Implementation of Federal Prize Authority: Fiscal Year 2015 Progress Report

A Report from the
Office of Science and Technology Policy

In Response to the Requirements of the
America COMPETES Reauthorization Act of 2010

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DEPARTMENT, AGENCY, OFFICE, AND DIVISION ABBREVIATIONS

ASA	Office of the HHS Assistant Secretary for Administration (part of HHS)
CDC	Centers for Disease Control and Prevention (part of HHS)
CNCS	Corporation for National and Community Service
CPSC	Consumer Product Safety Commission
CTTSO	Combating Terrorism Technical Support Office (part of DOD)
DARPA	Defense Advanced Research Projects Agency (part of DOD)
DHS	Department of Homeland Security
DOC	Department of Commerce
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DTRA	Defense Threats Reduction Agency (part of DOD)
EDA	Economic Development Administration (part of DOC)
Education	Department of Education
EPA	Environmental Protection Agency
EERE	Office of Energy Efficiency and Renewable Energy (part of DOE)
FDA	Food and Drug Administration (part of HHS)
FMC	Federal Maritime Commission
FTC	Federal Trade Commission
GSA	General Services Administration
HHS	Department of Health and Human Services
HRSA	Health Resources and Services Administration (part of HHS)

HUD	Department of Housing and Urban Development
IARPA	Intelligence Advanced Research Projects Activity
NASA	National Aeronautics and Space Administration
NIC	National Institute of Corrections
NIEHS	National Institute of Environmental Health Sciences (part of NIH in HHS)
NIH	National Institutes of Health (part of HHS)
NIST	National Institute of Standards and Technology (part of DOC)
NIJ	National Institute of Justice (part of DOJ)
NNCO	National Nanotechnology Coordination Office
NNI	National Nanotechnology Initiative (coordinated out of NNCO)
NOAA	National Oceanic and Atmospheric Administration (part of DOC)
NSA	National Security Agency
NSF	National Science Foundation
OMB	Office of Management and Budget (part of the Executive Office of the President)
ONC	Office of the National Coordinator for Health Information Technology (part of HHS)
OSTP	Office of Science and Technology Policy (part of the Executive Office of the President)
SAMHSA	Substance Abuse and Mental Health Services Administration (part of HHS)
SBA	Small Business Administration
TSA	Transportation Security Administration (part of DHS)
USAID	United States Agency for International Development
USBR	United States Bureau of Reclamation (part of DOI)
USDA	Department of Agriculture
USFWS	United States Fish and Wildlife Service (part of DOI)
USGS	United States Geological Survey (part of DOI)
USSOCOM	United States Special Operations Command
VA	Department of Veterans Affairs

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EXECUTIVE SUMMARY

This report is being provided by the Office of Science and Technology Policy (OSTP) to the Senate Committee on Commerce, Science, and Transportation and the House Committee on Science, Space, and Technology under the requirements of the America COMPETES Reauthorization Act of 2010.

On January 4, 2011, President Obama signed into the law the America COMPETES Reauthorization Act of 2010 (COMPETES). Section 105 of COMPETES added Section 24 (Prize Competitions) to the Stevenson-Wydler Technology Innovation Act of 1980 (Stevenson-Wydler), granting all agencies broad authority to conduct prize competitions to spur innovation, solve tough problems, and advance their core missions.

The authority to conduct prize competitions provided in COMPETES has led to significant new efforts, applying prize competitions and challenges to national priority areas including energy, space exploration, health, cybersecurity, and infrastructure. Since its creation, 134 prize competitions have been offered through the authority provided by COMPETES by 35 agencies. In FY 2015, 47 prize competitions were conducted under COMPETES authority, as well as 69 challenges conducted using authorities other than COMPETES. By June 2016, Challenge.gov had featured more than 700 prize competitions and challenges—conducted under the authority provided by COMPETES and other authorities—from over 100 Federal agencies, departments, and bureaus.

Prize competitions and challenges have an established record of spurring innovation in the private and philanthropic sectors. This report details examples of how well-designed prize competitions and challenges, integrated into a broader innovation strategy, have enabled Federal agencies to:
- Pay only for success and establish an ambitious goal without having to predict which team or approach is most likely to succeed;
- Reach beyond the "usual suspects" to increase the number of solvers tackling a problem and to identify novel approaches, without bearing high levels of risk;
- Bring out-of-discipline perspectives to bear;
- Increase cost-effectiveness to maximize the return on taxpayer dollars; and
- Establish clear success metrics and validation protocols that themselves become defining tools and standards for the subject industry or field.

The Obama Administration has taken important steps to make prize competitions and challenges a standard tool in every agency's innovation toolbox. The *Strategy for American Innovation*[1]— first issued in 2009 and most recently updated in October 2015—recognizes the potential for prizes to mobilize America's ingenuity to solve some of the Nation's most pressing challenges. Among numerous other forms of support to agencies, in March 2010, the Office of Management and Budget (OMB) issued a formal policy framework[2] to guide agency leaders in using prize

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[1] https://www.whitehouse.gov/sites/default/files/strategy_for_american_innovation_october_2015.pdf
[2] http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-11.pdf

competitions and challenges to advance their core missions; and in September 2010, the Administration launched Challenge.gov[3], a one-stop shop where entrepreneurs and citizen-solvers can find public-sector prize competitions and challenges.

The prize authority provided by COMPETES supports this Administration effort. By giving agencies a clear legal path, the legislation has made it dramatically easier for agencies to use prize competitions, subject to the availability of appropriations or other allowed sources of funds. Policy and legal staff in OSTP and OMB jointly developed a Fact Sheet and Frequently Asked Questions memorandum[4], issued in August 2011, which provides guidance to assist with implementation of the government-wide prize authority. The legislation has enabled agencies to pursue more ambitious prize competitions with robust incentives, and has inspired the use of other authorities to operate prize competitions and challenges. For example, during the fifth year since the COMPETES Act was signed into law, the Department of Health and Human Services (HHS) continued its use of the authority to stimulate, solicit, and implement effective solutions to problems large and small. In FY 2015, HHS designed and administered complex prizes and challenges; used bigger cash incentives than in prior years; established partnerships within and outside the Federal Government; and used prizes to tackle ambitious and critical problems. HHS completed a total of 18 competitions[5] and launched additional competitions during FY 2015, totaling $2.1 million in cash incentives and more than doubling the total number of HHS competitions conducted in FY 2014.

Some agencies, such as the National Aeronautics and Space Administration (NASA), HHS, the Environmental Protection Agency (EPA), the United States Department of Agriculture (USDA), the Department of Homeland Security (DHS), the National Institute of Standards and Technology (NIST), and the United States Agency for International Development (USAID), have established specific strategies and policies related to prize competitions and challenges, and dedicated personnel to lead prize competition and challenge design and administration efforts at their agencies, providing internal support to program managers interested in making use of prize competitions and challenges.

Twenty-three agencies offered prizes in FY 2015 enabled by the prize authority provided by COMPETES—including the Corporation for National and Community Service (CNCS), the Consumer Product Safety Commission (CPSC), the Defense Advanced Research Projects Agency (DARPA), USDA, the Department of Energy (DOE), DHS, the Department of Housing and Urban Development (HUD), the Federal Maritime Commission (FMC), the Federal Trade Commission (FTC), the General Services Administration (GSA), the National Institute of Corrections (NIC), NIST, the National Oceanic and Atmospheric Administration (NOAA), Office of Management and Budget (OMB), the Small Business Administration (SBA), the U.S. Bureau of Reclamation (USBR), and seven component agencies of HHS. Eight of these agencies

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[3] http://www.challenge.gov/

[4] https://cio.gov/wp-content/uploads/downloads/2012/09/Prize_Authority_in_the_America_COMPETES_Reauthorization_Act.pdf

[5] Thirteen of the18 competitions completed by HHS leverage the COMPETES Act Authority.

offered prizes under COMPETES authority for the first time, including CNCS, NIST, NOAA, USDA, DHS, USBR, FMC, and OMB.

As agencies expand their use of the prize authority provided to them under COMPETES, some agencies—including HHS, DOE, the Department of Defense (DOD), EPA, NASA, DHS, Department of Interior (DOI), and USDA—have continued to administer prize competitions and challenges developed under other pre-existing authorities, including agency-specific authorities, grant-making authority, and procurement authority, adding additional lessons learned and best practices regarding the use of prize competitions and challenges.

Comparing the 116 prize competitions and challenges conducted in FY 2015 under all authorities with previous years' reports shows several trends in public-sector prizes:
- Increased ambition and sophistication of prize designs enabled by partnerships;
- New models for engaging the public during competitions;
- Applying prizes as one tool in a broader portfolio of actions within a program;
- Conducting series of challenges to build momentum for specific issue; and
- Commercialization of solutions found through prizes to address market failures.

A review of the 47 prize competitions conducted under COMPETES in FY 2015 shows that agencies continue to leverage this new authority to conduct their first prize competitions and increase the ambition of their prize-competition efforts. This report indicates that this authority will continue to help agencies across the Federal Government reap the benefits of high-impact prize competitions and challenges.

INTRODUCTION

From the 1714 Longitude Prize that led to the world's first practical method to determine a ship's longitude, to the Orteig Prize that inspired Charles Lindbergh to fly nonstop from New York to Paris, to the 2011 Oil Cleanup X Challenge[6] that rewarded a company from Illinois for demonstrating more than four times the previous best tested recovery rate for cleaning oil from the ocean's surface, prizes have an established record of spurring innovation. A 2009 McKinsey report found that philanthropic and private-sector investment in prizes had increased significantly between 2000 and 2007.[7]

Inspired by the success of philanthropic and private-sector prizes, the Obama Administration has taken important steps to accelerate public-sector adoption of these innovative tools. By June 2016, Challenge.gov had featured more than 700 prize competitions and challenges from over 100 Federal agencies, departments, and bureaus. Tens of thousands of citizen "solvers" have participated in these competitions directly on Challenge.gov, with additional entrants joining the

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[6] http://www.iprizecleanoceans.org/
[7] McKinsey & Company, "And the Winner Is..."; Capturing the promise of philanthropic prizes, 2009, http://www.mckinseyonsociety.com/downloads/reports/Social-Innovation/And_the_winner_is.pdf

competitions through other means. A 2014 Deloitte report[8] found that between 2010 and 2014 "incentive prizes have transformed from an exotic open innovation tool to a proven innovation strategy" with $64 million in total prize money[9] being offered through Challenge.gov.

On January 4, 2011, President Obama signed COMPETES into law.[10] Section 105 of this Act added Section 24 (Prize Competitions) to Stevenson-Wydler, providing all agencies with broad authority to conduct prize competitions in order to spur innovation, solve tough problems, and advance their core missions. The legislation requires OSTP to submit an annual report to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives on activities under this prize authority during the preceding fiscal year.

This report documents the benefits the Federal government has already reaped from using prize competitions and challenges, the steps the Administration has taken to establish a lasting foundation for use of the prize authority provided by COMPETES, and detailed examples from FY 2015 of how the COMPETES authority and other authorities are increasing the number of agencies that use prize competitions and challenges to achieve their missions more efficiently and effectively.

