TESTIMONY OF DR. ALEX DEHGAN, CEO, CONSERVATION X LABS,

BEFORE THE HOUSE SCIENCE, SPACE AND TECHNOLOGY COMMITTEE, SUBCOMMITTEE ON RESEARCH AND TECHNOLOGY

WEDNESDAY, DECEMBER 13th, 2017

2318 RAYBURN HOUSE OFFICE BUILDING, WASHINGTON DC

# ACCELERATING INNOVATION & HARNESSING AMERICAN TALENT THROUGH PRIZES, CHALLENGES, AND OPEN INNOVATION

**THE PROBLEMS ARE BIG, BUT THE OPPORTUNITIES ARE BIGGER**

Good Morning. I am Dr. Alex Dehgan, CEO of Conservation X Labs, a conservation innovation company that focuses on finding solutions to the underlying drivers of extinction through exponential technologies, open innovation, and entrepreneurship. I am the former Chief Scientist of the US Agency for International Development.

I want to thank Subcommittee Chairwoman Barbara Comstock, Ranking Member Daniel Lipinski of the Subcommittee on Research and Technology and Ranking Member Eddie Bernice Johnson for the honor to speak about the power of open innovation, particularly prizes and challenges, as a powerful tool of innovation.

We face many challenges as a country. Many of those challenges are ones that increasingly fail to respect political boundaries, state sovereignty, and military force. They are challenges that come from the growing billions emerging into the middle class around the world, and the demands and competition that they will place on our resources, and their growing demand for dairy, protein, air conditioning, and refrigeration. They are challenges that come from new nations that seek to claim our place as the world's greatest economy and leader of the free world. Even the challenges that affect other places, other countries, other

peoples, are challenges increasingly capable of undermining American economic growth, and destabilizing our national security. Increasingly, we have seen that our solutions are linear, but our problems are exponential. We must incentive the revolutionary over the evolutionary in the available solutions in our scientific & technological arsenal.

However, much as we have created many of these problems, we also possess the abilities to address them by harnessing American ingenuity, entrepreneurship, and leadership. Many of these grand challenges are increasingly grand opportunities. We can use the power of open innovation to transform the very realm of what is possible, to democratize our ability to solve our biggest challenges, and to accelerate our nation's ingenuity and inventiveness.

Given the speed and scale of the problems that face us, many of which have their genesis as questions of science & technology, and similarly, their solutions, we can accelerate the speed of innovation through prizes and challenges as one of a suite of tools for innovation in science & technology, and research.

**THE VALUE PROPOSITION: PRIZES ACCELERATE INNOVATION, ALLOW US TO MORE FULLY BENEFIT FROM THE DEMOCRATIZATION OF SCIENCE & TECHNOLOGY, AND HARNESS PLANETARY GENIUS BY OPENING THE DOOR TO NEW SOLVERS AND SOLUTIONS.**

Open Innovation through prizes, challenges, and advanced market commitments solves a fundamental problem that we face as a government. While talent may be everywhere, opportunity is not. Open innovation allows the government to be in the business of creating greater opportunity to harness American (and when appropriate, global) talent to solve our most pressing problems, unlock new solvers and new solutions, breakdown barriers between scientific fields that are frequently stove-piped.

Unlike traditional grant or investment programs, they eliminate hidden biases by focusing on the problems rather than the solutions and encourage competition. They help translate and source new ideas from adjacent technical spaces, identify excellence, and allow funders to uncover the landscape of potential solutions and understand emerging trends. This has the net effect, when executed properly, of allowing us to accelerate innovation, break

down barriers among fields, and allow us to more fully harness the democratization of science and technology.

While the concept of prizes and challenges is not new, there is a renewed enthusiasm for their use. Before 2009, NASA, DOE, and DOD had limited authority to offer incentive prizes, and they conducted only a handful of competitions. Between 2009 and 2015, the federal government conducted more than 440 prize competitions and challenges. This increase in prizes and challenges demonstrates the power these tools have to transform how we find solutions.

**WHAT IS A PRIZE, A CHALLENGE, OR AN ADVANCED MARKET COMMITMENT?**

Prizes, Challenges, and Advanced Market Commitments are a relatively straightforward approach to finding solutions, yet require highly strategic implementation to efficiently and successfully identify impactful and innovative solutions.

