and regulators' attention on trends and experiences missed by agency monitoring and data collection. When agencies are able to respectfully generate and leverage community-designed and community-sourced knowledge and data, it bolsters the community's voice and reach in decision-making processes.

For science agencies, these engagement avenues increase and bolster scientific outcomes by strengthening the rigor, relevance, and reach of the knowledge and data.[16] Deeper engagement with communities is crucial for success, particularly when agencies are searching or enacting high-stakes or long-term solutions.[17] PC&C and CCS can nurture dialogue and collaboration that provides insights into the culture and context in which an agency solution or approach will exist in. Listening to communities and facilitating their input can result in an increased uptake of solutions, information, and results.[18] For science agencies, engagement builds pathways through which to better align their scientific priorities and be responsive to the communities they serve and increases the likelihood that the results are responsive to local needs. This has the potential to result in a more equitable distribution of outcomes

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[15] Hecker, Susanne, et al. "Innovation in open science, society and policy–setting the agenda for citizen science." *Citizen Science: Innovation in open science, society and policy* (2018): 1-23.

[16] Balazs, Carolina L., and Rachel Morello-Frosch. "The three Rs: How community-based participatory research strengthens the rigor, relevance, and reach of science." Environmental justice 6.1 (2013): 9-16.

[17] Gilman, Hollie Russon, Archon Fung, and Mark Schmitt. 2021. "Designing for Community Engagement: Toward More Equitable Civic Participation in the Federal Regulatory Process."

[18] O'Mara-Eves, et al. (2015). "The effectiveness of community engagement in public health interventions for disadvantaged groups: a meta-analysis," BMC Public Health 15(1). https://doi.org/10.1186/s12889-015-1352-y; L.R. Kaplan, et al. (2021). "Designing participatory technology assessments: A reflexive method for advancing the public role in science policy decision-making." Technological Forecasting and Social Change, 171, 120974. https://doi.org/10.1016/j.techfore.2021.120974; Aguilar-Gaxiola, S., et al. (2022). "Assessing Meaningful Community Engagement: A Conceptual Model to Advance Health Equity through Transformed Systems for Health," NAM Perspectives, 22(2). https://doi.org/10.31478/202202c7

from federally funded science. Additionally, a closer relationship between agencies and communities could mitigate against undesirable societal outcomes. Finally, engagement increases access to scientific processes, knowledge, and data, which in turn can broaden participation in science, technology, engineering, and mathematics (STEM) experiences, education, and workforce.

Appreciating these benefits is important given the increasing reach and engagement of these methods. Community participation in crowdsourcing and federal PC&C and CCS activities together have engaged thousands of participants (Figure 5). Based on the survey responses in FY21–22, the median number of participants in a PC&C activity was 33, with a maximum of almost 14,000 participants. The median CCS activity included a comparatively larger number of participants than PC&C, 146, with a maximum of over half a million participants.

Box 1. NOAA: The Hudson River Eel Project

2023 Hudson River Eel Project citizen scientists

Eel Project website:
https://hrnerr.org/eel-monitoring/

The Hudson River Eel Project is an example of citizen science that engages the public and broadens participation in species conservation and management is the Hudson River Eel Project. Once a year, juvenile American eels (*Anguilla rostrata*) migrate from spawning grounds in the Atlantic Ocean to East Coast estuaries to grow and mature. However, the challenges to American eels—including over-harvesting, barriers to habitat, and a negative perception from the public—pose a growing threat to eel populations. The New York State Department of Environmental Conservation Hudson River Estuary Program and National Estuarine Research Reserve aim to combat these threats through the Hudson River Eel Project. Since 2008, estuary staff have collaborated with a community of high school students, teachers, and other volunteers to collect annual migration data on juvenile eels, release eels above barriers like dams, and cultivate a positive public perception of eels. Each spring, up to 1,000 volunteers (trained on Atlantic State Marine Fisheries Commission (ASMFC) protocols) check nets placed in the river daily to count the transparent "glass eels" and release them above barriers. Participants have caught, counted, and released nearly two million juvenile eels to date. Because of the geographic diversity of eel migration patterns—eels travel through almost all waterways, from city creeks to rural brooks—the Project performed outreach and engagement to many local communities, including underserved groups from community after-school programs, urban farming organizations, and emerging student researchers. Data collected by volunteers was submitted for the 2022 ASMFC American Eel Stock Assessment.
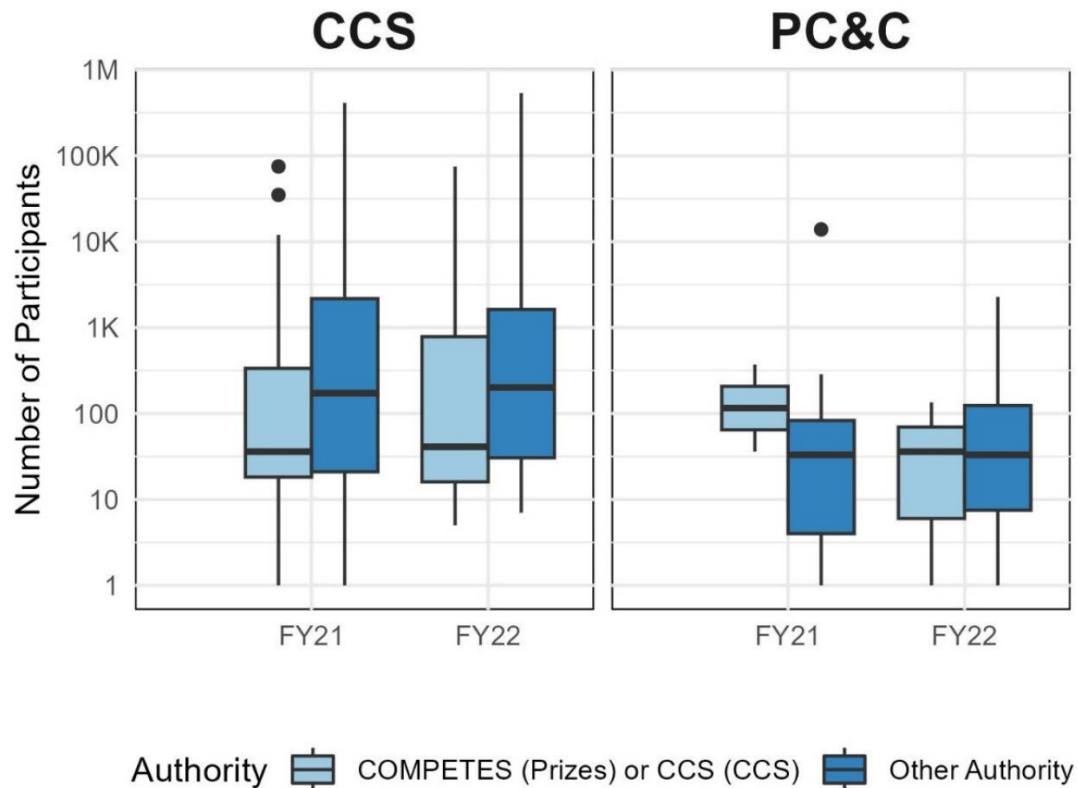
Figure 5. Distribution of the Number of Participants per PC&C or CCS Activity by Authority Type FY21-22.[19]