Figure 1. Reported number of prize competitions conducted by Federal agencies, FY 2011–FY 2015

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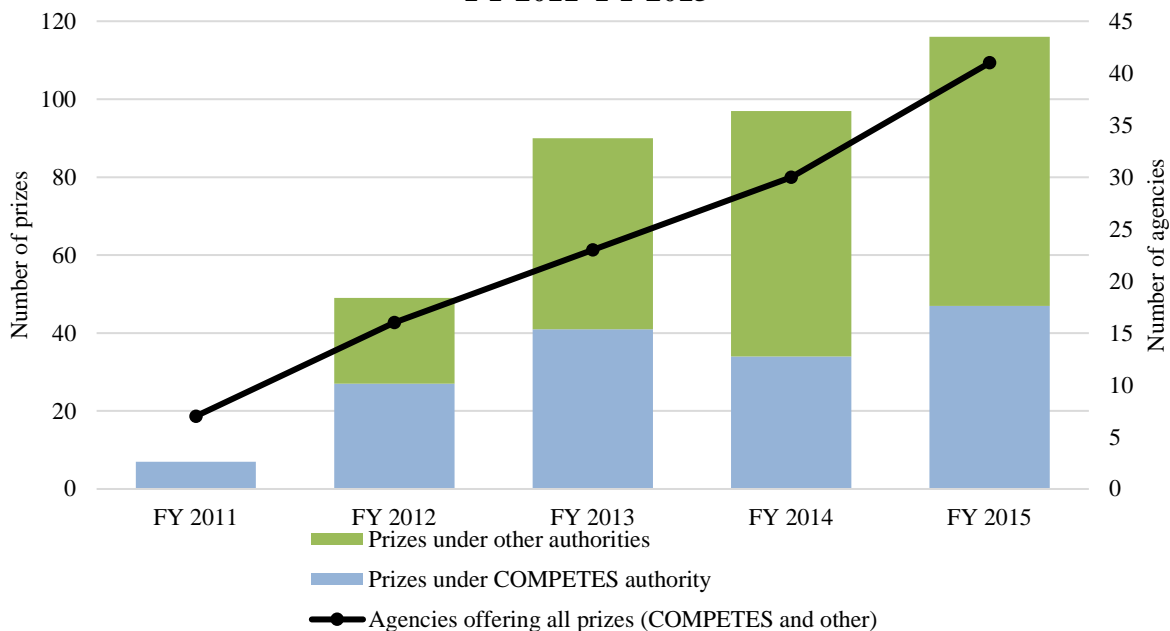
[8] Deloitte University Press, "The Craft of Incentive Prize Design"; Lessons from the Public Sector, 2014.
   http://dupress.com/articles/the-craft-of-incentive-prize-design/

[9] Based on 319 challenges listed on Challenge.gov between 2010 and 2014.

[10] Public Law 111-358.

Note: Reporting of prizes not conducted under COMPETES authority is not required, and in FY 2011, only COMPETES prizes were reported. Thus, these total values are minimum values and more prize competitions than are represented in this figure were completed (and not reported) during each fiscal year. Values for this figure and the number of agencies conducting COMPETES prizes are provided later in this document in Table 2.

The scope of this report includes a detailed description of every prize conducted in FY 2015 under the prize authority provided by COMPETES (as reported by Federal agencies to OSTP), with project descriptions in Appendix 1, and selective summaries of prize competitions and challenges conducted under other authorities in Appendix 2.

SECTION 1. BENEFITS OF PRIZES IN THE PUBLIC SECTOR

The unique benefits and diverse outcomes of prizes have been well documented in the private, philanthropic, and public sectors.[11] Early adopters in the public sector have seen the value of well-designed prizes over the last decade. For example, the Chief Technologist of NASA reports that "NASA recognizes the value of the public as a strategic partner in addressing some of the country's most pressing challenges. The agency is working to more effectively harness the expertise, ingenuity, and creativity of individual members of the public by enabling, accelerating, and scaling the use of open innovation approaches including prizes, challenges and crowdsourcing. These methods present an extraordinary opportunity to inspire the development of transformative solutions by offering a means to engage with non-traditional sources of innovative ideas, all in a remarkably cost-effective way."[12]

Even with demonstrated value in previous years, there exists a need to continue to communicate the benefits and lessons learned from Federal prize competitions. HHS reports that even after six years of prizes across 11 HHS divisions, "the availability of the prize mechanism is not widely known among program offices, and its potential benefits and drawbacks are not clearly understood."[13] At the same time, HHS has seen its competitions "evolve, with increasing complexity of design and problem statements better aligned with programmatic goals."[14] The agency sees this continuing evolution as part of the benefit of conducting challenges, and each year a different part of the agency finds a new use for the authorities that enable prize competitions.

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[11] See e.g., McKinsey & Company, "And the Winner Is..."; Capturing the promise of philanthropic prizes, 2009, http://www.mckinseyonsociety.com/downloads/reports/Social-Innovation/And_the_winner_is.pdf and Deloitte University Press, "The Craft of Incentive Prize Design"; Lessons from the Public Sector, 2014. http://dupress.com/articles/the-craft-of-incentive-prize-design/

[12] NASA Report to Office of Science and Technology Policy on Prize Competitions for Fiscal Year 2015, submitted by Jim Adams, NASA Deputy Chief Technologist, to the Office of Science and Technology Policy, February 9, 2016.

[13] HHS Report on Prize Competition Activities Conducted in Fiscal Year 2015, submitted by Susannah Fox, HHS Chief Technology Officers, and Colleen Barros, Acting Assistant Secretary for Administration to the Office of Science and Technology Policy, January 5, 2016.

[14] *Ibid.*

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Specifically, prizes have enabled the Federal Government to:

A. Pay only for success and establish an ambitious goal, without having to predict which team or approach is most likely to succeed

With a focus on proven results, prizes empower new, untapped talent to deliver unexpected solutions to tough problems. For example, the National Institute of Justice (NIJ), part of the Department of Justice, utilized prize competitions "to generate fresh ideas and new perspectives," and the organizers "hoped to mobilize researchers and technology innovators who may not have applied for Federal R&D grants and cooperative agreements."

DOE's SunShot Catalyst Program

Through a series of prize challenges, SunShot Catalyst makes it faster and easier for American innovators to launch cutting-edge solar companies, while tackling time-sensitive market challenges. Catalyst's prize-challenge framework introduces the business community to the vast array of tools, capabilities, data assets, and additional resources developed by DOE and its National Laboratories. Catalyst's open, fast-paced innovation cycle allows crowd-sourced engagement and frequent partnerships with the nation's growing networks of technology mentors, incubators, and accelerators. By the end of 2015, DOE ran two Catalyst Cycles. For each Cycle of the program, the primary incentive is over $1,000,000 total in prize awards given across the four steps of Catalyst prize program: Ideation, Business Innovation, Prototype, and Incubation. There are two rounds of Incubation: "seed" and "growth." Five teams won $30,000 in prizes by successfully completing the "seed" round of the Incubation step, and were eligible to receive up to $70,000 in additional funds, contingent upon meeting product milestones. Of the final five teams, 3 fully met product milestones during this round, securing a total of $100,000 in prize money per team. The five companies have collectively raised over $1 million from private investors in 2015.

IARPA's Automatic Speech Recognition in Reverberant Environments (ASpIRE) Challenge

ASpIRE challenged teams to apply and refine state-of-the-art speech-to-text (STT) techniques to transcribe recordings of native speakers of American English. Typically, speech-recognition systems are trained on speech recorded in environments very similar to those in which they are expected to be used. The ASpIRE challenge tackled a more ambitious problem of building accurate systems for automatically transcribing speech recorded in noisy and reverberant environments without any training data that resembled the challenge's final test conditions—and without knowing anything about the recording devices used, the placement of the talker relative to the recording device, or the acoustics of the rooms where the speech was recorded. Despite this ambitious goal, the winning solutions were significantly more accurate than IARPA's baseline system. The four ASpIRE challenge winners developed systems that delivered 50 percent error reduction or greater compared to the IARPA baseline system. IARPA structured this prize competition so that prize payments would be made only if the desired performance requirements for the challenge were met or exceeded. Since the requirements were exceeded and the baseline significantly improved upon, IARPA considers the results to be quite successful for the cost.

B. **Reach beyond the "usual suspects" to increase the number of solvers tackling a problem and identify novel approaches, without bearing high levels of risk**

As Sun Microsystems co-founder Bill Joy is credited with saying, "No matter who you are, most of the smartest people work for someone else." That is true for the Federal government as well. Prizes are one tool to tap the top talent and best ideas wherever they lie, sourcing breakthroughs from a broad pool of both known and unknown sources of innovation. As challenge solutions are delivered prior to payment, the Government can benefit from these novel approaches without bearing high levels of investment risk.

DARPA's Cyber Grand Challenge

The DARPA Cyber Grand Challenge (CGC) utilizes a series of competition events to test the abilities of a new generation of fully automated cyber-defense systems. CGC teams create automated systems to compete against each other to evaluate software, test for vulnerabilities, and generate and apply security patches to protected computers on a network. Utilizing prize authority under the America COMPETES Act made it possible to work with academic institutions and affiliated teams, large commercial interests not involved in defense contracting, small businesses, small teams of experts, and individuals, most of whom had not worked with DOD previously. The competition drew teams of top experts from across a wide range of computer-security disciplines. Collectively, the automated systems participating in CGC were able to mitigate all currently known security flaws in the sample software (no individual system accomplished this). Competitors' systems were able to identify 96 of the 131 security vulnerabilities (73 percent) in the software challenges without human assistance. The automated synthesis of input proofs and secure replacement software without human involvement demonstrates a groundbreaking level of autonomy.

SBA's 2015 Growth Accelerator Fund Competition

In August 2015, SBA completed the second installment of the Growth Accelerator Fund competition with a total prize purse of $4.4 million to continue building the support structure needed to help startups become commercially viable and create more jobs quickly. This opportunity for qualified accelerators provides resources to boost the startup and entrepreneurship communities. In running this competition, SBA hoped to support both new and existing accelerators from all across the country that were not yet familiar with the SBA's services nor being fully serviced by the traditional venture-capital or angel-capital community. Because these accelerators do not traditionally work with the SBA, this prize competition allowed the SBA to work with entirely new groups to support the startup ecosystem and create jobs. SBA awarded $4.4 million of Congressionally appropriated funds to 88 accelerators located in 50 states, the District of Columbia, and Puerto Rico, with 14 being in rural counties, 24 focusing on manufacturing and marketing, 39 owned by women, 21 owned by minorities, 21 focused on women, 36 focused on the underserved, and 13 focused on veterans. Last year's accelerator winners have helped create 5,000 jobs, launched approximately 1,400 startups, and raised collectively over $600 million in additional funding.

C. Bring out-of-discipline perspectives to bear

Empirical research conducted at the Harvard Business School has found that breakthrough solutions to scientific challenge competitions are most likely to come from outside the scientific discipline or at the intersection of two fields of study.[15] Challenges posed under COMPETES authorities often seek and enable these interactions.

USAID's Fighting Ebola Grand Challenge

The Fighting Ebola Grand Challenge sought out solutions to combat the challenges faced by health care workers. These challenges include personal protective equipment (PPE), lack of adequate health centers, difficulty in tracking person-to-person transmission, the absence of rapid point-of-care diagnostics, and a need to accommodate traditional burial ceremonies involving direct contact with a deceased body. The purpose of USAID's open ideation challenge was to engage a wide variety of creative thinkers with diverse expertise around the globe to rapidly source and develop potential solutions to this epidemic. The Fighting Ebola Grand Challenge sourced over 1,500 ideas and potential solutions. The selected awardees fell into the following six categories: improving PPE, cutting-edge tools for enhanced patient care, reimagined health care settings, decontaminants, behavior change, and information-communication technology solutions. As an example of the diversity of ideas and the reach of the Challenge, the founders of a sportswear apparel start-up learned about the Fighting Ebola Grand Challenge on Twitter and believed their wearable cooling packs for athletes could be adopted for use by health care workers. They posted about their product on the open ideation platform and were ultimately among those entrants selected to undergo rigorous testing of their products.

D. Increase cost-effectiveness to maximize the return on taxpayer dollars

Prizes can be efficient and cost-effective approaches for identifying solutions from the private sector. Teams in prizes and challenges compete for not just the cash purse, but also for the associated validation, prestige, and satisfaction that result from solving important problems. Therefore, prizes can incentivize significant additional private-sector and philanthropic investment, leveraging the prize purse's impact. In the Orteig Prize won by Charles Lindbergh in 1927, nine teams spent a cumulative $400,000 to win the $25,000 prize purse.[16] The $10 Million Ansari X PRIZE was won in 2004 by Burt Rutan and SpaceShipOne, after the 26 competing teams spent more than $100 million attempting to win the prize.[17]

NASA's Disruption Tolerant Networking Challenge Series (DTN)

The DTN Series is an ambitious, multi-year series of challenges to develop data networking protocols that can extend the Internet into the Solar System. The challenges helped improve the security, performance, and application of network protocols that can withstand the time delays

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[15] Jeppesen, Lars Bo, and Karim R. Lakhani. "Marginality and Problem-Solving Effectiveness in Broadcast Search." Organization Science 21 (September - October 2010): 1016-1033.