***Prizes*** award a single winner, using the first to achieve a clear objective or goal. They are intended to move the needle in terms of potential solutions, demonstrate a breakthrough, literally showing that the impossible is now possible. Monetary prizes can help spur private-sector action by offering a lump sum to winners of contests, but prizes may utilize other types of incentives and structures beyond monetary prizes, including recognition, advanced market commitments, media attention, and credibility. These lump sums typically represent a return on investment for the winners, and use the psychology of gamification to incentivize previously untapped innovators and encourage them to engage with difficult problems.

***Challenges*** are similar to prizes in the way they tap into the wisdom and experience of "unusual suspects." Unlike prizes, however, they reward a few winners, rather than a single winner. They seek to spur collaboration, especially cross-sectoral collaboration, and participation to solve large, seemingly intractable public problems and to build communities of practice, essential for building new ecosystems of solutions, rather than a single point solution. By bringing together insight and experience from a variety of actors with different backgrounds,

challenges can inspire out-of-the-box thinking and innovative approaches to problem solving. Finally, they help map the larger landscape of potential innovations.

**Advanced Market Commitments**. Advanced Market Commitments (AMCs) are a type of prize. An AMC is a legally-binding agreement for an amount of funds to subsidize the purchase, at a given price, of an as yet unavailable product whose creation would create a substantial advance against a specific challenge. The establishment of AMCs should encourage the development of future generations of such innovations, and work to resolve a market failure, by creating incentives for private industry and capital to generate such solutions. They essentially serve to derisk research and development by guaranteeing a market.

Prizes, Challenges, and AMCs can be incredibly powerful tools to focus attention on a problem, without being constrained by existing communities of practice. A prize can be useful to focus on a specific breakthrough, while a challenge could result in a community of possible solutions. With well-developed problem statements and identified characteristics of a solution, a challenge or prize model may be employed for rapidly developing deployable solutions. If significant research and development is needed to bring identified solutions to market, a challenge can lead to an identified community of solutions that can then be rapidly developed for scale.

## BENEFITS OF OPEN INNOVATION

Prizes, Challenges, AMCs, and other forms of open innovation offer a number of advantages when well executed.

### 1. EFFICIENT & CAREFUL USES OF AMERICAN TAXPAYER DOLLARS

Prizes and challenges are efficient and cost-effective uses of American taxpayer dollars. First, they are pay for performance mechanisms. You only pay for success - Prizes and challenges are only paid when a specific objective is met or a specific problem in solved.

Moreover, rather than searching for the right solution to a problem, through a contract or grant, they incentivize the solution to find you.

Second, they are forms of procurement reform. At USAID, we were heavily straddled with systems that prevented us from working with all but a small number of implementers. Moreover, the cost of even being able to apply for USAID funding is in the thousands of dollars. By creating an open, transparent, and simple process that is focused on outcomes, not process & bureaucracy, they open the door for new entrants and even build momentum for new entries. They also serve to eliminate hidden biases of traditional grant programs by focusing on the problems rather than the solutions. While experts may be able to help identify the problems we want solved, the complexity of science and technology prevent any single person or institution from owning most of the solutions.

Moreover, prizes and challenges can be an extraordinarily effective use of resources due to the leveraging of additional funds by the innovators themselves, low monitoring costs of fund disbursement, a relatively simple application process (compared to grant funding), quicker feedback cycles, and streamlined review based on simple solutions-based criteria.

Third, prizes and challenges also provide additional layers of motivation beyond money, such as prestige, recognition and credibility, and intellectual curiosity. In an era when more and more people want to see solutions to societal problems that have proved resistant to traditional market or academic solutions, prizes—and their flexibility to address a range of issues— are increasingly valuable for social entrepreneurs who benefit from prize money and the recognition from the global community, and for prize sponsors seeking change.

Fourth, prizes and challenges provide substantial leverage and mitigate risks for American taxpayer dollars. At USAID, because of the size of the Grand Challenges, we executed all the Grand Challenges for Development with other partners – this included other bilateral and multilateral development agencies, foundations like Gates and Omidyar, and private sector companies. This had multiple benefits to the American taxpayer. We were able to mitigate risk among multiple organizations, and leveraged considerable prize capital among multiple parties,

as well as were able to incentivize a greater number of participants to compete for the prize through greater amplification through each of the partners.

