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Federal Prize Competitions

Marcy E. Gallo
Analyst in Science and Technology Policy

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Federal Prize Competitions

Prize competitions are a tool for incentivizing the achievement of scientific and technological innovation by offering monetary and nonmonetary benefits (e.g., recognition) to competition participants. Prize competitions have a long history of use in both the public and private sectors, but have gained popularity in recent years. Experts view federal prize competitions as an alternative policy instrument for spurring innovation, not a substitute for more traditional methods of federal support for research and innovation such as competitive research grants and procurement contracts.

SUMMARY

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Marcy E. Gallo
Analyst in Science and Technology Policy
-redacted-@crs.loc.gov

The use of prize competitions by the federal government has increased significantly since the passage of the America COMPETES Reauthorization Act of 2010 (P.L. 111-358). P.L. 111-358 encouraged the use of prize competitions by providing the head of any federal agency with the authority to carry out prize competitions that have the potential to stimulate innovation and advance the agency's mission. Congress has also provided various federal agencies, including the Department of Defense, the National Aeronautics and Space Administration, the Department of Energy, the National Science Foundation, and the Department of Health and Human Services, with additional authority to conduct prize competitions. The United States General Services Administration estimates that since 2010 federal agencies have conducted nearly 1,000 prize competitions. The total amount of prize money offered by federal prize competitions conducted under P.L. 111-358 has increased over time from $247,000 in FY2011 to over $37 million in FY2018. Additionally, the median amount of prize money offered per prize has increased from $34,500 in FY2011 to $80,000 in FY2018.

According to the Office of Management and Budget and the Office of Science and Technology Policy, prize competitions benefit the federal government by allowing federal agencies to (1) pay only for success; (2) establish ambitious goals and shift technological and other risks to prize participants; (3) increase the number and diversity of individuals, organizations, and teams tackling a problem, including those who have not previously received federal funding; (4) increase cost effectiveness, stimulate private-sector investment, and maximize the return on taxpayer dollars; and (5) motivate and inspire the public to tackle scientific, technical, and societal problems.

Despite an increase in the use of federal prize competitions, there is limited information on their effectiveness and impact in spurring innovation and providing other potential benefits to the federal government. Members of Congress may wish to examine the ability of prize competitions to spur innovation in comparison to more traditional policy tools (e.g., grants and contracts); the cost effectiveness of prize competitions; the metrics federal agencies are using to evaluate the success of federal prize competitions; and the capability of federal agencies to appropriately design and administer prize competitions.

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Background

Since at least the 18th century, governments, industry, philanthropic organizations, and other nongovernmental organizations throughout the world have offered prizes as a way to reward accomplishments in science and technology (S&T). Napoleon's government offered a 12,000 franc prize (worth more than four years of a French captain's pay in 1803) for a technology that would enhance the preservation of food and help the government feed advancing military troops. In 1809, the prize was awarded to Nicolas François Appert, whose method of heating, boiling, and sealing food in airtight jars was published as a condition of the reward and serves as the basis for the modern process of canning foods. In 1919, businessman Raymond Orteig offered $25,000 (more than $375,000 today) for the first nonstop flight between New York and Paris. Charles Lindbergh, in the *Spirit of St. Louis*, won the prize in 1927. The success of the Orteig Prize in advancing commercial aviation is cited as inspiring the Ansari X-Prize[1] more than 70 years later to lower the risk and cost of commercial space travel.[2]

Prizes generally fall into two main categories: innovation inducement prizes, which are designed to encourage the achievement of scientific and technical goals not yet reached, and recognition prizes such as the National Medal of Science, National Medal of Technology and Innovation, or the Nobel prizes, which reward past S&T accomplishments and do not have a specific scientific or technical goal. The prize competitions and legislation discussed in this report refer to innovation inducement prizes.

According to some experts, prize competitions should be viewed as "a potential complement to, and not a substitute for, the primary instruments of direct federal support of research and innovation—peer-reviewed grants and procurement contracts."[3] Furthermore, prizes are not always considered to be the most appropriate mechanism to address all research and innovation objectives; for example, a 2014 report by the U.S. Chamber of Commerce Foundation specifically states that prizes are not a substitute for long-term basic research.[4]

The comparative strengths of prize competitions in relation to the use of federal grants and contracts, as described by the National Academy of Engineering in a 1999 report, include (1) the ability to attract a broader spectrum of participants and ideas by reducing costs and bureaucratic barriers to participation; (2) the potential leveraging of a sponsor's financial resources; (3) the ability of federal agencies to shift the technical and other risks to contestants; and (4) the capacity to educate, inspire, and potentially mobilize the public around scientific, technical, and societal objectives.[5]

[1] The Ansari X-Prize offered $10 million to the first team "to build a reliable, reusable, privately-financed, manned spaceship capable of carrying three people to 100 kilometers above the Earth's surface twice within two weeks." The prize was awarded in 2004 to Mojave Aerospace Ventures. More about the prize can be found at https://ansari.xprize.org/.

[2] Knowledge Ecology International, Selected Innovation Prizes and Reward Programs, KEI Research Note 2008:1 at http://www.keionline.org/misc-docs/research_notes/kei_rn_2008_1.pdf.

[3] National Research Council, *Concerning Federally Sponsored Inducement Prizes in Engineering and Science*, The National Academies Press, Washington, DC, 1999, p. 1, https://doi.org/10.17226/9724.

[4] Michael Hendrix, *The Power of Prizes: Incentivizing Radical Innovation*, U.S. Chamber of Commerce Foundation, Washington, DC, 2014.

[5] National Research Council, *Concerning Federally Sponsored Inducement Prizes in Engineering and Science*, The National Academies Press, Washington, DC, 1999, https://doi.org/10.17226/9724.