[16] http://www.innovationinthecrowd.com/examples/orteig-prize.pdf

[17] http://space.xprize.org/ansari-x-prize

caused by the immense distances between planets and the disruptions and non-contiguous paths of the space communication links. The series of challenges included two challenges in 2013, two challenges in 2014, and three challenges in 2015. The most significant challenge to close in 2015 was the Astronaut Email Challenge. This challenge aimed to fix an existing problem with the International Space Station (ISS) email system's ability to handle large file attachments for astronauts by developing an architecture that uses the DTN protocols to solve the problem. The Astronaut Email challenge received 24 entries for 18 contests, and awarded 12 winners a total of $23,638. The Astronaut Email software will begin the process of flight certification for eventual use on the ISS. If this issue had been fixed in-house, NASA estimates it would have cost $193,000. In the challenge format, this challenge cost NASA about $81,000, 42 percent of the estimated in-house solution cost.

E. Establish clear success metrics and validation protocols that themselves become defining tools and standards for the subject industry or field

In order to evaluate solutions submitted by entrants in prize competitions, managers of those competitions sometimes develop clearer success metrics, validation protocols, and standards than currently available in a given industry. These new methods for measurement can create new ways to evaluate solvers and solutions head-to-head, both for the prize competition and the industry or technology field more broadly.

DOE's Wave Energy Prize

The Wave Energy Prize will double the state-of-the-art performance of wave energy converters (WECs) through an 18-month design-build-test prize competition. Ninety-two teams registered to participate in the prize competition during the registration phase, three times greater than the expected response. The Prize is not yet completed, but there have been huge successes so far, including the development of rigorous metrics to evaluate diverse WEC configurations. Unlike wind turbines that extract energy from a two-dimensional flow through one degree of freedom of motion of the turbine, WECs can be designed to move in six degrees of freedom like an aircraft or spacecraft, which makes the devices complicated. The National Renewable Energy Laboratory's (NREL) standard metric for measuring the efficiency of a technology is the levelized cost of energy (LCOE). LCOE is calculated based on the full life-cycle cost of an energy technology's installation, operations, and financing. For an emerging technology such as WECs, life-cycle cost information is not available, and so NREL developed a new metric (the Average Climate Capture Width per Characteristic Capital Expenditure, or the "ACE") to assess the performance of WECs that could serve as a proxy. The ACE is a simple benefit-to-cost metric, much as LCOE is a cost-to-benefit metric ($/kWh). The ACE is a brand new evaluation metric and will be rigorously tested on proposed technologies in a testing campaign that will determine which teams are eligible to win the $1.5 million grand prize.

The use of incentive prizes by Federal agencies offers the above benefits, as well as numerous other advantages, such as the ability for prizes to inspire risk-taking, and give entrepreneurs and innovators license to pursue an endorsed stretch goal that otherwise may have been considered overly audacious.

Prizes are not the right tool for every problem, but, if aligned with a broader strategy and used systematically within an agency, they can be a powerful mechanism for spurring innovation. The prize authority provided by COMPETES has been instrumental in unleashing that potential.

Section 4, Section 5, and Appendix 1 of this report focus on the prizes developed under the specific prize authority provided by COMPETES. Appendix 2 provides a brief summary of prizes conducted under other authorities. Reporting of prizes under other authorities is not comprehensive, as agency reporting to OSTP on prizes under authorities other than that provided by COMPETES is voluntary.

SECTION 2. SUPPORT FOR SCALING THE USE OF PRIZES

Since 2009, the Obama Administration has taken important steps that are helping to scale the successful use of prize competitions and challenges across the entire Executive Branch. COMPETES plays a key role in the Administration's work to make prize competitions and challenges a standard tool in every agency's toolbox by granting clear, broad authority to all Federal agencies. The Administration has laid the policy and legal groundwork to take maximum advantage of the new authority. Actions taken by the Administration include:

- The September 2009 *Strategy for American Innovation*[18]—first issued in 2009 and most recently updated in October 2015— recognized the potential for prizes to mobilize America's ingenuity to solve some of the Nation's most pressing challenges.

- In March 2010, OMB issued a formal policy framework[19] to guide agency leaders in using prize competitions and challenges to advance their core missions.

- In September 2010, the GSA launched Challenge.gov,[20] a one-stop shop where entrepreneurs and citizen solvers can find public-sector prize competitions and challenges.

- Policy and legal staff in OSTP and OMB jointly developed a Fact Sheet and Frequently Asked Questions (FAQ) memorandum, which was issued in August 2011.[21]

- In the Second Open Government National Action Plan (2013),[22] the Administration committed to "convene an interagency group to develop an Open Innovation Toolkit for Federal agencies that will include best practices, training, policies, and guidance on authorities related to open innovation, including approaches such as incentive prizes, crowdsourcing, and citizen science." The first half of this toolkit[23], for citizen science and crowdsourcing, was released to the public on September 30, 2015. OSTP, GSA, the Federal Community of Practice for Challenges and Prizes, and a project team identified through GSA's Open Opportunities Program are working to release the second half of the toolkit, for prizes and challenges, in 2016.

- On October 7, 2015 the White House, in conjunction with the Case Foundation, the Joyce Foundation, and Georgetown University hosted "All Hands on Deck: Solving Complex Problems through Prizes and Challenges[24] to catalyze the next generation of ambitious prizes. This event included over 150 Federal agency managers, along with state and local government leaders, representatives from foundations and other non-government

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[18] https://www.whitehouse.gov/sites/default/files/strategy_for_american_innovation_october_2015.pdf

[19] http://www.whitehouse.gov/sites/default/files/omb/assets/memoranda_2010/m10-11.pdf

[20] http://www.challenge.gov/

[21] Prize Authority in the America COMPETES Reauthorization Act: http://www.cio.gov/documents/Prize%20Authority%20in%20the%20America%20COMPETES%20Reauthorization%20Act.pdf

[22] http://www.whitehouse.gov/sites/default/files/docs/us_national_action_plan_6p.pdf

[23] www.citizenscience.gov/toolkit

[24] https://spi.georgetown.edu/prizes

organizations (NGOs), and private-sector supporters, and provided concrete tools for designing more ambitious prizes and effectively using incentive prizes to improve outcomes in addressing complex social, policy, and technological challenges.

- On October 8, 2015 the GSA hosted a 5-year anniversary event[25] for Challenge.gov to acknowledge the rise of the Federal prizes and challenges community, which has grown steadily in size and influence over the past 5 years. Challenge.gov presented nearly 50 awards[26] recognizing individuals, agencies, and teams for public-sector prize competitions across categories ranging from creative and entrepreneurial to most groundbreaking and trailblazing.

Building on the support provided by the Administration, both GSA and NASA continue to provide support to the Federal prizes and challenges community through the Challenge.gov program and NASA's Center of Excellence for Collaborative Innovation (CoECI), respectively.

Assistance and support from GSA

GSA provides support and assistance to all Federal agencies operating prize competitions and challenges. In addition to managing the online platform Challenge.gov, providing tier-one helpdesk support, the GSA program office manages outreach to a Federal community of practice of over 690 challenge practitioners, an active listserv, and a growing base of public solvers. The program also provides a variety of resources, research, best practices, and templates for the challenges community on DigitalGov.gov. These resources, along with case studies and step-by-step process guidance, will be incorporated into the Prizes and Challenges Toolkit slated to be released in 2016. Through a partnership with DigitalGov University, the program has developed a comprehensive, monthly in-person and digital training curriculum for the community, and has trained over 2,000 people across government.

Section 24(n) of Stevenson-Wydler called on GSA to "develop a contract vehicle to provide agencies relevant products and services, including technical assistance in structuring and conducting prize competitions to take maximum benefit of the marketplace as they identify and pursue prize competitions to further the policy objectives of the Federal Government." In response, GSA launched Advertising and Integrated Marketing Sub-Schedule 541 4G, "Challenges and Competitions Services"[27] in July of 2011. Contractors on the schedule offer agencies options for technical assistance, prize platforms, and communities of individuals and teams interested in entering prize competitions. GSA continues to assist agencies in taking advantage of the available services and to inform private-sector vendors and agencies about the schedule and its benefits.

In September 2015, GSA built the framework for a mentoring program, bringing together 20 experts in public-sector prizes from across government to serve as force-multipliers for the

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[25] http://www.digitalgov.gov/2015/10/13/challenge-gov-honors-federal-agencies-staff-for-raising-the-bar-on-public-sector-prize-competitions/

[26] https://www.challenge.gov/challenge-gov-celebrates-five-years-of-open-innovation/

[27] http://www.gsaelibrary.gsa.gov/ElibMain/sinDetails.do?scheduleNumber=541&specialItemNumber=541+4G

Challenge.gov team. The goal of this program is to advise and educate novice agencies on prize design and strategy from the earliest planning phases through competition execution and reporting.

GSA has continued to evolve the Challenge.gov web platform to assist agencies in running prize competitions at no cost. With input from agency administrators, the GSA team has continued to advance the platforms capabilities and functionality to support more advanced hosting and reporting features.

Government-wide Center of Excellence for Collaborative Innovation

In 2011, the Administration launched the Center for Excellence for Collaborative Innovation (CoECI), a NASA-led, Government-wide center of excellence to provide agencies guidance and support in implementing certain types of prize competitions and challenges. In 2015, CoECI awarded 10 contracts under its fixed-price, Indefinite Delivery/Indefinite Quantity (IDIQ) NASA Open Innovation Services (NOIS) procurement. That procurement forms a foundation for expanded use of challenges across the Federal Government for the next 5 years. NOIS provides a robust, yet competitive, mechanism to expand the number, variety, and skill sets of vendors available to continue the successful use of challenges to meet agency missions. The contracts were awarded in early June of 2015, and CoECI competed and awarded eight task orders for an array of technical challenges within and beyond NASA, which are all scheduled to launch in 2016.

Since its inception, CoECI has launched over 156 crowdsourced challenges, including those launched on its internal NASA@Work platform and 16 challenges of various complexity for other agencies. CoECI has worked alongside the U.S. Patent and Trademark Office (USPTO), the Centers for Medicare and Medicaid Services (CMS), USAID, OPM, DOE, EPA, the National Science Foundation (NSF), and the Department of Veterans Affairs (VA) as those agencies garnered their own expertise in how best to apply the use of challenges. In 2015, CoECI continued to provide consulting services and worked with DOD, DOJ, DOI, DHS, the National Institutes of Health (NIH), the National Maritime Intelligence-Integration Office (NMIIO), and USGS to offer guidance on subjects ranging from challenge design to legal and procurement advice. Continuing to improve the mechanisms by which other agencies can leverage CoECI's expertise, efforts were applied this year with its legal and financial management teams to streamline CoECI's inter-agency agreement (IAA) process. In addition to gaining practical and operational knowledge on day-to-day best practices for the use of challenges, CoECI continued to facilitate academic research on the use of open innovation practices, both through its contract with Harvard University, as well as its grant to the Massachusetts Institute of Technology (MIT) Sloan School of Management Innovation Lab. At the end of the fiscal year, the Harvard contract was drawing to a close and resulted in 15 peer-reviewed papers focused on stratagems for repeatable practice, examining such topics as motivation, incentives, team formation, and user-focused metrics. CoECI also launched a pilot to determine how prize administrators at agencies can use a government credit card to engage a challenge-based model for a small dollar value.