In this year's survey, agencies were asked to provide insight on the communities they reach with these engagement approaches. Specifically, agencies were asked how CCS and PC&C activities have advanced agency objectives related to diversity, equity, inclusion, and accessibility (DEIA). The Biden-Harris Administration has defined the importance of diverse community participation in *Executive Order 14305 on Diversity, Equity, Inclusion and Accessibility,* where agencies were required to develop strategic plans for DEIA.[20] Thus, all agencies have DEIA strategic objectives. Two survey questions were posed and analyzed:

- For programs that indicated they made a specific effort to engage certain group(s), they were asked to "describe the effort(s) [they] made to engage these group(s)," and

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[19] Figure 5 presents the number of participants using a boxplot, displaying the distribution of participants graphically. The thick bar in the middle represents the median, the lower edge of the shaded region represents the first quartile, the upper edge of the shaded region represents the third quartile, while the lines extending from the bottom and top of the shaded region represent the minimum and maximum (excluding outliers), respectively. Dots shown above the lines extending from the shaded regions represent outliers. The number of participants on the Y-axis is presented on a log scale.

[20] Exec. Order No. 14305. 2021, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/06/25/executive-order-on-diversity-equity-inclusion-and-accessibility-in-the-federal-workforce/.

- For the Prizes survey, they were also asked if their activity "was designed to advance diversity, equity, inclusion, and accessibility" and to "describe specific ways in which it accomplished this."

For the first question, 174 of 251 PC&C activities and 81 of 82 of CCS activities indicated that they undertook specific efforts to engage certain group(s) of people. Of the 174 responses for the Prizes survey, 54 activities specified the group they engaged; whereas 43 of the 81 activities specified the group for the CCS survey. Figure 6 provides a breakdown of the characteristics of the groups that the activities sought to engage. Responders were allowed to select more than one group. As a result, the counts represented in Figure 6 reflect the total number of selected groups responders chose.
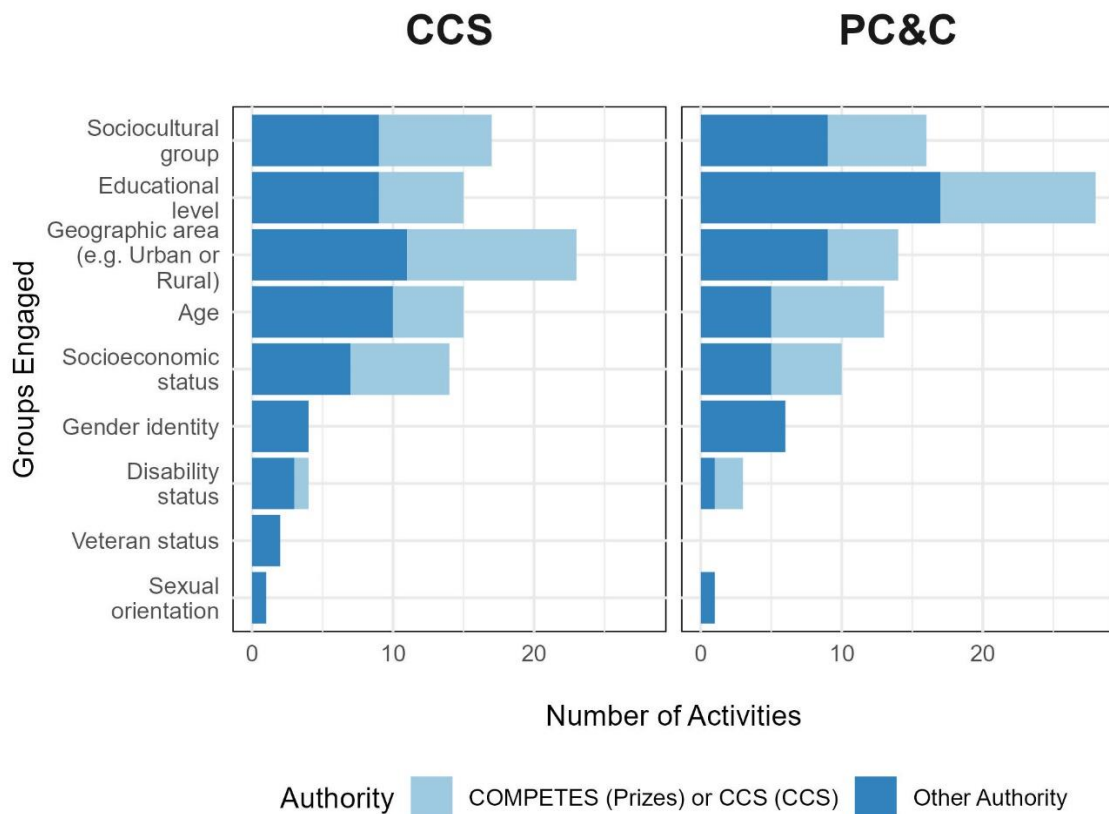