Saving Lives at Birth, our first Grand Challenge for Development, is an insightful example. It sought to address two problems. First, if we could provide medical care to women and their children from the onset of labor to 48 hours after delivery, no matter what was the setting in which they gave birth – in a hospital or a hut – we could dramatically improve the chances of survival for both the mother and the child. Second, we recognized that there weren't sufficient resources, even among all the development agencies in the world, to build world-class hospitals, equipment, and well trained physicians and nurses in every village that needed them to save the lives of women and children. We needed to be innovative. Specifically, we needed to create innovations for maternal and child-care that ensure their survival and health irrespective of where a woman gave birth. Saving lives at Birth, which became a partnership of Gates, Norway, Korea, the United Kingdom, Grand Challenges Canada, ended up leveraging for US taxpayers $100 Million+ in external funding, based on an investment of $20 Million by the US. Overall, the Grand Challenges program at USAID has leveraged over $400 million in external funding.

Finally, prizes, challenges, and AMCs can also jumpstart the flow of private capital. They serve as vetting mechanisms for the private sector. And through AMCs, we may harness the private sector to create new market incentives for private investment. The Department of Energy Better Buildings Advanced Market Commitment partnered with private sector commercial firms, like Whole Foods, to make commitments of increasing cooling efficiency on all its buildings, creating a market incentives for manufacturers to improve existing cooling technology. Since 2013, 300 partners have replaced or upgraded a total of 77,000 units, saving over $166 million in energy costs and racking up $66 million in savings in 2016 alone.

**2. CREATING NEW SOLUTIONS & ACCELERATING INNOVATION**

Prizes, challenges, and AMCs also help create new breakthrough solutions and accelerate innovation. They do this by focusing on the problem, not the solution, and as such,

they do not constrain the potential innovation space. When well crafted, they set aspirational goals for discovery and invention, which incentivizes the entry of new disciplines, and the application of breakthroughs from adjacent fields to being applied to new problems in new ways. This helps translate and source new ideas from adjacent technical spaces, and allows the funder to uncover the landscape of potential solutions, understand emerging trends, and create communities of interests. A recent Harvard Business School report, The Value of Openness in Scientific Problem Solving, found that "the further the problem was from the solver's expertise, the more likely they were to solve it."[1]

The US Government has used prizes and challenges to accelerate innovation on important human health and security challenges where traditional approaches were insufficient. These include, but are in no way limited to:

- **Food Safety:** The Food and Drug Administration launched the Food Safety prize competition in 2014 to encourage innovators to think of ideas that would quickly detect disease-causing organisms in food. The winning team from Purdue University, led by Professor Michael Ladisch, developed a technology that concentrates Salmonella to detectable levels using automated microfiltration, making it possible to process samples in hours instead of days.
- **Desalinization**: The U.S. Agency for International Development (USAID) and the Bureau of Reclamation challenged innovators around the world to create cost-effective, energy efficient, sustainable desalination technologies to provide water for people and crops. The winning Massachusetts Institute of Technology (MIT) team designed a solar-powered system that removes salt from water with electricity and uses ultraviolet rays to disinfect the water, showing the potential for photovoltaic-powered electrodialysis to be a scalable, sustainable, and affordable desalination technology for rural areas of developing countries.

[1] Karim R. Lakhani, et al. 2007. "The Value of Openness in Scientific Problem Solving," Harvard Business School working paper.

- **Disease Outbreaks**. USAID used prizes and challenges to accelerate innovation for child and material care, education, energy & agriculture, water, but most recently, has been using prizes and challenges as ways of addressing the Ebola and Zika outbreaks.

**3. NEW SOLVERS – MOBILIZING NEW TALENT**

The ability of prizes to mobilize new talent to focus on difficult problems is an important driver of innovation. The history of science is filled with instances of outsiders proposing novel and ultimately, revolutionary solutions to problems that had vexed insiders. At USAID, the Agency has increasingly seen prize and challenge applicants coming from sectors that have never previously approached the Agency. Many awards were from first-time applicants and a significant number of applications, and a growing share of the winners, came from the developing world. It makes sense that those closest to the problem may have some good ideas of how to address it. Prizes and challenges provide that opportunity.