Beyond these Federal Government-wide sources of assistance and support, many agencies have reported building various types of infrastructure to support developing and operating prize competitions and challenges at their agencies (summarized in

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Table 1), including:

Issuance of department-wide policy or guidance on the use of prize competitions and challenges

Agencies have established strategies and policies to further accelerate widespread use of prize competitions and challenges. HHS has been at the forefront of agency implementation efforts of the new prize authority granted under COMPETES since 2011. On October 12, 2011, Secretary Sebelius issued a memorandum notifying HHS of the new prize authority, outlining the strategy to optimize the use of prize competitions, and calling on the heads of operating and staff divisions to forecast their future use of prize competitions to stimulate innovation in advancing the Agency's mission. The full set of HHS's policy statements, guidance, and resources is available online.[28]

Additional departments and agencies have since issued agency-wide policy and guidance including NASA (2013),[29] EPA (2013),[30] DHS (2014),[31] USDA (2015),[32] and DOI (2015).[33] NIST plans to issue agency-wide prize guidance in 2016. As a result of new authority granted to USAID in the Consolidated Appropriations Act, 2016 (Public Law 114-113) to make innovation incentive awards, USAID is also developing guidance to further integrate prizes into its work by utilizing no more than 10 new awards through this authority of $100,000 or less during FY 2016.[34]

Common contract vehicles

Leveraging the work done by GSA to develop the Sub-Schedule 541 4G, several agencies have developed agency-wide prize and challenge-service contract vehicles to streamline access to vendors to support the design and implementation of prize competitions and challenges. These contract vehicles support the groups currently operating challenges, and also lower the barrier for new groups within the agency who intend to develop challenges. In addition to NASA's open innovation platforms, HHS (2013), DHS (2014), and the Department of Education (2014) have developed agency-wide contract vehicles to provide management and technical support to prize competitions within their agencies.

For example, the Office of Career, Technical, and Adult Education in the U.S. Department of Education awarded a five-year IDIQ Contract to a small business through a competitive procurement process to provide maximum flexibility to organize, design and conduct that

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[28] http://www.hhs.gov/idealab/what-we-do/hhs-competes/

[29] http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPD&c=1090&s=1

[30] This development was originally documented in the FY 2013 COMPETES report (page 13).

[31] DHS Secretary Johnson delegated the prize authority granted under COMPETES to the DHS Science and Technology Directorate, which developed a DHS Prize Competitions Directive and prize-competition instruction.

[32] http://www.ocio.usda.gov/document/departmental-regulation-2405-001

[33] http://www.doi.gov/techtransfer/prize-competition-guidelines.cfm

[34] Fiscal Year 2015 Report on Use of Prize Authority in the America COMPETES Reauthorization Act: United States Agency for International Development (USAID), submitted to the Office of Science and Technology Policy, January 5, 2016.

office's challenges. A task order is issued based on the design and intent of each challenge. The contract is available to all program offices in the department and can be used for a variety of challenge formats and activities. Additionally, EPA is working on a blanket purchase agreement (BPA) in order to more efficiently work with GSA prize contractors. The agency anticipates that the BPA will be signed in 2016.

Coordinated external communications

As agencies increase the volume of prize competitions and challenges they support, some have developed coordinated communications strategies for engaging with solver communities across the various prize competitions and challenges they conduct. Agencies have used websites, listservs, and social media outreach to better promote opportunities to the public. For example, EPA maintains a public website that provides the public with links to EPA challenges. NASA manages the *NASA Solve* website, a one-stop shop where the general public can learn about and engage with the challenges, prize competitions, and crowdsourcing activities that aim to solve tough problems related to NASA's mission. The site has consistently generated approximately 30,000 unique visitors weekly and program managers have reported this portal to be a major point of entry for solvers.

Supporting agency personnel working on prize competitions

Agencies are assigning personnel to work on institutionalizing and designing prizes in a number of different ways including:

- Assigning dedicated, central prize and challenge leads. Several agencies have dedicated personnel to lead prize and challenge design and administration efforts at their agencies and to provide internal support agency-wide to program managers interested in making use of prize competitions and challenges. Prize design, management, and oversight are full-time jobs for these employees in response to the demand for the use of prize competitions and challenges within their agencies. They are often responsible for policy and guidance, internal and external agency communication strategies for prize competitions and challenges, the development of common contract vehicles, and consultation for specific prize and challenge designs. Agencies that use this approach include NASA, HHS, USAID, DHS, EPA, and NIST.

- Assigning an agency prize and challenge point of contact. Other agencies have identified agency points of contact for prize competitions and challenges who have taken on responsibilities such as policy and guidance development, but who are not devoted full time to prize competitions and challenges. DOD, NSF, USDA, DOE, and DOI have identified prize points of contact who fill a variety of part-time roles including developing guidance, conducting annual reporting, and convening communities of practice.

- Enabling distributed networks of prize managers and points of contact within agencies. At some agencies, personnel are distributed across groups engaged in operating prize competitions and challenges, and there is no central coordination. "One-off" prizes or prize programs are conducted without a centralized agency strategy. In some of these cases, central coordinators or agency personnel with experience designing prizes and challenges work with

a distributed network within their agencies to spread the use of prizes and competitions through the agency's divisions and organizations.

Providing training and design support to agency staff

NASA has been providing prize-specific consultation services and training to NASA staff through CoECI since 2012. As the number of staff supporting prize competitions across government has expanded, the number of training and consultation services provided within agencies to agency employees has also increased to support scaling the use of prizes in a more sustainable way. For example, DHS conducted five training sessions for DHS components, leaders, and program managers, and sponsored two brownbag discussions in FY 2015.

HHS, taking a customer-centric approach to the institutionalization of prize activity, determines what support for prize activity it will centrally provide, depending on the demands of those HHS offices that recognize value in the tool. HHS recognizes that the novelty of the challenge mechanism still presents a steep learning curve for offices who wish to use it. In particular, the majority of likely prize sponsors in the agency have little interest in gaining expertise in its nuances; rather, similar to establishing contracts and grants, they seek to rely on the expertise of others to guide them. As a direct response to this observation, HHS piloted a 2-week virtual bootcamp in July 2015 that provided HHS teams an opportunity to develop a prize idea in an accelerated, peer environment with access to mentors and experts within and outside HHS. HHS enrolled 11 teams initially, two dropped out, another two merged into one, and another decided to collaborate with one of the mentors. Two challenges have already launched out of this bootcamp effort. HHS received overwhelmingly positive feedback from the participating teams, in particular regarding the access to prize/challenge mentors and legal, policy, procurement, 508 compliance, and Paperwork Reduction Act (PRA) compliance mentors. Building off the pilot's success, a full, expanded version of the bootcamp was conducted in March 2016.

In part as a result of HHS's centralized, broad outreach efforts, HHS has seen great diversity of usage among the 11 HHS Operating Divisions ("Divisions"), as evidenced in **Error! Reference source not found.**, which shows the challenges grouped into Division and Fiscal Year.

Figure 2. Grouping of competitions by HHS Division and Fiscal Year in which the entire or one phase of a challenge was completed, FY 2011–FY 2015
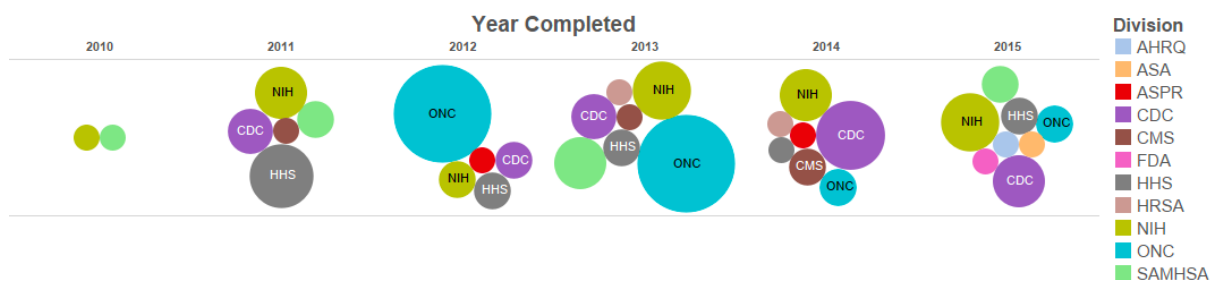
Note: The area of each circle is proportional to the number of challenges conducted by the associated HHS Division. The number of competitions conducted in each year from FY 2010 to FY 2015 is 2, 16, 21, 30, 18, and 18, respectively.

Developing centers for interagency challenges in specific topic areas

The U.S. Bureau of Reclamation (USBR) within DOI established the Water Prize Competition Center in FY 2015 to launch prize competitions under the authority provided by the COMPETES Act. The Reclamation Water Prize Competition Center has begun to launch prizes that seek innovative solutions related to several mission-critical areas including infrastructure sustainability, ecosystem restoration, and water availability.

USBR forged collaborations with other Federal agencies that have a stake in these mission areas to collaboratively design, launch, and judge the prize competitions. Federal collaborators currently include USGS, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service (FWS), NASA, EPA, U.S. Army Corps of Engineers, USDA, and NIST. The Federal collaboration will enable agencies to leverage Federal capabilities, catalyze interagency working relationships, better define and solve joint problems, avoid duplication, find solutions that have a broader impact across the mission of multiple Federal agencies, and advance the interests of their stakeholders and the public good.

During FY 2016, USBR plans to launch several challenges in each of the 3 subject-matter themes. USBR also plans to explore ways to combine the authorities provided by the COMPETES Act with Technology Transfer Act of 1986 authorities (15 USC§ 3710a) to forge partnerships with non-Federal organizations, including the private sector, to accelerate innovation and the lab-to-market process through jointly sponsored prize competitions.

Table 1. Challenges and prizes infrastructure

AGENCY PRACTICES	FY 2014	FY 2015
Issuance of department-wide policy or guidance on the use of prize competitions and challenges	HHS, EPA, NASA, DOI, USDA, DHS	HHS, EPA, NASA, DOI, USDA, DHS
Common contract vehicles	Education, HHS, DHS, EPA, NASA	Education, HHS, DHS, EPA, NASA
Internal communications tools	HHS, DHS, EPA, NASA, DOE	HHS, DHS, EPA, NASA
Coordinated external communications	NASA, EPA	NASA, EPA, DHS
Dedicated, central prize and challenge leads	NASA, HHS, USAID, DHS, EPA	NASA, HHS, USAID, DHS, EPA, NIST
Identified agency prize and challenge point of contact (not dedicated full time to prizes)	USDA, DOI, DOD, NSF	USDA, DOI, DOD, DOE, AFRL, CTTSO, NSF, DOJ
Distributed network of prize managers and points of contact within the agency	HHS, NASA, HHS, USAID, DHS, EPA, USDA, DOE, DOD, AFRL	HHS, NASA, USAID, EPA, USDA, DOE, DOD, FTC, DARPA, IARPA
Providing centralized training and design support to agency staff	NASA	HHS, NASA, DHS
Developing centers for the interagency challenges in specific topic areas		DOI

While the number of agencies using the clear and broad authorities provided to them under COMPETES increased in FY 2015 (Table 2), numerous public-sector prize competitions and challenges continued to be administered under other pre-existing authorities, including: agency-specific authorities; procurement; the authority to award grants, participate in cooperative agreements, or both; and others. Some agencies used both COMPETES and other authorities. These prize competitions add additional lessons learned and best practices to the growing community of practice engaged in public-sector prize competitions and challenges. For example, during FY 2015, the Department of Education reports having gained significant insights on how to plan and conduct challenges under authorities other than COMPETES, leverage its public-private partnerships to augment its ability to provide prize incentives, and explore innovative procurement strategies to accomplish its objectives. The Department of Education has used these insights to improve its internal processes and enable greater innovation and creativity to meet its mission.

In FY 2016, the use of the prize competitions and challenges likely will continue to increase as more agencies complete internal policies and strategies related to their implementation; agency experience with prize competitions and challenges grows; more resources for training of agency personnel and for the development, implementation, and promotion of challenges become available to agencies through GSA; and CoECI continues to provide support for pilot programs at other agencies. These activities are expected to result in highly leveraged, open innovation programs that help agencies to address grand challenges and meet their respective missions.