Figure 6. Number of Activities Engaging Different Groups by Group Type FY21-22

As a follow-up question, agencies were asked to describe "*how* [they] engaged participants." Because this was a voluntary question, 52 activities from the Prizes survey and 40 activities from the CCS survey included a response to this question. There was large variation in both the content and the length of the responses.[21] The engagement methods mentioned by the agencies varied from partnerships, to hosting information sessions, to increasing accessibility of training materials. Given the varied nature and small number of responses, the responses were categorized using a deductive coding scheme,

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[21] Answer lengths varied from 6 words to 250 words.

detailed in Table 1.[22] The count of the coded categories[23] suggests that PC&C activities employed digital engagement strategies much more than CCS activities, which relied more on direct engagement strategies and increasing accessibility. Both digital and direct engagement, as seen by the subcategories, are examples of agencies reaching out to the public, establishing communication channels that then can be leveraged for consultation and deeper involvement.

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[22] Responses were coded for all possible engagement categories. As a result, the counts represented in Table 1 reflect the total number of engagement categories identified across all responses.

[23] All survey responses were classified into certain categories. Category development was based on all responses.

Table 1. Categories of Engagement Methods

Categories	Subcategories	PC&C Survey	CCS Survey
Partnerships	-	6	12
Digital Engagement	Email lists	-	11
	Webinars	2	1
	Social Media	1	8
Direct Engagement	Meeting with community groups	3	3
	Outreach to community groups	7	3
	Work with schools	2	4
Accessibility and education efforts	Translation	5	-
	Create curriculum	3	-
Provide resources to communities	Offer funds to groups in need	1	-
Community advertisements (includes signage posting in community areas, community publications, and community events attendance)		2	-

Below are excerpts from the survey of CCS and PC&C activities illustrating how Federal agencies engage communities through the range of approaches and methods:

> *We attended two local festivals and engaged the public in an informal science activity that evaluated water quality based on visual observations.*

> *We recruited citizen scientists to the project using an outreach video and through advertisement in Grand Canyon rafting publications.*

> *[T]eams were required to demonstrate active engagement with representatives from the disability community. Among other criteria, submissions were evaluated on their potential impact and benefit to people with disabilities.*

Agencies that reported using Prize competitions were additionally asked to describe *how* their activities advanced DEIA objectives. Responses to this question were also voluntary, with 76 of 256 Prize activities providing responses that could be analyzed.

Analysis of agency responses were categorized under two types of responses:
- By increasing participant diversity in STEM and/or the federal STEM landscape through inclusivity and accessibility efforts, or
- By addressing social inequality, including environmental, energy, gender, health and other inequities, etc.

50 responses from 12 unique agencies were coded as increasing participant diversity. Some examples of these efforts include:

This prize was specifically open for applicants that had not received DOE [Department of Energy] funding from [the Hydrogen and Fuel Cell Technologies Office] in the past and the prize submission requirements were less burdensome than traditional funding mechanisms. This prize was intended to be more accessible to small business and university applicants.

[Just Energy Transition (JET)] Minerals Challenge was designed to advance diversity, equity, inclusion, and accessibility by lowering barriers to entry to work with USAID and our partners… The JET Minerals Challenge additionally has two phases, with the first phase only requesting a 4-page concept note to apply, which we hope, in combination with our strategic communications, will reduce barriers to entry and encourage local organizations to participate.

26 responses from 10 separate agencies were coded as addressing social inequities. An example of a response addressing health inequities is:

The intent of this challenge is to recognize individuals and organizations or community coalitions associated with the [Regional Education Assessment Crisis Habilitation (REACH)] program that meaningfully assisted with and carried out culturally tailored interventions that advance health equity, reduce health disparities, and increase community engagement to address preventable risk factors in populations or groups disproportionately affected by chronic disease; specifically, African American/Black, American Indian or Alaska Native, Asian, Hispanic or Latino, and Native Hawaiian or other Pacific Islander persons.

Federal agencies also highlighted their partnerships with Minority-Serving Institutions (MSIs), especially Historically Black Colleges and Universities (HBCUs) as part of this question. They noted that growing relationships with MSIs and HBCUs is a successful method to diversify participation in the federal S&T landscape.

Agencies that reported on CCS activities did not have an equivalent question directly asking how they advanced DEIA. Nevertheless, 11 responses made a connection between the activity and advancing environmental justice and working with communities to address environmental injustices. For example, EPA's New England Stormwater Toolbox Equipment Loan Program asked recipients to share the announcement about the program "with any new or existing water monitoring group, with an emphasis on sharing with groups in communities with Environmental Justice concerns."