Prizes also attract diverse groups of experts, practitioners, and laypeople—regardless of formal credentials—to attempt to solve difficult problems. The citizen-inventor working out of a garage is a cherished part of prize lore. Technology may allow more garage innovators to succeed. The democratization of science & technology through exponential gains in the power of technology and exponential decreases in the cost of computing power and storage, greater connectivity through the internet and cell phones to an ever increasing and unprecedented trove of human knowledge, the merger of biology and technology to advance molecular sciences & microbiology, and the many ways the information technology enables cheap and easy collaboration are working together to dramatically expand the pool of potential solvers and lower the cost of attempting or recognizing solutions.[2]

Saving Lives at Birth, USAID's Grand Challenge, for instance was notable for one of its winners: an Argentinian car mechanic who created one of the first new innovations for

[2] McKinsey & Company. 20009. *And the Winner Is: Capturing the Promise of Philanthropy Prizes.* Read Developing and Delivering Effective Prizes.

obstructed labor in 40 years inspired by a Youtube video. Innovation can come from many sectors, and we can use prizes and challenges to uncork it.

Incentives prizes also provide more entrepreneurial opportunities for under represented sectors because they level the playing field.[3] In a study of more than 166 science challenges involving over 12,000 scientists, open innovation scholars Karim Lakhnai and Lars Bo Jeppesen found that "female solvers—known to be in the 'outer circle' of the scientific establishment—performed significantly better than men in developing successful solutions." By "removing barriers to entry to non-obvious individuals," prizes increase access to innovation.[4]

**4. CREATING NEW INDUSTRIES**

Prizes, challenges and AMCs have the power to create entire new industries, markets, businesses, and leaders while extending the frontiers of possibility. This may be because they make the impossible possible, and capture the public imagination. That breakthrough effect serves to galvanize others to enter into the space, including again, investors and finance. The history of prizes and challenges is filled with such examples:

The Longitude Prize created by an act of Parliament in the UK in 1714 was used to establish a simple and practical method for precisely determining a ship's longitude, which greatly facilitated transatlantic shipping. Napoleon issued a prize in 1794 for a new method to preserve food and avoid loss of capacity from food poisoning, particularly "when an invaded country was not able or inclined to sell or provide food." That prize led to canning, which was won by a French confectioner Nicholas Appert, who lacked any formal training in science. He went on to create a canning factory that revolutionized food safety. In 1863, the first conservation prize, intended to replace ivory in billiard balls, provided $10,000 for the inventor of a suitable substitute as ivory became increasingly scarce. It resulted in a celluloid that helped spur the modern plastics industry.

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[3] pers. comm. Jenn Gustetic, NASA

[4] Lars Bo Jeppesen, and Karim Lakhnai, "Marginality and Problem Solving Effectiveness in Broadcast Search," Organization Science 21 (2010): 1016. doi 10.1287/orsc.1090.0491.

Two more recent prizes stand out. The Orteig Prize in 1919 promised $25,000 to the first Allied aviator who could cross the Atlantic from Paris to New York or New York to Paris in a single flight. Charles Lindberg, who had been a mail messenger flying from St. Louis to Chicago, took out a $15,000 bank loan, and won that prize in 1927 in the *Spirit of St. Louis*, a feat which was thought impossible. Within 18 months of that flight, the modern airplane industry was born. Passenger traffic increased 30 times, the number of aircraft increased 4 times, pilot applications increased four times, and aviation stocks stored.

Similarly, the Ansari X Prize, which was a $10-million prize for the first team to privately build a spacecraft that could carry 3 adults to 100 km twice in a week, helped incentivize the private space craft industry. Twenty-six teams, from 7 nations, spent over 100 million dollars competing for the prize, which lead to over a billion dollars of investment in the sector. The Ansari X-prize helped create a new wave of commercial space exploration and contributed to a fundamental shift in NASA's approach to travel to low earth orbit. Even the non-winners found it helpful: 40% of non-winning participants said the process of applying was helpful in clarifying their ideas and connecting them with new partners. Half were still developing their solutions even though they did not receive funding from the prize competition. The winning ship, SpaceShipOne, sits in the Air and Space Museum on the Mall next to the *Spirit of St. Louis.*

A final example of how prizes and challenges incentivize new industries was 2004 DARPA Grand Challenge that helped lead to the self-driving car revolution. Fourteen years ago, the idea of a self-driving car seemed within the realm of science fiction, when DARPA first launched its Grand Challenge.