Similarly, during the Obama Administration, the Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP) described prize competitions as having the benefit of allowing the federal government to

- pay only for success and identify novel approaches, without bearing high levels of risk;
- establish ambitious goals without having to predict which team or approach is most likely to succeed;
- increase the number and diversity of individuals, organizations, and teams tackling a problem, including nonscientists and individuals who have not previously received federal funding;
- increase cost effectiveness, stimulate private-sector investment, and maximize the return on taxpayer dollars;
- further a federal agency's mission while motivating and inspiring others and capturing the public imagination; and
- establish clear success metrics and validation protocols that themselves become defining tools and standards for the subject, industry, or field.[6]

Some experts have indicated that while prize competitions have more uncertainty in terms of program outputs and outcomes than more traditional instruments (i.e., grants and contracts), the potential payoffs to federal agencies can be higher if properly designed and implemented.[7] Specifically, determining the correct size of the cash prize; transparent, simple, and unbiased contest rules; and the proper treatment of intellectual property rights are considered important aspects of a successful prize competition.[8]

Broad Prize Competition Authority

In 2010, Congress passed the America COMPETES Reauthorization Act of 2010 (P.L. 111-358) providing the head of a federal agency with the authority to carry out prize competitions "to stimulate innovation that has the potential to advance the mission of the respective agency."[9] Specifically, P.L. 111-358 added Section 24 to the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. §3719) defining what activities constitute a prize competition and detailing how a federal agency should address liability issues, intellectual property rights, the judging of a prize competition, and other topics.

In 2017, the American Innovation and Competitiveness Act (P.L. 114-329) made a number of technical and clarifying amendments to this broad prize competition authority, including language authorizing the head of a federal agency to request and accept funds for the design and administration of a prize competition or for the cash prize itself from other federal agencies, state

[6] Jeffrey D. Zients, Deputy Director for Management, *Guidance on the Use of Challenges and Prizes to Promote Open Government*, Office of Management and Budget, M-10-11, Washington, DC, March 8, 2010, p. 2, https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2010/m10-11.pdf; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2016 Progress Report*, Washington, DC, July 7, 2017, p. iv, https://www.challenge.gov/toolkit/files/2017/07/FY2016-Implementation-Federal-Prize-Authority-Report-and-Appendices.pdf.

[7] Luciano Kay, *Managing Innovation Prizes in Government*, IBM Center for the Business of Government, Washington, DC, 2011.

[8] National Research Council, *Concerning Federally Sponsored Inducement Prizes in Engineering and Science*, The National Academies Press, Washington, DC, 1999, https://doi.org/10.17226/9724.

[9] 15 U.S.C. §3719; federal agency as defined under 15 U.S.C. §3719 excludes legislative branch agencies.

and local governments, private-sector for-profit entities, and nonprofit entities. The general provisions of the law, as amended, are as follows:

- Prize competitions are defined as being one or more of the following: (1) a competition that rewards and spurs the development of a solution to a well-defined problem; (2) a competition that helps identify and promote a broad range of ideas and facilitates development of such ideas by third parties, especially in an area that may not otherwise receive attention; (3) competitions that encourage participants to change their behavior or develop new skills during and after the competition; and (4) any other competition the head of an agency considers appropriate to stimulate innovation and advance the agency's mission.
- Federal agencies must advertise a competition widely to encourage broad participation, including publishing a notice of the competition on a publicly accessible government website (e.g., http://www.challenge.gov/).[10] The notice must describe the subject of the prize competition, rules for participating, the registration process, the amount of the prize purse, and how the winner will be selected.
- To be eligible to win a federal prize competition, an individual, participating singly or within in a group, must be a United States citizen or permanent resident, cannot be a federal employee acting within the scope of their employment, and must be registered and in compliance with all the requirements and rules of the prize competition. Similarly, to be eligible to win a federal prize competition, a private entity must be incorporated in and maintain a primary place of business within the United States and must be registered and in compliance with the requirements and rules of the prize competition.
- Federal agencies must require all participants to register, assume any and all risks, and waive claims against the government. Registered participants must also obtain liability insurance or demonstrate financial responsibility; however, an agency can waive the insurance requirement.
- The federal government cannot gain an interest in intellectual property developed by a participant without written consent of the participant.
- The head of a federal agency must appoint one or more judges using guidelines that are transparent and promote balance. Additionally, a judge cannot have a personal or financial conflict of interest with any of the registered participants.
- Funding for a prize competition, including the design and administration of a competition, may consist of federally appropriated funds and/or funds provided by a state or local government or a private-sector for-profit or nonprofit entity. A federal agency can solicit and accept funds from other federal agencies, state and local governments, private-sector for-profit entities, and nonprofit entities. A prize competition cannot be announced until all of the funds have been appropriated or committed in writing.
- Federal agencies can enter into an agreement with a private-sector for-profit or nonprofit entity or a state or local government agency to administer a federal prize competition.

[10] Challenge.gov is a listing of federal challenge and prize competitions; the website was launched in 2010 and is managed by the U.S. General Services Administration.