Overall, PC&C and CCS activities help advance DEIA objectives of agencies by reaching populations that are not otherwise engaged in the federal landscape and thus diversifying the science and technology innovation ecosystem.

Box 2. NOAA: Urban Heat Island Mapping Campaign

Community volunteers interpreting results of heat mapping data collection.

Engagement with and participation of all communities is essential to democratizing the benefits science and data. For instance, the burden of heat is distributed unevenly in cities due to the urban heat island effect. This effect often occurs in built-up areas where cooling natural infrastructure like trees are replaced by heat absorbing materials. Low-income neighborhoods often disproportionately confront this burden and the resulting increased risks of heat stroke and higher air conditioning costs. To understand and address these issues, the National Integrated Heat Health Information System, in partnership with the NOAA Office of Education and Climate Program Office, conducts participatory science Urban Heat Island Mapping Campaigns in communities across the country every year. The campaigns empower residents to measure temperature and heat index on their own for use in city sustainability plans, public health practices, urban forestry, and other projects. Volunteers from over 70 communities across the United States have collaboratively planned and conducted these campaigns, and applied the resulting maps and data to make a difference. Community leaders and decision-makers work across sectors and with disadvantaged communities to identify and implement equitable cooling solutions, providing relief for the hottest neighborhoods.

PC&C and CCS strengthen innovation

The innovation ecosystem is an important catalyst and engine for science, and in turn, the economy. More and better community engagement in government and science has the potential to expand the circle of innovators.[24] Building avenues to bring in a greater diversity of perspectives, voices, and priorities strengthens the innovation pipeline. This is particularly important for supporting increased participation of communities that have historically been excluded from the process of innovation. Technology development is more likely to be shaped by the needs of a diverse user base if it incorporates feedback from a wider segment of the American public. This increased input also improves and enhances the targeted dissemination of opportunities and products resulting from innovation. More engagement increases participation from a broader range of communities in the process of innovation and in doing so expands what is considered innovation, who innovates, and for whom innovation benefits.

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[24] Block, Fred L., and Matthew R. Keller. *State of innovation: the US government's role in technology development*. Routledge, 2015;
Lightbody, Ruth. 'Hard to reach' or 'easy to ignore'? Promoting equality in community engagement." (2017).
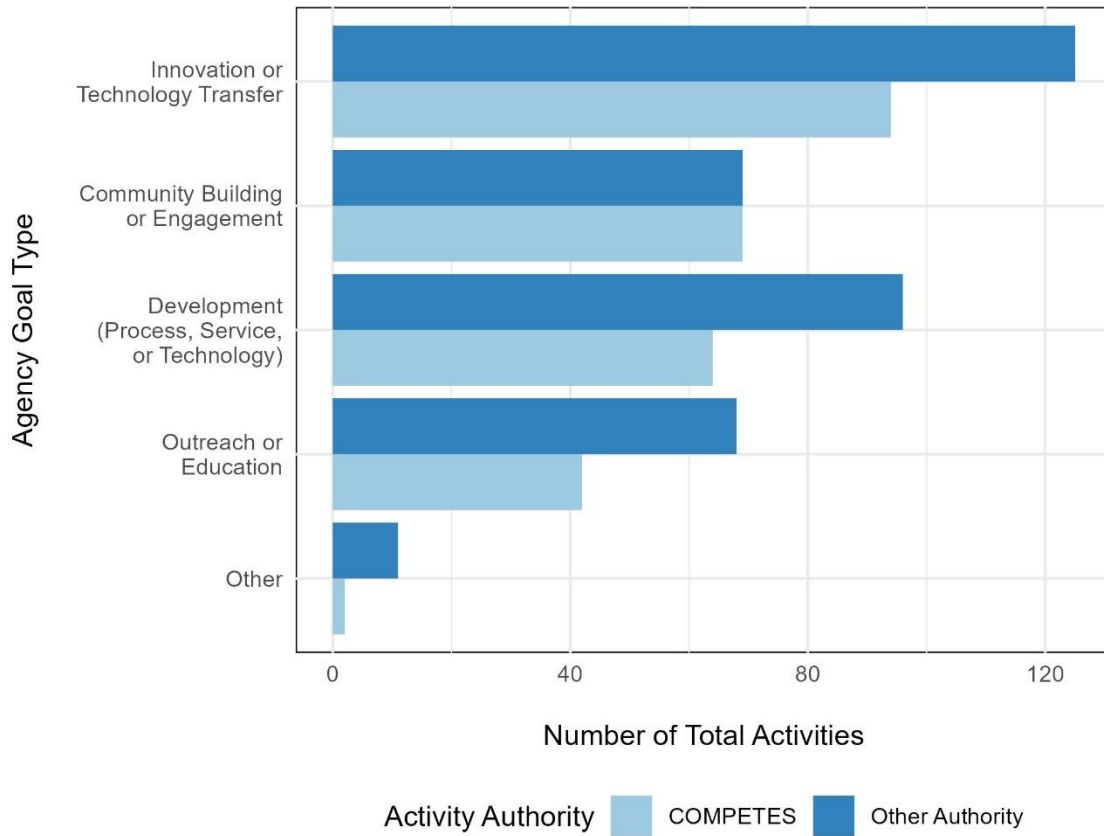
Figure 7. The Number of PC&C Reporting Each Goal Type by Fiscal Year in FY21-22.