The immediate goal of the DARPA Grand Challenge was to autonomously navigate a 142-mile course across a Nevada desert. The first team to pass a series of qualification tests and then complete the course in less than 10 hours would win a million-dollar cash prize. The longer-term aim was to accelerate development of the technological foundations for autonomous vehicles that could ultimately substitute for men and women in hazardous military operations, such as supply convoys.

Like other challenges, it was a way to incentivize new solvers and solutions, and build new communities of practice and collaborations across diverse fields. No one won the first round, however, with the top-scoring vehicle traveling only 7.5 miles. The competition however offered a chance to view the future and see that autonomous driving was possible. A second Grand Challenge took place 18 months later in 2005, and 5 vehicles successfully completed the course. DARPA conducted a third competition, the Urban Challenge, in 2007 that featured driverless vehicles navigating a complex course in a staged city environment in Victorville, Calif., negotiating other moving traffic and obstacles while obeying traffic regulations. These would have the effect of encouraging the development of a multibillion dollar autonomous vehicle industry that looks to change the American landscape.

**5. ITS NOT JUST ABOUT THE WINNERS**

Finally, through my work at Conservation X Labs and at USAID, I have learned that prizes and challenges are not enough, but can be complemented by other mechanisms. There is a great value to harnessing both competitive and collaborative mechanisms to spur innovation. For this reason, in addition to running prizes and challenges, we have investing into mass collaboration – through the creation of a Digital Makerspace, a collaborative innovation platform - to encourage the development of ideas that were successful. Many of the innovations that don't win may still have nuggets of innovation, that when combined with other ideas or further iterated on, can provide powerful solutions.

Mass Collaboration, another form of open innovation, has previously solved significant problems. The Open Source Drug Discovery (OSDD) created a large community comprised of more than 5,700 registered users of the portal from 130 countries, who helped create new license-free drugs for malaria and TB that were not being created by traditional pharmaceutical industry.

**RULES FOR EFFECTIVE PRIZES AND CHALLENGES**

While powerful tools, prizes and challenges need to be executed effectively to work well. This requires a focus on problems, not solutions, which frequently sounds easy, but is difficult to achieve. Prizes, challenges, and AMCs must ensure that they are solving the right problem, and a problem that is sufficiently audacious but achievable. They must address a large enough and important enough problem to excite, inspire, and attract broad communities of solvers, from disparate fields, to the problem. They must target by definition-- a market failure. They also must clearly define the criteria for winning.

Second, there must be a sufficient purse. Prizes shift the risk to the participants as a pay for success mechanism. As such, there has to be a sufficient understanding of the participant cost structure to incentivize their participation. This is especially true of prizes and AMCs where the purse must also be large enough to attract broad public attention and create demand for the solutions.

Third, execution is critical. My experience at USAID has taught me integrating procurement and legal teams with the design teams is necessary to create a great prize. It must be rewarding and simple for both teams to participate and for Agencies to operate. There are increasingly sophisticated ways to run prizes, using staged capital to incentivize greater success, and create a pathway to scale. It is not enough just to design a prize, but we must design for what happens afterwards. Scale must be built into the process from the beginning.

However, most things are not a prize or a challenge. Prizes, challenges, and AMCs are a tool in a research and technology portfolio. They should only be used when there is a clear and measurable outcome defined in advance. They are best when taking on problems where the objective is clear, but the way to achieve it is not. As McKinsey noted in its report, *And the Winner is, "*By attracting diverse talent and a range of potential solutions, prizes draw out many possible solutions, many of them unexpected, and steer the effort in directions that established experts might not go but where the solution may nonetheless lie."

**CONCLUSION**

Prizes, challenges, and AMCs are powerful tools in our science & technology toolbox for advancing American innovation and solving wicked problems. While they are not right for every approach, or even most of them, they can transform the realm of what is possible, allow for greater interdisciplinary solutions, attract new solvers and solutions, and catalyze new industries.

Such open innovation tools have the very qualities that define the best of American values and spirit – they are entrepreneurial, rely on self-selection, are by definition open and transparent, and reward merit, ingenuity and hard work. In some ways, they reflect the values of the American story, where everyone has a chance, and the pathways to success are open to anyone.