- A prize in excess of $50 million cannot be offered unless 30 days have elapsed after written notice is provided to Congress. The head of a federal agency must approve any award of more than $1 million.
- The Director of the Office of Science and Technology Policy (OSTP) must submit a biennial report to Congress detailing the use of the prize competition authority provided by P.L. 111-358.[11]

P.L. 114-329 also provided federal agencies with the "explicit authority to use crowdsourcing and citizen science … to advance federal science agency missions and stimulate and facilitate broader public participation in the innovation process" (see the box, "Crowdsourcing and Citizen Science" below for more information).[12]

Crowdsourcing and Citizen Science

According to OSTP, the federal government has long engaged citizens in the scientific process and in helping federal agencies accomplish their missions. For example, the Cooperative Observer Program under the National Weather Service was formally established in 1890 to support volunteers in the collection of observational meteorological data.[13] Additionally, the U.S. Geologic Survey uses the "Did You Feel It?" program to collect information from people who felt an earthquake and create maps that show what people experienced and the extent of damage.[14]

According to P.L. 114-329, crowdsourcing and citizen science projects offer a number of benefits, including the acceleration of scientific research, increasing the return on taxpayer dollars, addressing societal needs, providing science, technology, engineering, and mathematics (STEM) learning experiences, and connecting the public directly to federal science agency missions. P.L. 114-329 defines crowdsourcing as "a method to obtain needed services, ideas, or content by soliciting voluntary contributions from a group of individuals or organizations, especially from an online community." It defines citizen science as "a form of open collaboration in which individuals or organizations participate voluntarily in the scientific process in various ways," including through the collection, analysis, and interpretation of data, among other areas.[15]

In addition to providing federal agencies with explicit authority to create crowdsourcing and citizen science projects, P.L. 114-329 directed the General Services Administration to identify and develop relevant products, training, and services to facilitate the use of crowdsourcing and citizen science activities.[16] These resources and a catalog of crowdsourcing and citizen science projects can be found at CitizenScience.gov.

Agency Specific Prize Competition Authorities

Over the years, Congress has provided some federal agencies with additional explicit authority to conduct prize competitions. Federal agencies with specific prize competition authorities are as follows:

- **Department of Defense (DOD)**: In 1999, Congress provided prize competition authority to the Defense Advanced Research Projects Agency through the

[11] 15 U.S.C. §3719.

[12] 15 U.S.C. §3724.

[13] Office of Science and Technology Policy, *Implementation of Federal Prize and Citizen Science Authority: Fiscal Years 2017-18*, Washington, DC, June 2019, p. 15, https://www.whitehouse.gov/wp-content/uploads/2019/06/Federal-Prize-and-Citizen-Science-Implementation-FY17-18-Report-June-2019.pdf.

[14] For more information on the "Did You Feel It?" program, see https://earthquake.usgs.gov/data/dyfi/background.php#for.

[15] 15 U.S.C. §3724.

[16] Ibid.

National Defense Authorization Act for Fiscal Year 2000 (P.L. 106-65).[17] In 2006, the authority was extended to the military departments through the John Warner National Defense Authorization Act for Fiscal Year 2007 (P.L. 109-364). Specifically, the authority states that the Secretary of Defense can award prizes "in basic, advanced, and applied research, technology development, and prototype development that have the potential for application to the performance of the military missions of the Department of Defense."

- **Department of Energy (DOE)**: In 2005, through the Energy Policy Act of 2005 (P.L. 109-58), the Secretary of Energy was authorized to carry out a program "to award cash prizes in recognition of breakthrough achievements in research, development, demonstration, and commercial application that have the potential for application to the performance of the mission of the Department."[18] P.L. 109-58 also authorized the Freedom Prize with the goal of advancing technologies that will reduce America's dependence on foreign oil. In 2007, through the Energy Independence and Security Act of 2007 (P.L. 110-140), Congress authorized DOE to conduct the Hydrogen Prize and the Bright Tomorrow Lighting Prize to stimulate innovation and advancement in hydrogen energy technologies and solid-state lighting products, respectively.[19] In 2011, through P.L. 111-358, Congress authorized the Director of the Advanced Research Projects Agency-Energy to provide awards in the form of cash prizes, among other mechanisms.[20]
- **National Aeronautics and Space Administration (NASA):** In 2005, through the National Aeronautics and Space Administration Authorization Act of 2005 (P.L. 109-155), the Administrator of NASA was granted the authority to award cash prizes "to stimulate innovation in basic and applied research, technology development, and prototype demonstration that have the potential for application to the performance of the space and aeronautical activities of the Administration."[21]
- **Department of Health and Human Services (HHS)**: In 2006, through the Pandemic and All-Hazards Preparedness Act (P.L. 109-417), the Secretary of HHS was authorized "to award contracts, grants, cooperative agreements, or enter into other transactions, such as prize payments" to promote innovation and research and development on biodefense medical countermeasures.[22] In 2016, through the 21st Century Cures Act (P.L. 114-255), the Director of the National Institutes of Health was directed to support prize competitions that would realize significant advancements in biomedical science or improve health outcomes, especially as they relate to human diseases or conditions.[23]

[17] 10 U.S.C. §2374a.

[18] 42 U.S.C. §16396.

[19] 42 U.S.C. §16396; 42 USC §17243.

[20] 42 U.S.C. §16538.

[21] 51 U.S.C. §20144.

[22] 42 U.S.C. §247d-7e.

[23] 42 U.S.C. §283q.

- **National Science Foundation (NSF)**: In 2007, the America COMPETES Act (P.L. 110-69) authorized NSF "to receive and use funds donated by others" for the specific purpose of creating prize competitions for basic research.[24]
- **Department of Transportation (DOT)**: In 2012, through the Moving Ahead for Progress in the 21st Century Act (P.L. 112-141), the Secretary of Transportation was authorized to use up to 1% of the funds made available from the Highway Trust Fund for research and development to carry out a prize competition program "to stimulate innovation in basic and applied research and technology development that has the potential for application to the national transportation system."[25]
- **Department of Commerce (DOC)**: In 2018, through the Consolidated Appropriations Act for Fiscal Year 2018 (P.L. 115-141), the Secretary of Commerce, subject to the availability of funds, was directed to conduct prize competitions that will accelerate the development and commercialization of technologies to improve spectrum efficiency.[26]

Prize Competition Trends

Overall, the U.S. General Services Administration (GSA) estimates that since 2010 federal agencies have conducted nearly 1,000 prize competitions.[27] The use of prize competitions by federal agencies has grown since the enactment of the America COMPETES Reauthorization Act of 2010 (P.L. 111-358) and its inclusion of a broad prize competition authority as described above. As shown in **Figure 1**, the number of active prize competitions conducted under the authority provided in P.L. 111-358 grew from 7 in FY2011 to 67 in FY2018.[28] The number of active prize competitions conducted under other authorities has also increased, peaking at 70 in FY2015.[29] The number of federal agencies conducting active prize competitions has increased from 7 federal agencies in FY2011 to 22 in FY2018, with a high of 41 federal agencies conducting prize competitions in FY2015.