The survey responses echoed that PC&C and CCS activities are critical to strengthening innovation. For PC&C, 95 agency survey responses under the COMPETES authority and 124 survey responses for activities under other authorities cited innovation or technology transfer as a major goal of the activity (Figure 7).
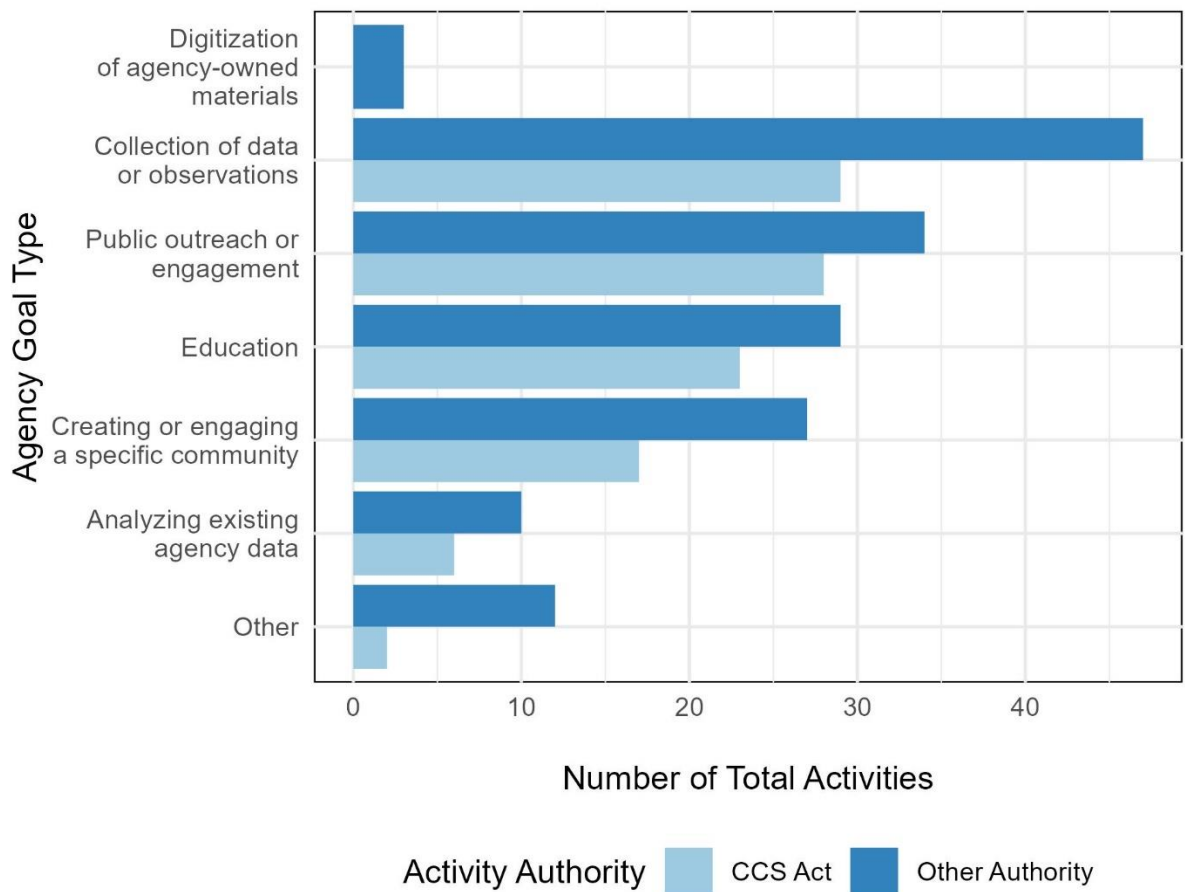
Figure 8. The Number of CCS Activities Reporting Each Goal Type in FY21-22.

On the other hand, CCS survey responses cited collection of data or observations as a major goal (Figure 8).[25] Public outreach or engagement was also reported as a substantial goal of activities reporting this goal in FY21 and FY22, demonstrating the importance of CCS activities in engaging with the public to fuel innovation.

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[25] 29 activities reporting under the CCS Act responded that data or observations was a major goal for the activity, and 47 of activities reporting under other authorities cited the same goal.

Box 3. DOE: Energy Program for Innovation Clusters (EPIC) Prize Round 2

Prize competitions and challenges have a storied history, strengthening innovation in areas and sectors where it is needed most. DOE's Office of Technology Transitions (OTT) launched the American-Made EPIC Prize Round 2 in FY2022. OTT developed EPIC to encourage robust growth of regional energy innovation ecosystems across the United States. Innovation ecosystems, or clusters, increase the productivity of start-ups, drive the direction and pace of innovation, and stimulate the formation of new businesses, further reinforcing the cluster itself. Providing capital to enable creative, forward-thinking organizations is critical to allow these groups to think more expansively about the role of incubators in the broader regional innovation and entrepreneurial ecosystem.

2023 EPIC Pitch Competition winners, other competitors, and event organizers alongside Secretary of Energy Jennifer M. Granholm and Officer and Director of OTT Dr. Vanessa Z. Chan on the stage in New Orleans, Louisiana. Photo by Leo Boczar

The $4.5 million competition awarded cash prizes to regional incubators that implement high-impact ideas to support energy start-ups and entrepreneurs. Core to the EPIC Prize Round 2 is the incubator program, which consists of three phases: (1) design a plan to support energy start-ups and entrepreneurs, (2) implement the innovative, place-based plan, and (3) demonstrate success. OTT partnered with other DOE program offices to provide Bonus Prizes for incubators supporting a specific technology area. The program also included two national pitch competitions, in which EPIC incubators nominated energy start-ups for a chance to win over $350,000.