SECTION 3. HIGHLIGHTS AND TRENDS FROM PRIZES AND CHALLENGES CONDUCTED IN FY 2015

Aided by the support described in Section 2, agencies have expanded their use of prizes conducted under COMPETES and other authorities, with 116 prizes offered by 41 agencies in FY 2015 (

, Table 2). The data analysis included in this section is focused on the 80 prize competitions (conducted under all authorities) that were newly announced in FY 2015 and for which data were provided.[35] These competitions provide evidence for how the COMPETES authority is helping agencies across the Federal government reap the benefits discussed in Section 1. A review of prizes conducted in FY 2015 reveals the following trends and best practices in using public-sector prizes.

Agencies use prizes to achieve goals such as: improving service delivery; finding and highlighting innovative ideas; solving a specific problem; advancing scientific research; developing and demonstrating technology; informing and educating the public; engaging new people and communities; building capacity; and stimulating markets.

In FY 2015, the majority of challenges (83 percent) were designed to achieve multiple goals, and 47 percent were designed to produce multiple types of solutions. The most common goals for FY 2015 challenges were *solve a specific problem* (50 percent), *develop technology* (50 percent), *engage new people and communities* (47 percent), and *highlight ideas* (42 percent).[36] The goals of the challenges were also tracked in FY 2014 so the data can begin to be compared across fiscal years (

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[35] A total of 85 prize competitions were newly announced in FY 2015 of the 116 prize competitions. The agencies self-reported the primary goals and types of solutions for each prize competition included in these data.

[36] The other primary goals ranged from 10-33 percent of the total prizes.

Figure 3). From FY 2014 to FY 2015, the biggest changes in occurrence of specific goals is an increase in the ratio of challenges that sought to *develop technology* (23 percent increase), and although still common among challenges, a decrease in the ratio of challenges that *engage new people and communities* (16 percent decrease). Agencies continue to recognize that prizes are a powerful tool to tap into expertise in new communities and disciplines, and several challenge operators described connections with new academic and technical communities to be among the greatest positive impacts of running the challenge.

Figure 3. Percentage of challenges with each primary goal, FY 2014–FY 2015
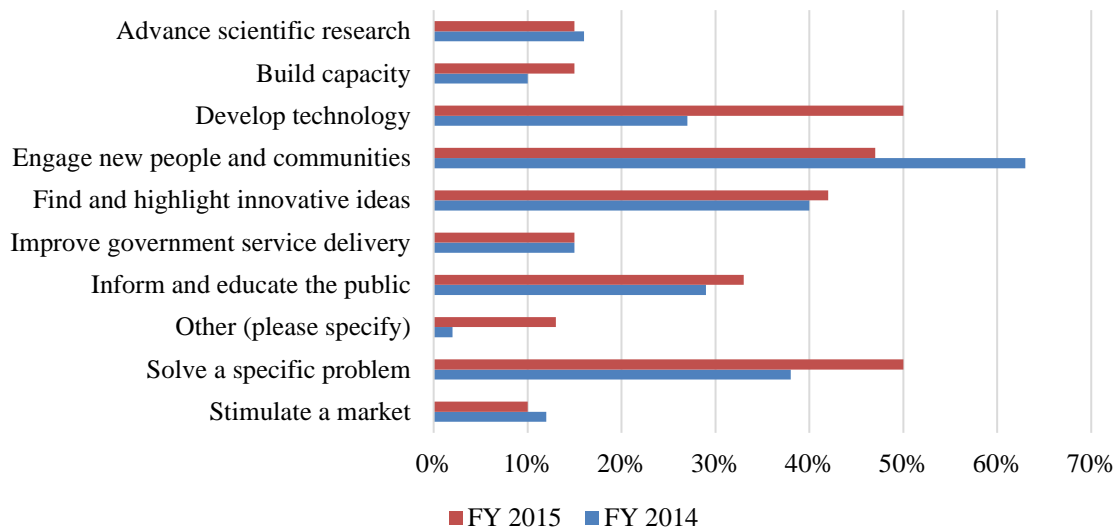
Note: Each challenge may have multiple goals.

The most common type of solutions sought by FY 2015 challenges was *Ideas*, which was sought by 41 percent of the challenges (**Error! Reference source not found.**). While *Ideas* was also a popular type of solution in FY 2014 and FY 2013, *Software and Apps* decreased from about third of the challenges in FY 2014 to a fifth of the challenges in FY 2015. Also notable is the two-year increase in the proportion of challenges seeking *Technology* or *Scientific* solutions, from 7 percent in FY 2013 to 24 percent in FY 2014 and to 31 percent in FY 2015.[37] These data suggest that agencies are using a larger fraction of prize competitions for hardware and scientific solutions and for a smaller fraction of software solutions.

Figure 4. Percentage of challenges with each type of solutions, FY 2014–FY 2015
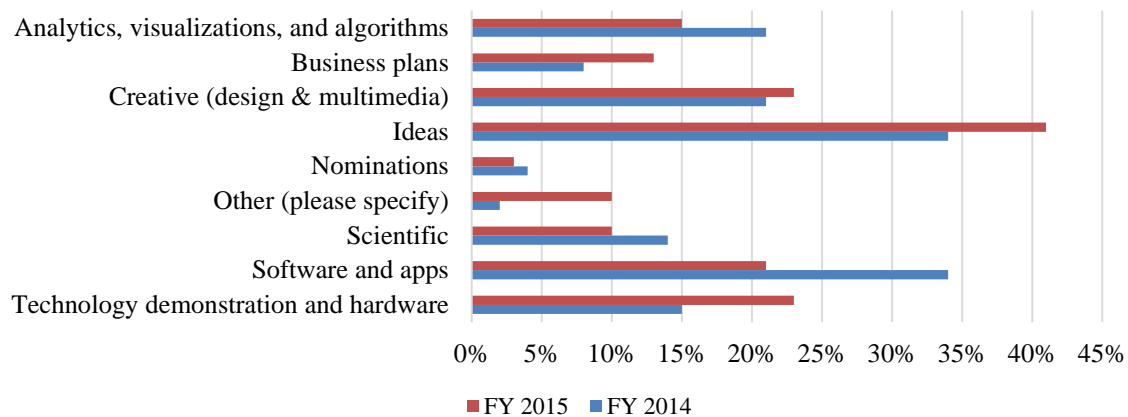
Note: Each challenge may have multiple types of solutions.

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[37] Challenges that sought both *Technology* and *Scientific* solutions are only counted once in these ratios.

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Increased ambition and sophistication of prize designs enabled by partnerships

In FY 2015, partnerships were utilized broadly. Partnerships with other Federal agencies, not-for-profit, and for-profit entities allow agencies to be more ambitious in designing and executing challenges because partners are able to provide additional resources and perspectives. In FY 2014, 56 percent of all prizes and challenges leveraged partnerships to expand their reach, impact, and scope. In FY 2015, 68 percent of all prizes and challenges leveraged partnerships. This figure can be further divided by authority. Sixty-six percent of challenges that utilized the authority provided under COMPETES, which includes partnership flexibilities in its statute, leveraged partnerships, as compared to 58 percent of challenges conducted through authorities that do not include partnership flexibilities.[38] This difference suggests that agencies are able to use the COMPETES authority to partner more frequently with external organizations.

Over the coming years, more agencies are likely to pursue progressively more sophisticated and ambitious prize designs that harness partnerships as Federal prize designers build off their early experience with more simplistic prize designs, such as app competitions. Despite this trend, it is important to note that the Federal Government could further expand the overall level of ambition present in the use of prize competitions. A 2014 Deloitte Report found that "while challenges are becoming more complex on the whole, the most ambitious outcomes on both spectra—market stimulation and inspire transformation—continue to make up a very small percentage of challenges on Challenge.gov, comprising less than two percent of outcomes sought [between 2011 and 2014]." [39]

The following prizes conducted in FY 2015, which are supported by strong partnerships, demonstrate sophisticated challenge design with ambitious solution goals:

NIST's Head Health Challenge III

Through a partnership between with the National Football League, Under Armour, GE, and NIST, the Head Health Challenge III is offering up to $2 million in prizes for the development of materials that provide excellent energy absorption and energy dissipation. The challenge evaluated initial abstracts by participants and invited authors of 55 top-rated abstracts to submit more detailed proposals with samples of the material. From these full proposals, 21 materials underwent mechanical testing at NIST, and based on the performance of the materials, the challenge judges selected five teams as First Round awardees.

These five teams will further develop their materials over the coming year in consultation with the challenge partners. In early 2017, the judges will again come together to select one Grand Prize winner. This was NIST's first competition under COMPETES and is quite ambitious in that it relies on multiple partnerships, provides testing for a technology development challenge, and involves NIST in a complex judging process.

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[38] This percentage does not include 14 prizes conducted under other authorities like NASA's space act authority that also provides the partnership flexibilities provided under COMPETES.

[39] Deloitte University Press, "The Craft of Incentive Prize Design"; Lessons from the Public Sector, 2014. http://dupress.com/articles/the-craft-of-incentive-prize-design/

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NASA's Cube Quest Challenge

CubeSats are a type of cubic miniaturized satellite used in space. CubeSats are small, light, inexpensive, and often utilize commercial-off-the-shelf (COTS) components for their electronics and structure. Because of their versatility and ease of use, CubeSats have been used to demonstrate functionality in areas ranging from Earth observation to life sciences to space tether experiments. The farther these small spacecraft get from low-Earth orbit, however, the more difficult it is for them to survive and function. The Cube Quest Challenge seeks to develop and test subsystems necessary to perform deep-space exploration using small spacecraft. NASA's Cube Quest Challenge offers a total of $5.5 million in prize money and is divided into three areas: (1) Five Ground Tournaments (GT-1, GT-2, GT-3, GT-4, GT-5) ($500,000) to determine who will have the ability to fly on the first integrated flight of NASA's Orion spacecraft and Space Launch System (SLS) rocket; (2) Deep Space Derby ($1.5 million) for demonstrating communication and CubeSat durability at a distance greater than 2.5 million miles (10 times the distance from the Earth to the moon); and (3) Lunar Derby ($3 million) for demonstrating the ability to place a CubeSat in a stable lunar orbit and demonstrate communication and durability near the moon.

NASA Ames Research Center, the NASA center that is executing the challenge, formed a partnership with San Jose State University. San Jose State University (SJSU) supports Cube Quest by setting up a virtual meeting place and conducting a series of technical workshops relevant to Cube Quest for the teams to attend. The virtual meeting space facilitates self-organization of challenge teams, offers challenge-related services, organizes bulk purchases of CubeSat components to amortize costs across teams, and fosters general dialogue in the CubeSat communities relevant to Cube Quest. The workshops are a series of at least six technical topics proposed and selected by NASA. Topics may include radiation tolerance, navigation at the moon, and other topics relevant to Cube Quest. A SJSU student leads the workshops.

A launch as a secondary payload on the SLS rocket for selected teams is also an important part of the structure of the prize. This incentive is the first time NASA has offered a ride on a rocket through a prize, which shows a more serious use of prizes for in-space technology demonstration. Alternatively, teams could choose to use private companies to launch their CubeSats. The SLS launch could be considered a priceless incentive because there are few launch opportunities that could get those CubeSats into a good trajectory for the lunar elements of the challenge.

The Cube Quest Challenge began registration in November 2014, and the challenge will run for an estimated 4 years. Thirteen teams competed in GT-1. Five were awarded prize money of $20,000 each for their design and presentations. All 13 teams are eligible to compete in GT-2; additional teams can also participate in GT-2 without the requisite of GT-1 participation.

New models for engaging the public during competitions

In FY 2015, challenge managers continued to experiment with new ways to engage the public and develop new communities focused on challenge topics during prize competitions. The approaches for engagement included: soliciting public comment on draft rules; operating a pilot

challenge to determine interest and gather feedback from in the target participant population; inviting winners to present webinars on their solutions to the target participation population; using "co-design" platforms to integrate user needs and opinions into the design of solutions; announcing challenges at events where target participants already were in attendance; publishing winning solutions as open-source resources; using crowdfunding to support entrants; hosting physical and virtual forums that allowed entrants and stakeholders to discuss, develop, and improve solutions both during and after the challenge; broadcasting video to document and communicate challenges; conducting public votes on solutions; and developing dedicated websites.