[24] 42 U.S.C. §1870.

[25] 23 U.S.C. §502.

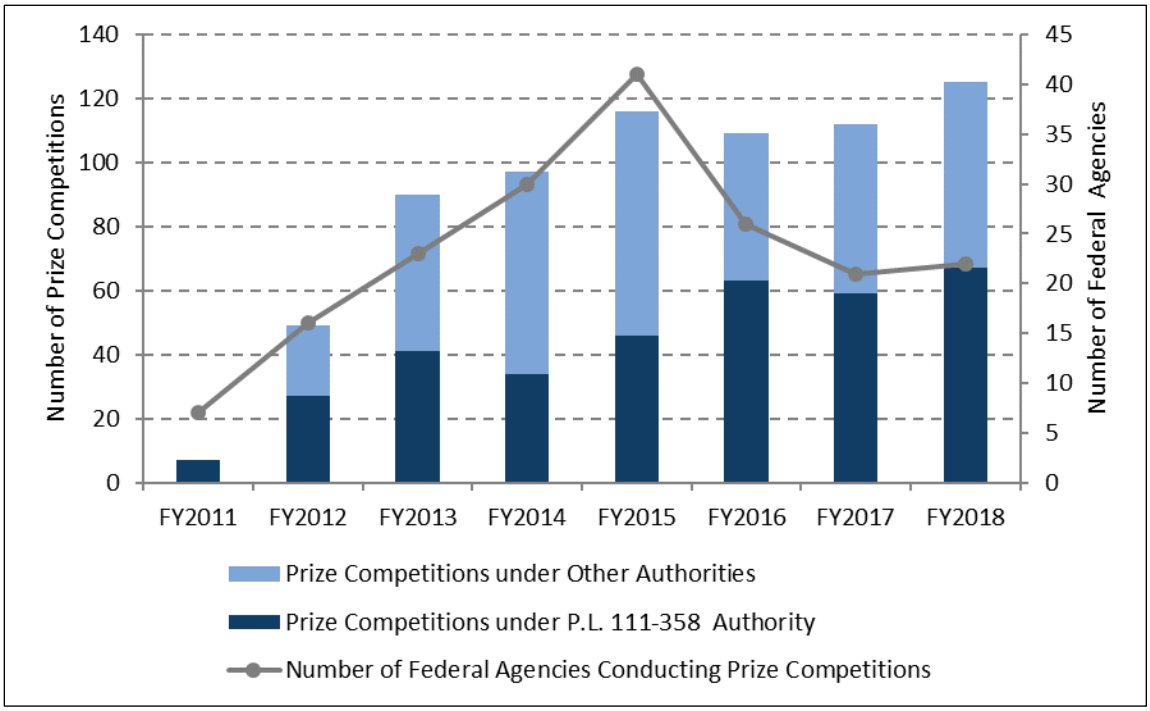
[26] 47 U.S.C. §1509.

[27] General Service Administration, "About Challenge.gov," at https://www.challenge.gov/about/.

[28] An active prize competition means a prize competition that has not been awarded and remains open in a given fiscal year. Prize competitions may be counted in subsequent fiscal years.

[29] Federal agencies conducting prize competitions using authorities other than P.L. 111-358 are not required to provide information to the Office of Science and Technology Policy for inclusion in the biennial reports, so the data presented here maybe incomplete.

Figure 1. Number of Active Federal Prize Competitions, FY2011-FY2018



Source: Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Progress Report*, Washington, DC, March 2012; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2012 Progress Report*, Washington, DC, December 2013; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2013 Progress Report*, Washington, DC, May 2014; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2014 Progress Report*, Washington, DC, April 2015; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2015 Progress Report*, Washington, DC, August 2016; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2016 Progress Report*, Washington, DC, July 2017; and CRS analysis of Office of Science and Technology Policy, *Implementation of Federal Prize and Citizen Science Authority: Fiscal Years 2017-18*, Washington, DC, June 2019.

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Notes: Federal agencies conducting prize competition under authorities other than P.L. 111-358 are not required to report data on the use of prizes and therefore the data included in this figure for "Prize Competitions under Other Authorities" may be incomplete.