All EPIC competitors must address the program requirements to create new programming, support start-up creation, build regional partnerships, and support at least one of the following: diversity, equity, and inclusion; rural and disadvantaged communities; lab-to-market; sector-specific support; or another high-impact theme. For competitors addressing DEIA and rural and disadvantaged communities, they must propose solutions that find and support underrepresented or under-supported entrepreneurs and help start-ups recruit, hire, and retain employees from underrepresented backgrounds. Competitors are asked to clearly illustrate how their proposed program advances diversity, equity, and inclusion principles, including any context particular to their region. EPIC Prize Round 2 places emphasis on both energy innovation and its intersections with DEIA. These goals align with Administration priorities of advancing American economic competitiveness with innovation that represents diverse approaches and voices. The EPIC model was designed in a flexible way so others who want to work with incubators could adapt it. An example of this is the Direct Air Capture (DAC) Pre-Commercial EPIC Prize, which awards up to $3.7 million in cash prizes to incubator teams that submit creative and impactful plans to support entrepreneurs and innovators in the DAC space and create meaningful community engagement.

PC&C and CCS further agency mission and goals

Federal agencies rely on PC&C and CCS activities to bolster a wide range of agency goals. From pursuing cost-effective project strategies to seeking out the most innovative talent, these activities play an important role in furthering agencies' missions. Agencies have used PC&C and CCS activities to identify new innovators, develop solutions in quicker timeframes, share knowledge with the public, pursue responsible use of fiscal resources, analyze data, and more. Overall, agencies have sought PC&C and CCS to go beyond what is possible within their constraints, opening avenues for new ideas, collaborations, or resources.

To gain insight as to how PC&C and CCS factor into agency goals during FY21–22 and thus provide "justification" for the use of PC&C and CCS, the survey asked agencies to "explain why (Prizes/CCS) were chosen to achieve the intended goals." This question was mandatory and resulted in 251 responses for PC&C activities and 82 responses for CCS activities. The PC&C survey question was categorical and the list of categories can be found in Figure 9. The CCS survey question was an open text response that was coded using the following four categories:

- Cost-effective approach given the lack of agency resources,
- Opportunity to involve the public,
- Opportunity to reach out to the public, and
- Opportunity to leverage diverse expertise or interdisciplinary collaboration.

Most CCS activity responses aligned with these categories, though there were three responses that did not (Figure 10). Responses that were not coded in the following categories included:

CCS presents an opportunity to quickly reach target audiences; prior success with CCS justified its continued use; or to address a funding concern related to other federal grants. These categories were not mutually exclusive, and therefore a given agency could chose multiple justifications.

PC&C and CCS differed in their justifications in a number of ways. PC&C activities were generally justified through a desire to seek out diverse and/or innovative solutions or identify new collaborators. Figure 10 describes the variety of justifications for the use of CCS. Because the COMPETES authority had a particular focus on innovation, Figure 9 separates out the PC&C activities under the COMPETES authority and other authorities.
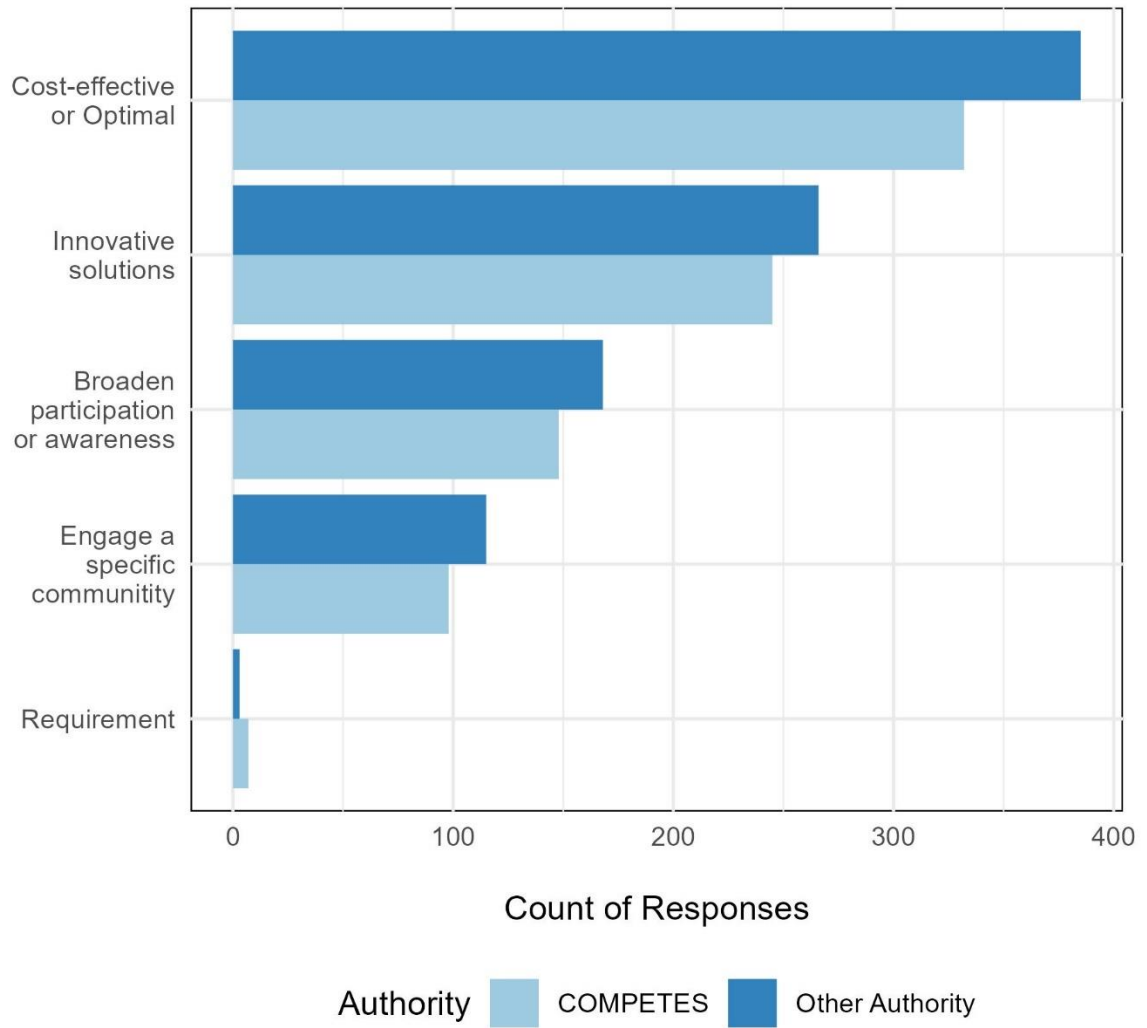
Figure 9. The Number of PC&C Activities Reporting Each Justification Type in FY21-22