Examples of prizes that included interesting approaches to engaging the public and building a community include:

NSA's Codebreaker Challenge

This challenge was designed as an educational opportunity that provides students with an avenue for learning software reverse engineering (SRE) and a realistic, National Security Agency (NSA)-mission-centric scenario through which to hone their SRE abilities. The challenge was divided into 4 tasks, which needed to be completed in order (e.g., successful completion of the first task enabled students to proceed to the second task). After successful completion of the fourth task, the student completed the entire challenge.

The challenge was hosted on its own website and included an institutional leaderboard which showed in near real-time the progress of each university with at least one student registered on the site. Of the 2,217 students signed up from 329 educational institutions, 71 students submitted a correct Task 3 solution, and 54 students submitted a correct Task 4 solution. Those who completed Task 3 (including those who also completed Task 4) were contacted by NSA, which resulted in 7 conditional internship job offers and 2 full-time job offers, with several more job offers anticipated. Making it all the way through the challenge was a significant accomplishment, requiring a mix of reverse engineering, problem solving, programming, and vulnerability analysis. Many students indicated that the challenge helped them develop reverse engineering skills, and in at least a couple instances, students had no previous experience prior to attempting the tasks. Additionally, at least one professor is developing a reverse engineering course based on the formalized process presented in the challenge.

DOI Crushed Ivory

The U.S. Fish and Wildlife Service, in partnership with the Association of Zoos and Aquariums (AZA), launched the Crushed Ivory Design Challenge Prize to solicit creative ideas on how to use seized crushed ivory in informative and compelling displays around the country. The goals of the winning submissions are to use the crushed ivory to raise public awareness of wildlife trafficking and help reduce the demand for illegal wildlife products through feasible designs and without adding value to the crushed ivory. The competition's solutions are aimed at engaging the public in new ways in order to end illegal wildlife trade.

The competition received 44 submissions from students, aspiring artists, conservationists, and design professionals. Participants had to balance creating exhibits that would increase public awareness while also presenting the crushed ivory in an interesting way. The competition organizers are currently finalizing implementation of the final two designs, which will be distributed to zoos, aquariums, airports, schools, and other public facilities.

Applying prizes as one tool in a broader portfolio of actions within a program

Grand Challenges are ambitious but achievable goals that harness science, technology, and innovation to solve important national or global problems and that have the potential to capture the public's imagination. Grand Challenges are large initiatives to increase support and innovation for complex and tough issues. While Grand Challenges have been used as approaches to help catalyze breakthroughs that advance national priorities for several years, FY15 saw an increase in the number of prize competitions applied within these broader Grand Challenge programs in order to stimulate innovation and engage new communities.[40]

<u>USAID's All Children Reading: A Grand Challenge for Development (ACR GCD)</u>

ACR GCD is sourcing technology-based solutions to improve the literacy outcomes for children in developing countries. For ACR GCD, prizes solicit the development of a specific product, approach, or application that complement innovations produced from grants and fill gaps in addressing child literacy. For USAID, prizes are one tool to apply to the Grand Challenge activities, which also include grant making and other partnership activities. In FY 2015, USAID helped implement five prize competitions in support of this grand challenge: (1) Big Ideas@Berkeley – Mobiles for Reading Prize Competition 2014 – 2015; (2) Big Ideas@Berkeley – Mobiles for Reading Prize Competition 2015 – 2016; (3) Enabling Writers Prize Competition; (4) Technology to Support Basis Education in Crisis and Conflict Settings Ideation Challenge; and (5) Tracking and Tracing Books Prize Competition.

Each of these five competitions has leveraged international partnerships in order to further technologies for international literacy. The technologies developed have already achieved some of their desired success. For example, the Tracking and Tracing Books Prize Competition, which sought technologies to track books destined for early-grade classrooms around the world, was able to select two viable software solutions to move onto the second phase of creating development plans, prototyping their solutions, and field testing. The creation of two, independent systems allows for the desired end goal to be realized in more locations, since one solution might fare better than another in a particular country. In addition, competition between two solutions is expected produce better and more cost effective products in the future.

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[40] https://www.whitehouse.gov/administration/eop/ostp/grand-challenges

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DOE's SunShot Catalyst Program and the SunShot Prize: Race to 7-Day Solar

The SunShot Grand Challenge (now called the SunShot Initiative) out of the DOE Solar Energy Technologies Office "seeks to make solar energy cost-competitive with other forms of electricity" by 2020.[41] The Initiative has provided a variety of financial opportunities to jumpstart this research, and separates these opportunities by program area: systems integration, technology to market, photovoltaics, soft costs, and concentrating solar power. Two of these prize initiatives have been the SunShot Prize: Race to 7-Day Solar, which offers a $10 million prize purse for solutions to reduce the time from "permit-to-plugin" of solar cells in small systems and large systems, and the SunShot Catalyst Program, which seeks to aid the launch of solar companies. The whole initiative seeks to further solar energy use and these two prize competitions solicit innovation at distinct points in the solar energy ecosystem – an indication how incentive prizes can be one innovation mechanism in an agency's Grand Challenge plan.

Conducting series of challenges to build momentum for a specific issue

Agencies have utilized the series format for challenges for many years. In 2008, NASA paved the way in conducting series around a specific topic and has continued to use the series structure. As one example, the continuation of the Disruption Tolerant Networking Challenge Series in 2015 has led to specific challenge solutions across multiple years that all work toward the broad series goal of extending the internet into the Solar System. Drawing from these years of experience, NASA, especially through CoECI, has helped other agencies launch their own challenges and series.

As prizes are utilized over several years, now multiple agencies are utilizing the series format and finding success. For example, the Federal Trade Commission (FTC) has completed 4 challenges in its Robocall series. The first Robocall Challenge launched in October 2012, and led to the development of Nomorobo, a free product for consumers to block unwanted calls. This product has blocked over 83 million robocalls since launching in 2013.[42] FTC held a second contest in the series, Zapping Rachel, in 2014 and promoted the development of robocall honeypots, an instrument that enhances law-enforcement efforts, advances technological solutions that combat robocalls, and furthers the general understanding of robocaller tactics. This year, the FTC launched two new robocall challenges: (1) DetectaRobo and (2) Robocalls: Humanity Strikes Back (Strike Back).

The collective media attention on the four challenges has continued to promote public awareness of the FTC's technical initiatives, specifically about illegal telemarketing calls. Through conducting a series of challenges, an agency is able to develop a following and increase public awareness more broadly than through one challenge. Building off previous challenges with similar branding can create sustained attention on an issue and create a campaign.

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[41] http://energy.gov/eere/sunshot/about-sunshot-initiative

[42] https://www.nomorobo.com/

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Other series of challenges that continued or started in FY 2015 include:

<u>HHS's Startup Series</u>

HHS recognized in its 2015 report on challenges that "serial challenges are gaining prestige and demonstrating impact [of prize competitions]." Specifically, the 2015 Neuro Startup Challenge was built on the foundations of the 2014 Breast Cancer Startup Challenge and has built a robust community of students, investors, mentors, and inventors. These challenges asked solvers to take early-stage technologies to full commercialization. For the Neuro Startup Challenge, university teams created startups and business plans to develop and commercialize 16 early-stage neuro-related technologies invented by NIH intramural researchers. The agency was able to recycle many of the operational aspects of the Breast Cancer Startup Challenge to run the Neuro Startup Challenge more effectively. These challenges were conducted through a partnership between NIH and the Center for Advancing Innovation.

These challenges have led to the creation of 27 new startups, trained over 1000 students in entrepreneurial skills, and increased the likelihood of taking NIH inventions to market. Based on the success of these two startup challenges, NIH has launched a third startup challenge in October 2015, the Nanotechnology Startup Challenge (NSC2), for commercially viable, nanotechnology cancer-related inventions.

<u>VA's Innovation Series</u>

The VA Innovation Creation Series was a set of three challenges that aimed to facilitate the development of personalized technologies to improve care and quality of life for veterans. Each challenge sought to bring together designers, engineers, and other solvers for specific technologies for veterans' needs. The VA Innovation Creation Series culminated in a 2-day "make-a-thon" event at the Richmond VA Medical Center where veterans, makers, and clinicians co-created, built, and tested the designs to showcase how they meet the needs of veterans. At least 305 makers were reached through the challenges and 3 designs are being further implemented and co-designed with veterans.

Partnerships through America Makes and The Girls Lounge allowed VA to collaborate with Google, GE, Toyota, Stratasys, and 3D Systems to triple the amount of investment and capital involved with the Innovation Creation Series.

<u>DOE's JUMP Series</u>

In FY 2015, the Oak Ridge National Laboratory (ORNL), in partnership with private sector organizations and the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Buildings Technology Office, launched the new prize program, JUMP, to crowdsource different buildings technologies. The three challenges for this year were conducted in partnership with General Electric, AO Smith, and United Technologies Research Center, and included: (1) Improve Water Heater Performance with Phase Change Materials; (2) Low-Cost BTU Sensor for Use in Building HVAC Control System; and (3) Low-Temperature Intrinsically Safe Defrost System. More than 400 participants have registered for the JUMP program, and building upon

the success of these three challenges, JUMP is conducting more prizes for more technologies in FY 2016.

Commercialization of solutions found through prizes to address market failures

In FY 2014, there was an increase in incentive prizes that focused on supporting entrepreneurship and commercialization. In FY 2015, that trend continued with half of the total challenges seeking to *develop technology*. This year, challenges sought to address gaps in the market by supporting technology development challenges that considered commercialization in the prize design.

EPA's Nutrient Sensor Challenge

Currently, the price of nitrate and orthophosphate sensors ranges between $20,000 and $30,000. A report by the Alliance for Coastal Technology estimated a need for 20,000 to 50,000 sensors in the next 5 years. The price point of existing sensor technologies, however, is unaffordable for most potential purchasers seeking to monitor nutrients. The Nutrient Sensor Challenge sought to accelerate the development, adoption, and use of affordable, reliable, and accurate nitrate and orthophosphate sensors, specifically to reduce the cost of each sensor to under $5,000 and to stimulate this potential market. The EPA hosted 29 participants at a Challenge Summit in Washington, D.C. in August 2015 where they gathered to learn, network, and demonstrate their technologies. After the summit, all 29 submissions were beta-tested, enhancing the preparation of all registered participants for the final challenge verification testing in 2016. According to organizers of the challenge, "the true incentive [of the challenge was] a chance at a piece of the untapped market. Challenge administrators have heard from teams who [were not] selected as finalists that still plan to continue developing their sensors."[43]

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[43] http://www.fondriest.com/news/paving-way-nutrient-sensor-boom.htm

SECTION **4. HIGHLIGHTS FROM PRIZES CONDUCTED UNDER THE AUTHORITY PROVIDED BY COMPETES IN FY 2015**

In FY 2015, the number of competitions conducted through all authorities increased over prior years and is 140 percent more than the number conducted in FY 2012 (Table 2). Forty-one agencies self-reported a total of 116 prizes conducted under all authorities in FY 2015, compared to 30 agencies in FY 2014 and 23 agencies in FY 2013—a 37 percent and 78 percent overall increase, respectively, over the prior 2 years. Of these 116 challenges, 47 were conducted under the authority provided by COMPETES by 23 agencies. Since COMPETES was signed into law during FY 2011, 135 prizes from 35 agencies have been offered under the COMPETES prize authority, and 51 agencies have reported on 312 prizes under all authorities.[44] The data analysis in this section focuses on the 47 challenges in FY 2015 that were conducted under the COMPETES authority.

Table 2. Number of prize competitions and agencies by authority, FY 2011–FY 2015[45]

	Number of prizes under COMPETES authority	Number of Agencies offering prizes under COMPETES authority	Number of prizes under all prize authorities	Number of agencies offering prizes under all authorities
FY 2011	7	7	*Not reported*	*Not reported*
FY 2012	27	12	49	16
FY 2013	41	15	90	23
FY 2014	34	17	97	30
FY 2015	47	23	116[46]	41

In FY 2015, more money was made available through this vehicle to engage innovators and entrepreneurs across the country. The total amount of prize money available in FY 2015 COMPETES challenges is 20 percent greater than the amount offered in FY 2014 COMPETES challenges. Also in FY 2015, six agencies offered prizes for the first time using COMPETES. These agencies include CNCS, NOAA, DHS, USBR, FMC, and OMB. Many of these agencies are having promising results with their first prizes conducted under the COMPETES authority, including:

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[44] This number includes all instances of annual competitions, but does not count competitions multiple times if they were reported more than once; it is therefore different from the sum of challenges reported each year.