The total amount of prize money offered by federal agencies has also increased over time.[30] In FY2011, the active prize competitions conducted by federal agencies under P.L. 111-358 offered a total of $247,000 and in FY2018 the total amount of prize money offered exceeded $37 million (**Figure 2**). The average value of the prize money offered by competitions under P.L. 111-358 increased from $35,286 in FY2011 to $592,136 in FY2018. The median amount of prize money offered per prize has also increased over time from a median value of $34,500 in FY2011 compared to $80,000 in FY2018.[31]

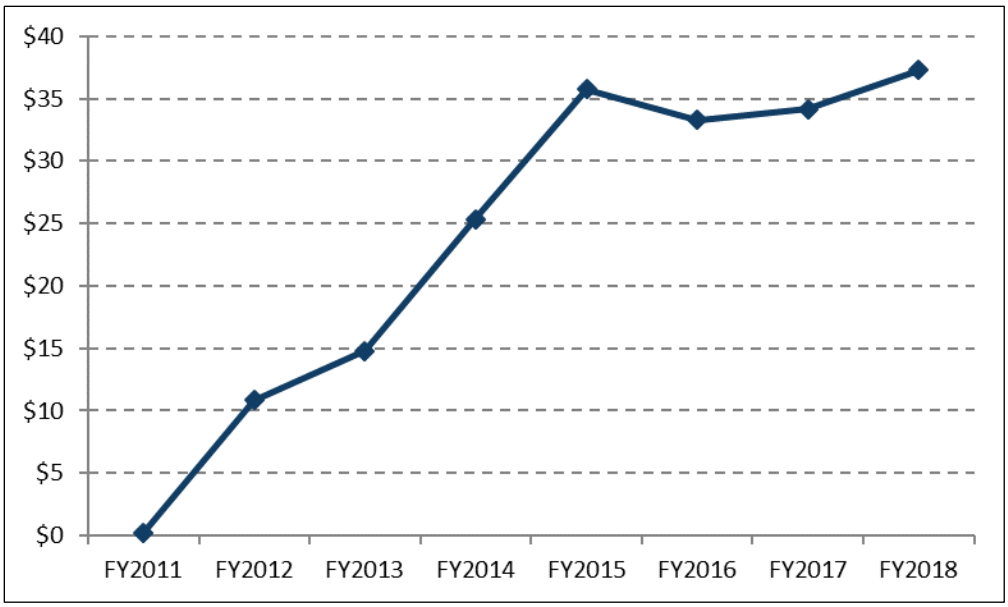
[30] The amount of prize money offered is not necessarily the amount of prize money awarded. Some prizes are not awarded if no competitor is successful. Federal agencies also may decide to award prize money to more winners than anticipated; a federal agency may have initially offered prize money to the top three contestants, but decided based on the outcome of the competition to award prize money to the top five contestants.

[31] The median is the middle number in a data set, which is determined by placing all the numbers in value order and finding the middle number in the data set. The mean or average is the sum of all the numbers in the data set divided by

According to OSTP, nine federal agencies—HHS, NASA, DOE, DOD, NSF, the Department of the Interior (DOI), the U.S. Environmental Protection Agency (EPA), the Office of the Director of National Intelligence (ONDI), and the U.S. Agency for International Development (USAID)—account for the majority of prize competitions and prize money offered between FY2014 and FY2018. For example, both HHS and NASA have conducted more than 100 prize competitions between FY2014 and FY2018 and the median value of prizes offered by HHS in FY2018 was $130,000.[32]

Figure 2. Total Federal Prize Money Offered by Active Prize Competitions Conducted Under P.L. 111-358, FY2011-FY2018

in millions of current dollars



Source: Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Progress Report*, Washington, DC, March 2012; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2012 Progress Report*, Washington, DC, December 2013; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2013 Progress Report*, Washington, DC, May 2014; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2014 Progress Report*, Washington, DC, April 2015; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2015 Progress Report*, Washington, DC, August 2016; Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2016 Progress Report*, Washington, DC, July 2017; and CRS analysis of Office of Science and Technology Policy, *Implementation of Federal Prize and Citizen Science Authority: Fiscal Years 2017-18*, Washington, DC, June 2019.

Notes: Prize money offered may differ from the amount of prize money actually awarded. For example, in 2004 under the Grand Challenge, the Defense Advanced Research Projects Agency offered a prize of $1 million to a fully autonomous, unmanned ground vehicle capable of traveling 142 miles across desert terrain in the best time under 10 hours. None of the vehicles were able to complete the course and no prize money was awarded.

the amount of numbers in the data set. If the median and mean are similar then the distribution of the data set is assumed to be symmetrical. If the median is smaller than the mean then the data set is skewed to the right and most of the numbers in the data set are smaller.

[32] Office of Science and Technology Policy, *Implementation of Federal Prize and Citizen Science Authority: Fiscal Years 2017-18*, Washington, DC, June 2019, pp. 11, 14.

Potential Policy Considerations

Federal agencies have increased the use of prize competitions to spur innovation and advance the mission of their respective agencies; however, there is limited information on the effectiveness and impact of prize competitions generally. According to experts, only a small number of prize competitions have been systematically evaluated.[33] Members of Congress may conduct oversight through hearings (or other means) to gain insight into existing federal prize competitions and related programs to inform potential changes in the use of prizes by federal agencies. Questions for congressional consideration might include the following:

- Would the technology or innovation have been developed in the absence of a prize competition?
- Did the prize competition shorten the timeframe for the development of the technology or innovation?
- Was the prize competition cost effective?
- What, if any, other benefits were gained from conducting the prize competition?
- Would the use of a more traditional policy tool such as a grant or contract have resulted in the development of a similar technology or innovation?
- If the prize competition were designed differently, would a more effective or revolutionary technology or innovation have been developed?
- What are the appropriate metrics for determining the success of a prize competition? Are the metrics different when evaluating the near-term and long-term impacts of a prize competition?
- What are the best practices of successful prize competitions?