In contrast, CCS activities were primarily used due to their cost-effective nature to accomplish the tasks such as data collection. Over half (46 of 82) of the CCS activity responses highlighted the cost-effective approach as part of their justification for conducting citizen science activities (Figure 10).
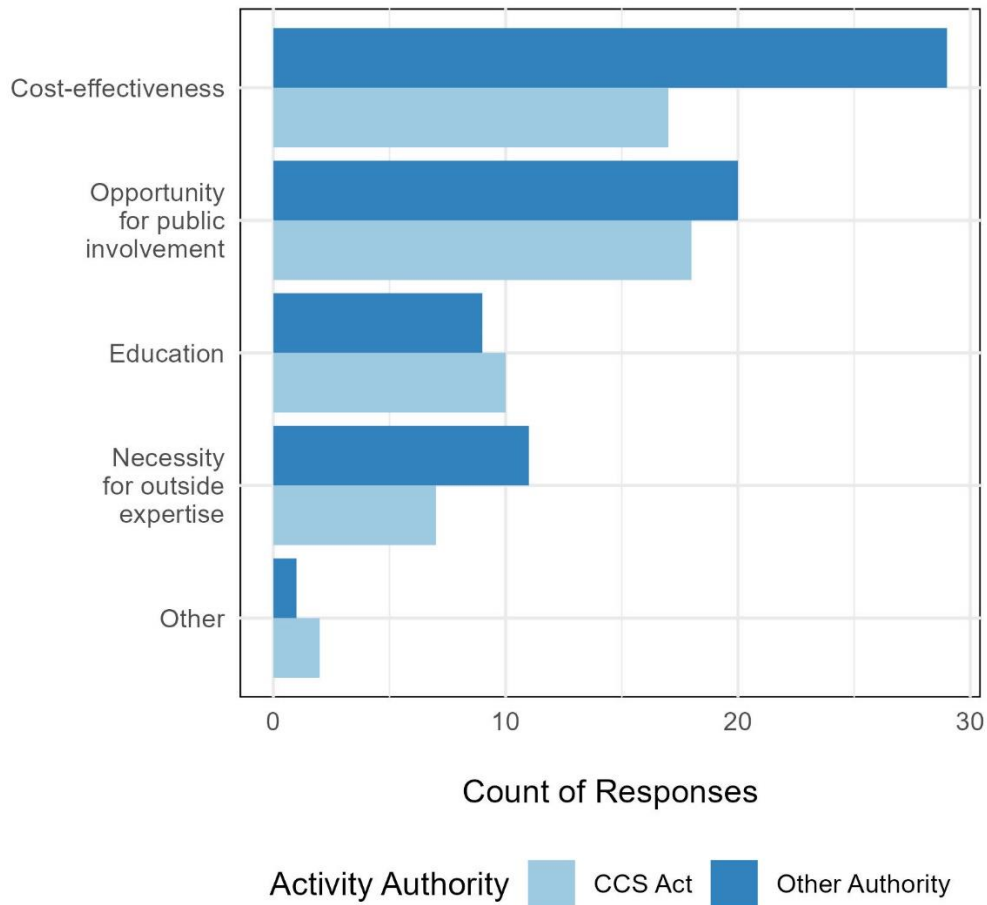
Figure 10. The Number of CCS Activities Reporting Each Justifications Type in FY21-22

To illustrate the varied nature of the justification given by agencies to use CCS, and to highlight how agencies contextualize these activities as furthering their mission and goals, below are excerpts from responses provided.

Cost-effective approach/Lack of resources:

[NOAA: FISHstory (South Atlantic Fishery Management Council](#)

> *Analyzing photos can be labor intensive and time consuming. The FISHstory pilot project archived over 1,300 historic fishing photos. …. Due to the large number of photos, the FISHstory team turned to CCS and built an online crowdsourcing project in the Zooniverse platform where volunteers help classify photos. The crowdsourcing approach is being used to make the photo analysis more efficient and cost-effective.*

Opportunity for public involvement

[FEMA: Geospatial Damage Assessments](#)

In the aftermath of a disaster, many people want to help in any way they can. This activity, including the training, provides a mechanism for people to provide support to disaster survivors without deploying to dangerous impact zones.