[45] The method for calculating these numbers was updated in the FY 2014 report from the method used in previous reports. Component agencies are counted separately if they use distinct infrastructure to operate challenges.

[46] 110 prize competitions reports are included in the appendices of this report. An additional 6 prize competitions (1 from HHS, 2 from the Department of Education, and 3 from CTTSO in the Department of Defense) were reported within the context of the entire agency's activities and did not have individual reports. These 6 competitions were conducted under agency prize authorities other than COMPETES. Annual reports are not required for these competitions. Additionally, DOD changed its agency-wide prize reporting requirements to occur biennially rather than annually, and in line with this reporting structure, the agency plans to submit individual reports for non-COMPETES prizes in the FY 2016 report.

USBR New Concepts for Remote Fish Detection[47]

This prize competition sought ideas for new or better ways to reliably track fish throughout their life-cycle. The ability to track fish is central to efforts to recover threatened and endangered fish species and reduce impacts to at-risk species. Reliable, affordable detection and tracking enables fish-recovery program managers to pursue targeted and more effective actions that can reduce mortality rates, improve habitat, and increase survival rates while continuing to meet the Bureau of Reclamation's (USBR) mission of delivering water and power to customers and stakeholders. Current methods to track fish rely on the capture and handling of fish to implant or attach tags that can be complex, costly, and stressful to the fish. Current tagging technologies also have longevity and detection capability shortcomings, which limit data interpretations to inform fish-recovery actions.

Five of the six top ranked submissions included the use of piezoelectric energy harvesting to power tracking tags attached to individual fish. Piezoelectric energy harvesting uses the swimming movement of the fish to self-power the energy needed by the tracking tag.

Winning participants were highly educated experts from technical domains other than fish tracking. Technical domains included electrical engineering, biomedical engineering, physics, geophysics, and telecommunications. One participant said: "I have to tell you that before the challenge I didn't know that much about the current state of fish tagging – it turned out to be a fascinating topic, with some surprising parallels to the technology of mobile phones. It also gave me an excuse to spend a day at the New England Aquarium, watching fish swim." The competition organizers believe that they "would not have been able to reach [these participants and their submissions] without using the prize competition business model."[48] USBR's next step is to develop a plan to further test, develop, and demonstrate the effectiveness of the best ideas received.

DHS's "Where Am I and Where Is My Team?" Indoor Tracking of the Next Generation First Responder[49]

DHS sought innovative solutions to help track first responders while they are inside a structure without having to set up prepositioned towers or other devices. With the advances in electronics, computers, and nano-manufacturing, DHS S&T sought the perspective of both traditional and non-traditional innovators.

The prize competition advanced the DHS S&T mission by gaining fresh and unique ideas on how to solve a problem that DHS S&T had spent several years and millions of dollars in research and development. The previous investment had been narrowly focused on one technological solution that appeared appropriate years ago. The DHS Science & Technology (S&T) First

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[47] https://www.challenge.gov/challenge/new-concepts-for-remote-fish-detection/

[48] Fiscal Year 2015 Report: Use of Prize Authority in the America COMPETES Reauthorization Act (15 USC 3719), submitted by Bureau of Reclamation of the Department of the Interior to the Office of Science and Technology Policy, March 7, 2016.

[49] https://www.innocentive.com/ar/challenge/9933726

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Responders Group is currently pursuing a program to assess the winning and non-winning solutions for further research and development.

In addition to these agencies demonstrating early results with COMPETES authority, many agencies continue to rely on the authority provided by COMPETES to conduct progressively more ambitious prize competitions. Six agencies have reported on COMPETES challenges for at least three of the five years the authority has been available, and a further eight have reported on challenges under COMPETES or other authorities for at least 3 years, illustrating that there is healthy, continuous use of prizes and challenges by many agencies.

Agencies have experienced the many benefits described in Section 1 through interesting approaches described in Section 3. Agencies have specifically utilized the authority provided by COMPETES to conduct many of its first prize competitions, design sophisticated prize structures, develop partnerships, and address a wide-variety of agency mission areas. Some of the ways COMPETES authority was used in FY15 include:

Putting novel solutions on a path to implementation through phased challenges

The authority provided through COMPETES has offered many benefits to agencies seeking to stimulate innovation through prizes and challenges. For example, in FY 2014, HUD's Rebuild by Design Challenge was structured in multiple stages and relied heavily on the support of partners, to infuse innovation and promote resilience in new designs for public spaces in the region affected by Hurricane Sandy. As HHS reports in FY 2015, "as the ambition and scale of problems addressed through prizes and challenges has increased, so too has the need to equip participants with the momentum to continue work beyond the competition. In response, several HHS challenges include pilot phases, providing an opportunity for prototypes to be tested and therefore supported after the competition. The Office of the National Coordinator for Health Information Technology's (ONC) Market R&D Pilot Challenge was specifically designed for this purpose, asking health IT companies to partner with clinics to perform small-scale testing and validation of products in real patient environments. The Health Research and Services Administration's (HRSA) Bridging the Word Gap Challenge, launched in late FY15, also builds in a third pilot phase to test technological interventions solicited in the first two phases."

Infusing fresh thinking in traditionally industry-dominated problem areas

It is notable that in FY15, two agencies, OMB and USDA[50], which were new to incentive challenges, designed prize competitions in two new domains. These agencies both created their competitions by soliciting input from experts during the competition's design phase. Both challenges reached beyond the usual suspects to find innovative solutions, utilized milestone-based prizes to pay only for success, and leveraged the knowledge of the practitioner communities prior to the challenge to refine the criteria for selection, ensuring that the solutions could be implemented immediately. These two agencies also sought solutions in areas that are not as easily implemented: Federal workforce training, and building construction and regulation.

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[50] OMB was a first-time implementer of the authority provided by COMPETES in FY15. USDA conducted a small scale prize in FY 2012, and their second challenge was conducted in FY15.

Implementation of Federal Prize Authority: Fiscal Year 2015 Progress Report

OMB and USDA both sought to utilize the COMPETES authority in ambitious, mission-critical ways.

OMB's Digital Service Contracting Professional Training and Development Program Challenge

The Office of Federal Procurement Policy (OFPP) and the U.S. Digital Service—both within OMB—worked together to solicit ideas to design a training program that will develop and produce contracting professionals who can be more successful in the era of digital government. Prior to finalizing the concept of the challenge and how it would be run, the organizers needed more information about the existing market in order to understand whether the challenge would be effective, how best to release the challenge and who the target audience should be. Holding a Reverse Industry Day, the government organizers presented the problem to industry experts and had representatives from nine organizations present current solutions to contract professional training. This approach allowed organizers to start outreach efforts prior to the challenge and solicit input from attendees on a draft version of the challenge. The organizers received a significant response to editing the draft challenge, and were able to tweak and modify some minor points before sending out the final challenge.

The challenge was multi-phased. Participants were asked to first develop concept white papers, from which three finalists were chosen (Phase I). Of 23 submissions, five were from private citizens; 12 were from companies with expertise in agile development; four were from companies with expertise in training; and two were from companies with expertise in training and agile development (one of which was a partnership between a company with agile development expertise and a company with training expertise). Three finalists were chosen to further develop their designs and then presented them at an oral presentation along with a 1-hour mock classroom training (Phase II). From the project design, one winner was selected to develop and present the 5-month pilot training program to 30 Federal contracting professionals (Phase III). The winner was selected based upon the overall effectiveness of the proposed program design, the overall capability to assess the effectiveness of the program, and the feasibility of implementation. The winning program will be designed and assessed in FY 2016.

USDA's Tall Wood Building Competition

USDA, in a partnership with the Softwood Lumber Board and the Binational Softwood Lumber Council, launched this prize competition to support the demonstration of tall wood buildings in the United States. The prize competition was conducted to showcase the architectural and commercial viability of advanced wood products in tall building construction to support employment opportunities in rural communities, maintain the health and resiliency of U.S. forests, and advance sustainability in the built environment. There are barriers to being the first to adopt new building materials and systems, including the cost of analyzing novel alternatives and verifying that these solutions comply with applicable code(s). The objective of the competition was to identify one or more existing viable projects with capable design and construction teams willing to convert their existing project from a traditionally constructed tall building to a design and construction approach using advanced wood building materials, new composite, or hybrid wood construction methods. The two winning design teams were granted a

total of $3 million in funding to help support the development of projects in New York and Oregon, which are 12 and 10 stories tall, respectively.[51]

More competitions to advance scientific research

In addition to early technology-development prizes, challenges also have a long history in the scientific world. Scientific societies in 18th and 19th century Europe would regularly post lists of challenges; David Hilbert famously listed 23 math problems of the century to solve in 1900 (some of which have not yet been solved).[52] Scientific challenges seek to promote the understanding of a problem, solution, or outcome using evidence-based practices (empirical or measurable) as the basis of that understanding. Challenges that advance scientific research can include those aimed at soliciting hypotheses from the crowd, advancing scientific research through hypothesis testing, performing discovery-based research, advancing computational approaches, predictive modeling using huge datasets, and applying scientific discoveries and knowledge to other problem areas.

Eight prize competitions in FY 2015 sought to *advance scientific research* as a primary goal, which is 17 percent of the total COMPETES prize competitions for the year. In comparison, in FY 2014, only 6 percent of COMPETES prizes sought to *advance scientific research* as a primary goal. As highlighted in the following competitions, agencies are achieving this goal by soliciting input from scientists or soliciting out of discipline expertise to make scientists' jobs easier.

FDA's Food Safety Challenge

This challenge was a call to scientists, academics, entrepreneurs, and innovators from all disciplines to submit concepts applying novel or advanced methodologies to foster revolutionary improvements in foodborne pathogen detection. Specifically, FDA was most interested in concepts that applied cutting-edge techniques to achieve significant improvements in the speed of detection methods for Salmonella with identification to the subtype/serovar level in minimally processed fresh produce.

The challenge received 49 total entries, most of which were not yet commercialized. The submissions spanned over 25 novel technology areas, going far beyond the research areas identified in the call to action. The winning team devised a method for concentrating Salmonella in samples to detectable levels using microfiltration. The solution has the potential to greatly reduce the time needed to prepare samples from 1-2 days down to 2-3 hours. The runner-up entry featured a portable device for rapid screening using DNA aptamer-magnetic bead sandwich assays. The device promises a total process and analysis time of 30 minutes.

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[51] Further details on the winners can be found at https://tallwoodbuildingcompetition.org/wp-content/uploads/2015/09/US-Tall-Wood-Building-Competition-Backgrounder.pdf

[52] http://www.ams.org/journals/bull/2000-37-04/S0273-0979-00-00881-8/S0273-0979-00-00881-8.pdf, http://mathworld.wolfram.com/HilbertsProblems.html

NOAA's Right Whale Recognition Challenge

Only around 500 North Atlantic right whales exist today making them one of the most endangered animals on the planet. Individuals can be identified by the pattern of callosities on the head along with scars and other markings. Researchers take photographs from vessels and airplanes, and then compare those photographs to the online North Atlantic Right Whale Catalog run by the New England Aquarium. Knowing the individual identity of a whale opens up many possible avenues of research and conservation management including demographics, social structure, reproductive biology, communication, and informed disentanglement operations. The process of matching a photograph to the catalog can be time-consuming, and marine biologists are often working under tight deadlines with limited funding. This competition asked solvers to find a way to automate this process to free up valuable time and resources so that scientists have more time and energy to devote towards the conservation of these endangered whales.