According to a 2017 report, "if measurement, assessment, and learning become standard parts of innovation challenges, the challenge community will have a growing evidence base with which to move ahead quickly in applying approaches best able to achieve funders' objectives, in terms of social impact and on other metrics."[34] The awarding of a prize may be considered by some as evidence of the success of a prize competition; however, experts generally agree that both quantitative and qualitative information is necessary to assess success. Members of Congress may examine what metrics and other data and information federal agencies collect on federal prize competitions, including any effort by OSTP or others to standardize data collection across the federal government. According to a 2015 article by NASA employees,

> As understanding of how open innovation approaches can advance scientific discovery and technology development grows, more study should be focused on performance measurement and management of these approaches. Since the types, outputs and outcomes of challenges vary so greatly, developing a set of metrics to guide performance management and resource allocation for these types of activities is a difficult, but important task.[35]

[33] Abigail Conrad, Tulika Narayan, and Judy Geyer, et al., *A Framework for Evaluating Innovation Challenges*, Abt Associates, Bethesda, MD, March 2017; Heidi Williams, "Innovation Inducement Prizes: Connecting Research to Policy," *Journal of Policy Analysis and Management*, vol. 31, no. 3, pp. 752-776 (2012).

[34] Abigail Conrad, Tulika Narayan, and Judy Geyer, et al., *A Framework for Evaluating Innovation Challenges*, Abt Associates, Bethesda, MD, March 2017.

[35] Jennifer L. Gustetic, Jason Crusan, and Steve Rader, et al., "Outcome-Driven Open Innovation at NASA," *Space*

The design and implementation of a prize competition is held by many to be critical to the success of the competition. Specifically, in a 1999 report, the National Academy of Engineering stated that "if prize contests are not designed or administered with care, they may discourage prudent risk taking or unorthodox approaches to particular scientific or technological challenges, or scare away potential contestants with excessive bureaucracy."[36] In a 2018 article, the authors stated that "the contests posted on the challenge.gov platform tend to show that if contests are well designed, they can spur both incremental and radical innovation. However, it seems that contests are better able to support technology/science advancement than commercial progress."[37]

Increased interest in the use of prize competitions by Congress and the current and previous Administrations has resulted in federal agencies developing more in-house expertise in the design and administration of prize competitions. For example, in FY2017 and FY2018, 8 federal agencies had department-wide policy and guidance on the use of prize competitions; 5 agencies had dedicated, full-time prize competition personnel; 16 agencies had distributed networks or communities of prize and project managers with prize competition expertise within the agency; and 5 agencies were providing centralized training and design support to agency staff. Additionally, GSA fostered the development of a federal community of practice in prize competitions, and in 2016, published a prize and challenges toolkit to assist federal agencies.[38] On the other hand, InnoCentive, a company that performs prize competition services for public and private organizations, has argued for increased outsourcing of the design and administration of publicly funded prize competitions, stating

> Governments and international public institutions should be actively seeking to improve their own innovation systems expertise, but they should also support the development of a strong, vibrant, and bold innovation management industry in the private sector. Ultimately, it is this vibrant marketplace of independent organizations, with their global diversity of perspectives and ideas, that will best drive forward the evolution and progress of innovation using challenges.[39]

Members of Congress may examine the capability and expertise of federal agencies in the design and administration of prize competitions, in addition to federal agencies' use of partners and paid vendors to create teams with the ability and experience needed to run successful prize competitions.

In addition to examining current federal prize competitions and federal agency expertise, some Members of Congress may want to establish new federal prize competitions through legislation. In developing such legislation, policymakers may consider some of the following questions:[40]

- Should the legislation be general and flexible, providing federal agencies with an overview of the prize goals, or specific, detailing instructions to the agency

Policy, vol. 34 (November 2015), pp. 11-17.

[36] National Research Council, *Concerning Federally Sponsored Inducement Prizes in Engineering and Science*, The National Academies Press, Washington, DC, 1999, p. 6, https://doi.org/10.17226/9724.

[37] Isabelle Liotard and Valérie Revest, "Contests as Innovation Policy instruments: Lessons from the U.S. Federal Agencies' Experience," *Technological Forecasting & Social Change*, vol. 127 (2018), p. 66.

[38] Office of Science and Technology Policy, *Implementation of Federal Prize Authority: Fiscal Year 2016 Progress Report*, Washington, DC, July 7, 2017, pp. 3-4; Challenges and Prizes Toolkit available at https://www.challenge.gov/toolkit/.

[39] InnoCentive, Inc., *Challenges, Prize Programs, and the Opportunity for Government*, https://info.innocentive.com/government-opportunites.

[40] The questions listed are illustrative, not exhaustive. Other questions may need to be addressed when drafting specific prize competition legislation. CRS does not provide specific recommendations on legislative matters and House or Senate Legislative Counsel should be contacted for actual drafting of legislative language.

regarding the prize competition? Such details may include timeframe, award amount, participant eligibility, administration, contest rule determination, competition judges, intellectual property rights, liability, and program evaluation.

- What should be the prize topic? Who should select it?
- What should be the goals of the program? What are the relative importance of technological advancement, education, and public awareness?
- Should there be a time limit for the prize?
- Should a monetary award be part of the prize? If so, how much? If not, is the publicity associated with winning the prize sufficient to encourage quality contestant participation?
- Should there be intermediary prizes (e.g., should partial prizes be awarded to participants that achieve certain milestones)?
- Who should be eligible to participate in the competition? For example, should employees of federal agencies or federally funded research and development centers (FFRDCs) be allowed to compete? If so, should they be able to use federal funds and facilities? Should foreign entities, such as non-U.S. citizens, corporations, or U.S. subsidiaries of foreign-owned corporations, be allowed to compete?
- Who should administer the program? For example, should a federal agency administer the program independently, do so in partnership with another federal agency or nonfederal organization, or act as a financial or nonfinancial partner in a competition administered by a nonfederal organization?
- Who should judge the competition? Should there be an appeal process?
- What are the criteria for the program to be considered successful?

Answering some of these questions may require the guidance and input of the science and technology community, federal agencies, and those experienced in the administration of prize competitions. The constantly changing state of the art of science and engineering due to new discoveries and innovation may lead observers to suggest providing flexibility in prize legislation.