Opportunity to educate and collaborate with the public

NOAA: Urban Heat Island Mapping Campaign

What makes the National Integrated Heat Health Information System Urban Heat Island (NIHHIS UHI) campaign unique is that [it] is a citizen science community project that relies on volunteers and organizers from each city or county to collect the temperature data, which leads to education about heat and health, as well as a deeper understanding of how heat is impacting their community. The mapping campaign is conducted by the residents of these neighborhoods who are collecting temperature and humidity data, learning about heat and health, and they are invested in not only seeing the results but taking actions based on those results.

Opportunity to leverage diverse expertise or interdisciplinary collaboration.

National Park Service (NPS): Increasing Community Resilience for Watershed Urbanization

This project seeks to leverage a community-level and interdisciplinary approach to water quality monitoring informed by local decision-makers, resource users, community members, and scientists. The project aims to incorporate generational knowledge acquired over the last 400 years through the local African American experience to develop local framing and understanding of complex scientific perspectives. This approach allows for better knowledge of how urbanization and water pollution impact local surface waters than can be achieved by park staff alone.

Agencies justified PC&C and CCS activities in a variety of ways. CCS activities focused on four fundamental issues of cost-effectiveness, public involvement, community education, and needing diverse expertise. PC&C and CCS activities provide agencies a pathway to engage the public while overcoming certain resource barriers.

Box 4. USGS: Did You Feel It? (DYFI)

USGS DYFI Annual Data Viewer tool. Images taken from the USGS ArcGIS website.
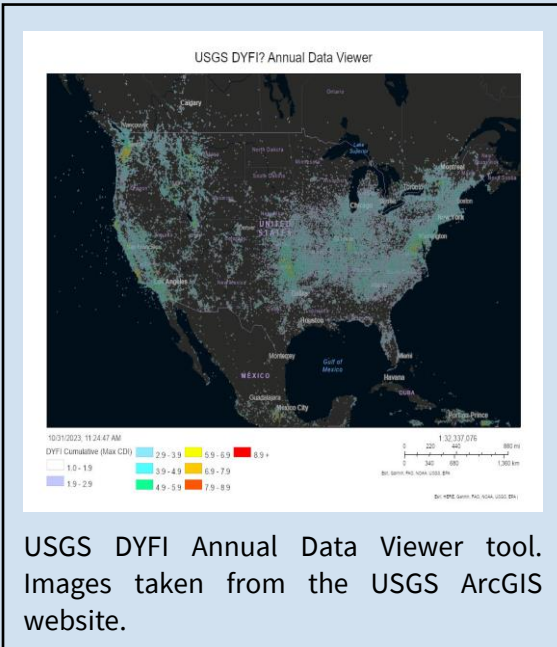
USGS's Did You Feel It? (DYFI) program demonstrates how citizen science can further an agency's mission and goals. DYFI was initiated in 1999 to collect near real-time, post-event data from people who just experienced earthquakes through an online questionnaire to supplement instrumental readings from seismometers. Before the advent of the internet, the initial version of DYFI used postcards sent to local postmasters, police, and other officials in the United States after an earthquake in the affected area to capture direct human experiences of earthquakes that would complement instrumental data. DYFI was based on the collection of felt reports through postcards sent by the U.S. Weather Bureau between 1884 to 1924. The shift from physical postcards to an online questionnaire enabled a more expansive and rapid collection of earthquake experiences around the world automatically geolocated. The DYFI questionnaire asks participants to answer multiple choice questions ranging from whether they were indoors or outdoors, if they noticed hanging objects swinging, and if there was any noticeable damage to structures or objects. These responses are designed to be easily translatable into a numerical format associated with shaking intensity values on the Modified Mercalli Intensity (MMI) scale and then geographically plotted based on the zip code locations provided by the respondents to more easily integrate with other earthquake measurements from seismographs and products like ShakeMap. The contributions from volunteers play a crucial role in refining earthquake intensity maps, informing emergency response in real-time, and improving the accuracy and comprehensiveness of seismic hazard assessments. Over the course of the operational DYFI system, USGS has received more than 6.7 million responses, with typically over 300,000 individual responses per year. The greatest number of responses was over 140,000 in 2011 for the 5.9 magnitude earthquake in Mineral, VA.

Conclusion

Federal PC&C and CCS activities have demonstrated mutual benefits for both federal agencies and the American public. These mechanisms engage the collective intelligence, creativity, and expertise of the American public to address intricate problems, facilitating the public's active involvement and relationship building. They can be two-way bridges that broaden the access to scientific research, and government more broadly. Federal agencies benefit from the increased access to cost-effective problem-solving, accelerated innovation, and enhanced public engagement that PC&C and CCS provide.

Public participants can benefit in multiple ways, from receiving awards for their innovations, contributing to knowledge about their environment and communities, and strengthening their connection with the science and technology initiatives of the federal government. As this survey shows, PC&C and CCS can also enhance public participation in science and government by involving specific social or cultural groups often excluded from the dynamic federal landscape. The PC&C and CCS mechanisms contribute to establishing a culture of open dialogue, shared responsibility, and collective problem-solving, contributing to national resilience. As illustrated by the continuum of engagement shared in this report, these mechanisms are just one of many that could deepen connections between the federal government and the communities it aims to serve. Not only are these programs driving and accelerating innovation, they also positively transform how communities engage and participate in the federal scientific ecosystem, and government as a whole. The sustained promotion and support and of these initiatives is crucial to the well-being of the relationship between the government and the public, fostering a more inclusive and effective governance model.