In total, 364 teams comprising 470 players competed to come up with the best solution to classify the individual right whale correctly in the photographic dataset. The *deepsense.io* team won the competition. The organizers hope to use the winning algorithm to create software to automate the process of identifying whales, thereby freeing up valuable time and resources. NOAA partnered with Kaggle and MathWorks to conduct the competition. Kaggle supplied a large community of data scientists motivated to tackle the problem and hosted the competition. MathWorks provided the prize money and hired a public relations firm to provide outreach for the competition.

The diversity of these highlighted challenges and the full collection of COMPETES challenges for this year reflect the diverse missions of the 23 agencies that conducted them. From identifying whales to building wood structures, the COMPETES authority allowed for innovation across varied fields in FY 2015.

Section 5 presents all 47 COMPETES prizes for FY 2015. Collectively, the competitions offered over $35 million in prizes with an average award of $760,000 per competition. This is the highest average prize purse of any year reported.[53]

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[53] FY 2014 had a total prize purse of $25 million for COMPETES prizes, with an average of $790,000 per competition.

SECTION 5. SUMMARY OF PRIZES CONDUCTED UNDER COMPETES IN FY 2015

				Summary of COMPETES Prizes					
Agency	Prize Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Winner #s	Total Prize Purse	Non-Monetary Incentives
CNCS	Excellence in AmeriCorps Programming and Service Awards	Nominations	Highlight Ideas; Educate public; Build capacity	5/28/2015	9/15/2015	113	5	$0	Recognition
CPSC	Carbon Monoxide Poster Contest	Creative	Engagement	7/14/2014	5/13/2015	700	10	$6,000	None
USDA	Tall Wood Building Competition	Tech/hardware	Highlight Ideas; Specific problem; Advance science; Educate public; Engagement; Build capacity; Stimulate market	10/9/2014	9/17/2015	8	2	$3,000,000	None
DOC	NIST Head Health Challenge III	Ideas; Tech/hardware	Develop technology; advance science	2/2/2015	12/15/2015	125	5	$2,000,000	Opportunities to consult and work with NIST, Under Armour, and the other partners
	NIST Reference Data Challenge	Software	Improve government service delivery; Specific problem; Engagement	7/27/2015	11/16/2015	25	3	$45,000	None
	NOAA Right Whale Recognition Challenge	Software	Develop technology; Specific problem	8/27/2015	1/7/2016	2644	3	$10,000	Leaderboard on Kaggle site, and Matlab software
DOD	DARPA Cyber Grand Challenge	Software	Specific problem; Engagement; Build capacity	10/29/2013	TBD	104	0	$6,750,000	None

				Summary of COMPETES Prizes					
Agency	Prize Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Winner #s	Total Prize Purse	Non-Monetary Incentives
DOE	EV Everywhere Logo Challenge	Creative (design & multimedia)	Highlight Ideas; Educate public; Engagement	8/13/2015	11/7/2015	89	1	$5,000	None
	JUMP Prize: Improve Water Heater Performance with Phase Change Materials	Ideas	Develop technology; Specific problem	9/24/2015	3/1/2016	TBD	TBD	$5,000	Interactions with private partners and suggestions for other funding
	JUMP Prize: Low-Cost BTU Sensor for Use in Building HVAC Control Systems	Ideas	Develop technology; Specific problem	9/24/2015	3/1/2016	TBD	TBD	$5,000	Interactions with private partners and suggestions for other funding
	JUMP Prize: Low-Temperature Intrinsically Safe Defrost System	Ideas	Develop technology; Specific problem	9/24/2015	3/1/2016	TBD	TBD	$3,000	Interactions with private partners and suggestions for other funding
	National Clean Energy Business Plan Competition - 2015	Business plans	Highlight Ideas; Develop technology; Engagement; Other	Fall 2013	6/24/2015	194	6	$300,000	Mentorship, virtual training, feedback from investors
	SunShot Catalyst Program	Ideas; Tech/hardware; Business plans	Develop technology; Engagement; Stimulate market	Multiple dates	Multiple dates	360	60	$2,212,000	Letter of commendation
	SunShot Prize: Race to 7-Day Solar	Ideas; Tech/hardware; Business plans	Develop technology; Specific problem; Stimulate market	3/4/2015	9/16/2015	5	5	$10,000,000	Recognition

	Summary of COMPETES Prizes								
Agency	Prize Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Winner #s	Total Prize Purse	Non-Monetary Incentives
DOE	Wave Energy Prize	Ideas; Tech/hardware	Develop technology; Specific problem	4/27/2015	11/1/2016	92	TBD	$2,250,000	Tank testing, MathWorks software, water-lubricated bearings, team building
HHS	ASA VizRisk	Software; Creative; Analytics; Scientific	Educate public; Stimulate market	7/26/2014	1/7/2015	11	3	$15,000	Recognition and visibility
	CDC No Petri Dish Diagnostic Test Challenge	Software; Creative; Ideas; Tech/hardware; Scientific	Educate public; Engagement; Stimulate market	9/1/2014	1/26/2015	8	1	$200,000	None
	CDC 2014 Million Hearts Hypertension Control Challenge	Nominations; Other	Improve government service delivery; Highlight Ideas; Educate public; Engagement; Stimulate market	8/20/2014	2/24/2015	42	30	$40,000	Recognition
	CDC 2015 Million Hearts Hypertension Control Challenge	Nominations; Other	Improve government service delivery; Highlight Ideas; Educate public; Engagement; Stimulate market	8/1/2015	Spring 2016	TBD	TBD	$40,000	None
	CDC HA-VTE Prevention Challenge	Tech/hardware; Scientific	Highlight Ideas; Specific problem	11/2/2015	4/1/2016	TBD	TBD	$70,000	None

				Summary of COMPETES Prizes					
Agency	Prize Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Winner #s	Total Prize Purse	Non-Monetary Incentives
HHS	FDA Food Safety Challenge	Tech/hardware; Scientific	Advance science; Educate public; Stimulate market	9/23/2014	7/22/2015	49	5	$500,000	Mentorship, visibility
	HRSA Bridging the Word Gap Challenge	Ideas; Tech/hardware	Develop technology	11/8/2015	3/1/2017	TBD	TBD	$300,000	None
	NIH/NIEHS Climate Change and Environment Exposures Challenge	Software; Analytics	Improve government service delivery; Specific problem; Engagement	10/1/2015	2/22/2016	TBD	TBD	$35,000	None
	NIH DEBUT Challenge 2015	Ideas; Tech/hardware; Scientific	Highlight Ideas; Develop technology; Stimulate market; Other	3/16/2015	8/21/2015	59	3	$45,000	Visibility, mentorship
	NIH Follow that Cell Challenge	Ideas; Scientific	Specific problem; Advance science; Stimulate market	8/15/2014	3/16/2015	53	5	$500,000	Invitation to NIH meeting
	NIH Harnessing Insights from Other Disciplines to Advance Drug Abuse and Addiction Research	Ideas	Improve government service delivery; Engagement; Build capacity	5/26/2015	8/6/2015	19	0	$25,000	None
	NIH Innovations in Measuring and Managing Addiction Treatment Quality	Ideas; Scientific	Advance science; Build capacity	1/14/2015	9/30/2015	5	0	$100,000	None

				Summary of COMPETES Prizes					
Agency	Prize Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Winner #s	Total Prize Purse	Non-Monetary Incentives
HHS	NIH U4C - Stimulating Innovation in Breast Cancer	Ideas; Scientific	Highlight Ideas; Specific problem; Advance science; Engagement	6/15/2015	4/16/2016	TBD	TBD	$50,000	None
	NIH Wearable Alcohol Sensor Challenge	Tech/hardware	Develop technology; Specific problem	3/2/2015	2/16/2016	TBD	TBD	$300,000	None
	ONC EHR Innovations for Improving Hypertension Challenge	Ideas	Highlight Ideas; Specific problem; Advance science; Engagement	7/9/2014	11/7/2014	3	2	$50,000	None
	ONC Market R&D Pilot Challenge	Tech/hardware; Business plans	Develop technology; Engagement; Other	10/21/2014	4/30/2015	82	6	$300,000	Pilot testing environment
	SAMHSA Offender Reintegration Toolkit Challenge	Software	Develop technology; Specific problem	6/1/2015	9/9/2015	9	3	$22,500	None
	SAMHSA Opioid Overdose Prevention Challenge	Software	Develop technology; Specific problem	6/1/2015	9/4/2015	15	3	$22,500	None
DHS	"Where Am I, Where Is My Team?" Indoor Tracking of the Next Generation First Responder	Ideas	Highlight Ideas; Develop technology; Specific problem; Advance science; Educate public; Engagement	3/3/2015	5/20/2015	58	2	$25,000	Recognition

			Summary of COMPETES Prizes						
Agency	**Prize Name**	**Solution Type(s)**	**Primary Goal(s)**	**Date Open**	**Date Complete**	**Entry #s**	**Winner #s**	**Total Prize Purse**	**Non-Monetary Incentives**
HUD	Second Annual Innovation in Affordable Housing Competition	Creative; Ideas; Business plans	Highlight Ideas; Specific problem; Build capacity	10/17/2014	4/21/2015	35	2	$30,000	Trip to DC to present in front of experts, résumé experience
DOI	USBR New Concepts for Remote Fish Detection	Ideas	Improve government service delivery; Highlight Ideas; Specific problem; Engagement	7/27/2015	11/9/2015	22	4	$20,000	None
DOJ	NIC Green Corrections Challenge	Ideas	Improve government service delivery; Develop technology; Specific problem; Advance science; Educate public; Engagement; Build capacity; Stimulate market	4/1/2014	11/21/2014	21	5	$0	Webinars, case studies
FMC	FMC Chairman's Earth Day Award	Nominations	Highlight Ideas	10/8/2014	3/30/2015	6	1	$0	Recognition and plaque
FTC	DetectaRobo	Analytics	Develop technology; Specific problem; Educate public; Engagement	6/6/2015	8/17/2015	7	3	$0	Publicity

			Summary of COMPETES Prizes							
Agency	Prize Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Winner #s	Total Prize Purse	Non-Monetary Incentives
FTC	Robocalls: Humanity Strikes Back	Analytics	Develop technology; Specific problem; Educate public; Engagement	3/4/2015	8/17/2015	2	2	$35,500	Publicity
GSA	Digital Innovation and Strategy Hack-a-Thon	Software; Analytics	Specific problem; Highlight Ideas; Develop technology; Engagement; Improve service delivery	4/28/2015	5/8/2015	65	12	$12,000	None
OMB	Digital Service Contracting Professional Training and Development Program Challenge	Ideas; Other	Improve service delivery; Highlight Ideas; Stimulate market	5/20/2015	7/8/2015	23	1	$360,000	Recognition
SBA	America's Seed Fund Logo Design Competition for the SBIR/STTR Programs	Creative	Specific problem; Engagement	5/4/2015	6/15/2015	280	1	$2,500	Unveiling at the White House
	Growth Accelerator Fund Competition - 2015	Creative; Business plans	Educate public; Stimulate market	4/1/2015	8/4/2015	417	88	$4,400,000	None
	InnovateHER Competition	Ideas; Business plans	Develop technology; Educate public	3/1/2015	5/8/2015	74	3	$30,000	None

				Summary of COMPETES Prizes						
Agency	Prize Name	Solution Type(s)	Primary Goal(s)	Date Open	Date Complete	Entry #s	Winner #s	Total Prize Purse	Non-Monetary Incentives
SBA	Startup in a Day Competition - Start Small Model	Software; Ideas	Highlight ideas; Improve government service delivery	6/11/2015	8/4/2015	81	27	$1,350,000	Community of Practice
	Startup in a Day Competition - Dream Big Model	Software; Ideas	Improve service delivery; Highlight Ideas	6/11/2015	8/4/2015	14	1	$250,000	Community of Practice

APPENDICES

Appendix 1. AGENCY PRIZES & CHALLENGES CONDUCTED UNDER THE
AMERICA COMPETES REAUTHORIZATION ACT OF 2010

Appendix 2. A SELECTION OF AGENCY PRIZES AND CHALLENGES
CONDUCTED UNDER AUTHORITIES OTHER THAN THE AMERICA
COMPETES REAUTHORIZATION ACT OF 2010