Legislation in the 116th Congress

In the 116th Congress, as of the date of this report, more than 30 bills have been introduced to authorize or establish prize competitions within various federal agencies. See **Table A-1** in the appendix for a list of the proposed legislation, a brief summary, and the most recent action.

Appendix. List of Federal Prize Competition Legislation

Table A-1. Federal Prize Competition Legislation in the 116th Congress

as of date of report

Bill Number	Bill Title	Summary	Latest Action(s)
S. 2657	Advanced Geothermal Innovation Leadership Act of 2019	Section 3 of the bill would require the Secretary of Energy to establish a prize competition to demonstrate the co-production of critical minerals from geothermal resources.	Considered by Senate on 3/10/2020.
H.R. 925 S. 3051	America's Conservation Enhancement Act	Section 101 of the bill would require the Secretary of the Interior to establish a prize competition to encourage technological innovation in reducing human-predator conflicts using nonlethal means, including the application and monitoring of tagging technologies.	H.R. 925 passed the Senate on 1/09/2020. S. 3051 was placed on the Senate Legislative Calendar on 12/12/2019.
S. 3356	Battery and Critical Mineral Recycling Act of 2020	Would direct the Secretary of Energy to continue to carry out the Lithium-Ion Battery Recycling Prize competition and would authorize an additional $10 million for Phase III of the competition in fiscal year 2021.	Referred to the House Committee on Energy and Natural Resources on 2/27/2020.
S. 1602	BEST Act	Section 7 of the bill would require the Secretary of Energy to establish a prize competition to advance the recycling of critical energy storage materials.	Placed on Senate Legislative Calendar on 10/22/2019.
H.R. 3282	Carbon Capture Prize Act	Would authorize the Secretary of Energy to establish a prize competition for the research, development, or commercialization of technology that would reduce the amount of carbon in the atmosphere, including by capturing or sequestering carbon dioxide or reducing the emission of carbon dioxide.	Referred to the House Subcommittee on Energy on 6/14/2019.
H.R. 3100	Challenges and Prizes for Climate Act of 2019	Would direct the Secretary of Energy to carry out a prize competition program that includes at least one prize competition in each of the following areas: carbon capture and beneficial use, energy efficiency, energy storage, climate resiliency, and data analytics.	Referred to the House Subcommittee on Energy on 6/5/2019.
H.R. 729	Coastal and Great Lakes Communities Enhancement Act	Section 108 of the bill would authorize the Secretary of Commerce to carry out a prize competition program to stimulate innovation in coastal risk reduction and resilience measures, including natural features, among others.	Referred to the Senate Committee on Commerce, Science, and Transportation on 12/12/2019.
H.R. 1317	Coastal Communities Adaptation Act	Section 5 of the bill would authorize the Secretary of Commerce to carry out a prize competition program to stimulate innovation in coastal risk reduction and resilience measures, including natural features, among others.	Referred to the House Subcommittee on Water, Oceans, and Wildlife on 3/6/2019.

Bill Number	Bill Title	Summary	Latest Action(s)
H.R. 3384 S. 1922	Coral Reef Sustainability Through Innovation Act of 2019	Would amend the Coral Reef Conservation Act to authorize the 12 federal agencies on the U.S. Coral Reef Task Force, which includes the National Oceanic and Atmospheric Administration, to carry out, either individually or cooperatively, prize competitions that promote coral reef research and conservation. The prize competitions should be designed to help the United States achieve its goal of developing new and effective ways to advance the understanding, monitoring, and sustainability of coral reef ecosystems.	H.R. 3384 referred to the House Subcommittee on Water, Oceans, and Wildlife on 7/1/2019. S. 1922 referred to the Senate Committee on Commerce, Science, and Transportation on 6/20/2019.
H.R. 3494	Damon Paul Nelson and Matthew Young Pollard Intelligence Authorization Act for Fiscal Years 2018, 2019, and 2020	Would require the Director of National Intelligence, acting through the Intelligence Advanced Research Projects Agency, to carry out prize competition programs to stimulate research and development relevant to 5G technology and to stimulate the research, development, or commercialization of technologies to automatically detect machine-manipulated media.	Subsequently included in P.L. 116-92.
H.R. 5532	Deep Fake Detection Prize Competition Act	Would require the Director of the National Science Foundation to carry out prize competitions to incentivize research into technology that advances the detection of deep fake audio, images, and video.	Referred to the House Committee on Science, Space, and Technology on 12/19/2019.
S. 1201	EFFECT Act of 2019	Would require the Secretary of Energy, in consultation with the Administrator of the Environmental Protection Agency, to establish a prize competition to award prizes for the development of technologies that capture carbon dioxide from dilute media.	Placed on Senate Legislative Calendar on 9/24/2019.
H.R. 3607	Fossil Energy Research and Development Act of 2019	Section 10 of the bill would require the Secretary of Energy to carry out a prize competition to advance the capture of carbon dioxide from ambient air or water.	Ordered to be reported, as amended, to the House on 7/24/2019.
S. 47	John D. Dingell, Jr. Conservation, Management, and Recreation Act	Requires the U.S. Fish and Wildlife Service to establish the Theodore Roosevelt Genius Prizes for (1) prevention of wildlife poaching and trafficking, (2) promotion of wildlife conservation, (3) management of invasive species, (4) protection of endangered species, and (5) nonlethal management of human-wildlife conflicts.	Became P.L. 116-9 on 3/12/2019.
H.R. 3044	Medical Device Sterilization Challenge Act of 2019	Would direct the Commissioner of the Food and Drug Administration to establish a program to be known as the "Medical Device Sterilization Challenge" for carrying out prize competitions related to the sterilization of medical devices.	Referred to the House Subcommittee on Health on 5/31/2019.

Bill Number	Bill Title	Summary	Latest Action(s)
S. 1790	National Defense Authorization Act	Sections 5723 and 5724 require the Director of National Intelligence, acting through the Intelligence Advanced Research Projects Agency, to carry out prize competition programs to stimulate research and development relevant to 5G technology and to stimulate the research, development, or commercialization of technologies to automatically detect machine-manipulated media, respectively.	Became P.L.116-92 on 12/20/2019.
H.R. 435	National Gun Violence Research Act	Would direct the Attorney General of the United States, acting through the National Institute of Justice, to carry out a prize competition to demonstrate through testing and evaluation the reliability of guns and gun accessories with integrated advanced gun safety technology (commonly referred to as smart guns, user-authorized handguns, childproof guns, and personalized guns).	Referred to the House Subcommittee on Research and Technology on 2/12/2019.
H.R. 1921	Ocean Acidification Innovation Act of 2019	Would amend the Federal Ocean Acidification Research and Monitoring Act of 2009 to authorize a federal agency with a representative serving on the Interagency Working Group on Ocean Acidification to carry out a program that competitively awards prizes for stimulating innovation to advance the nation's ability to understand, research, or monitor ocean acidification or its impacts or to develop management or adaptation options for responding to ocean acidification.	Referred to the Senate Committee on Commerce, Science, and Transportation on 6/10/2019.
S. 2194	PREDATORS Act	Would amend the John D. Dingell, Jr. Conservation, Management, and Recreation Act (P.L. 116-9) to establish the Theodore Roosevelt Genius Prize for reducing human-predator conflict.	Hearing held by Senate Committee on Environment and Public Works on 7/24/2019.
H.R. 3679	Promoting Research, Innovation, and Zeal in Emerging 5G Technology Act	Would direct the Director of National Intelligence, acting through the Intelligence Advanced Research Projects Agency, to carry out a prize competition program to stimulate research and development relevant to 5G technology.	Referred to the House Committee on Science, Space, and Technology, and in addition to the House Permanent Select Committee on Intelligence on 7/10/2019.
H.R. 4979	Rural STEM Education Act	Would direct the Secretary of Commerce, acting through the National Institute of Standards and Technology, to carry out a prize competition to stimulate the development of affordable and reliable broadband connectivity technologies that could be deployed to underserved rural communities.	Placed on the House Calendar on 2/13/2020.

Bill Number	Bill Title	Summary	Latest Action(s)
S. 1982 H.R. 3969	Save Our Seas 2.0 Act	Would require the Secretary of Commerce to establish a prize competition to encourage technological innovation with the potential to reduce plastic waste, and associated and potential pollution, and thereby prevent marine debris and to advance human understanding and innovation in removing and preventing plastic waste.	S. 1982 passed the Senate on 1/9/2020. H.R. 3969 referred to the House Subcommittee on Conservation and Forestry on 8/29/2019.
S. 2364	Save Our Seas 2.0: Enhancing the Domestic Marine Debris Response Act	Would require the Secretary of Commerce to establish a prize competition to encourage technological innovation with the potential to reduce plastic waste and thereby prevent marine debris and to advance human understanding and innovation in removing and preventing plastic waste.	Referred to the Senate Committee on Commerce, Science, and Transportation on 7/31/2019.
H.R. 2473	Securing Access for the central Valley and Enhancing (SAVE) Water Resources Act	Would require the Secretary of the Interior, through the Bureau of Reclamation, to establish a prize competition program to award prizes to eligible persons for achievements in the application of water technologies, including the demonstration of desalination of brackish or sea water with significantly less energy than commercially available reverse osmosis technology, among other specified areas.	Ordered to be reported, as amended, to the House on 3/11/2020.
S. 1985 H.R. 5609	STRANDED Act of 2019	Would require the Department of Energy to establish a prize competition to generate innovative proposals for affected communities to carry out alternatives to nuclear facilities, generating sites, and waste sites.	S. 1985 referred to the Senate Committee on Environment and Public Works on 6/26/2019. H.R. 5609 referred to the House Subcommittee on Economic Development, Public Buildings, and Emergency Management on 1/16/2020.
S. 268 H.R. 872	Wildlife Innovation and Longevity Driver (WILD) Act	Would direct the U.S. Fish and Wildlife Service to establish the Theodore Roosevelt Genius Prizes for (1) prevention of wildlife poaching and trafficking, (2) promotion of wildlife conservation, (3) management of invasive species, (4) protection of endangered species, and (5) nonlethal management of human-wildlife conflicts.	Subsequently incorporated into P.L. 116-9.

H.R. 6253	Crowdfunding to Combat the Coronavirus Act	Would direct the Director of the Centers for Disease Control and Prevention or the Director of the National Institutes of Health to report to the President and the Secretary of Treasury a determination that a person created a vaccine for COVID–19 that cuts the incidence and mortality rate of COVID–19 by more than 50% and makes such vaccine widely available to the public at affordable rates. It would further require that if after reviewing the report by the CDC or NIH, the President agrees, the Secretary of the Treasury would pay $1 billion to such person.	Referred to the House Committee on Financial Services, and in addition to the Committee on Energy and Commerce, on 3/12/2020.
S. 383 H.R. 1166	USE IT Act	Would require the Environmental Protection Agency to establish a prize competition program for certain technology projects that capture carbon dioxide directly from the air.	S. 383 report filed by Senator Barrasso from Senate Committee on Environment and Public Works on 05/13/2019. H.R. 1166 referred to the House Subcommittee on Water, Oceans, and Wildlife on 02/28/2019.

Source: CRS analysis based on data from Congress.gov.

Author Contact Information

Marcy E. Gallo
Analyst in Science and Technology Policy
#redacted#@crs.loc.gov...

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