A STRATEGY FOR AMERICAN INNOVATION

National Economic Council
and
Office of Science and Technology Policy

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Executive Summary

America has long been a nation of innovators. The United States is the birthplace of the Internet, which today connects three billion people around the world. American scientists and engineers sequenced the human genome, invented the semiconductor, and sent humankind to the moon. And America is not done yet.

For an advanced economy such as the United States, innovation is a wellspring of economic growth. While many countries can grow by adopting existing technologies and business practices, America must continually innovate because our workers and firms are often operating at the technological frontier. Innovation is also a powerful tool for addressing our most pressing challenges as a nation, such as enabling more Americans to lead longer, healthier lives, and accelerating the transition to a low-carbon economy.

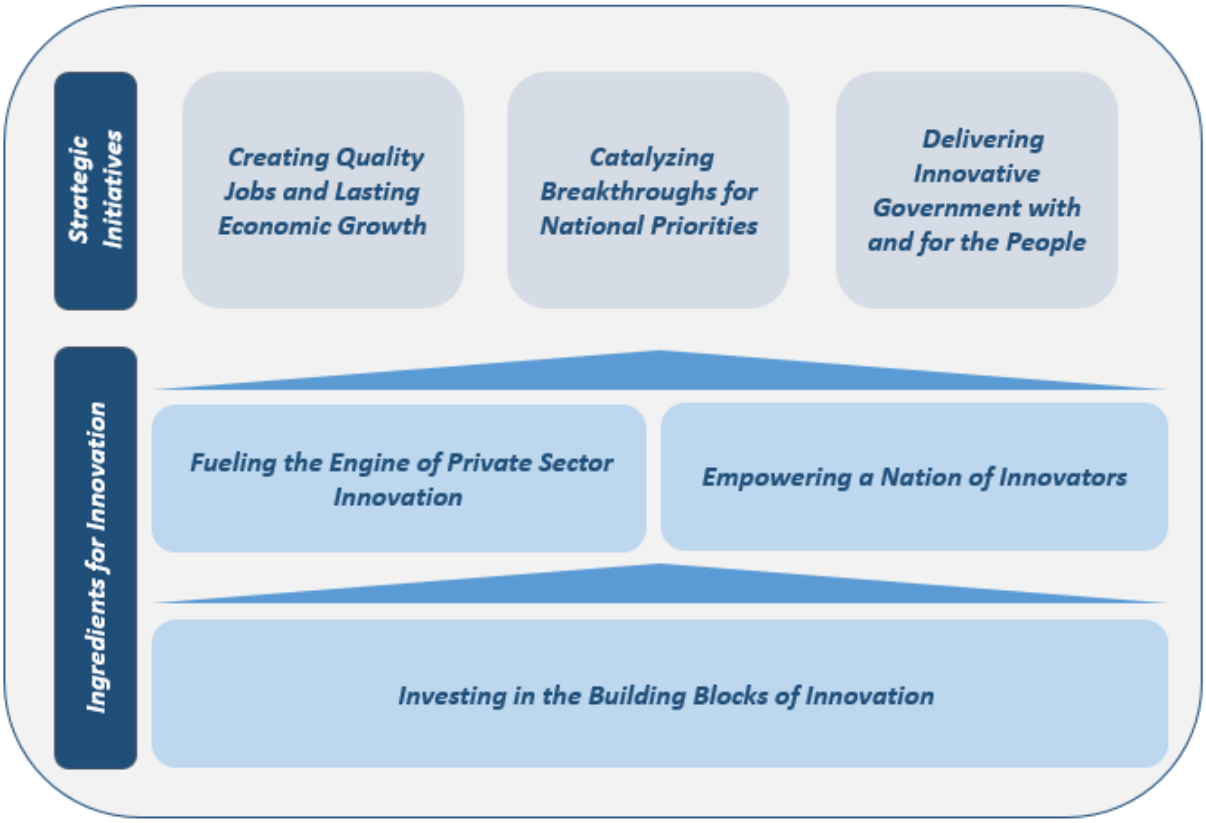
Last year, U.S. businesses created jobs faster than at any time since the 1990s. Now is the time to renew our commitment to innovation to drive economic growth and shared prosperity for decades to come. Now is the time for the Federal Government to make the seed investments that will enable the private sector to create the industries and jobs of the future, and to ensure that all Americans are benefiting from the innovation economy.

In 2009, President Obama first issued the *Strategy for American Innovation*, and it was updated in 2011. In this final refresh of the President's Strategy, the Administration has identified additional policies to sustain the innovation ecosystem that will deliver benefits to all Americans.

A Strategy for American Innovation

As the following graphic illustrates, the President's *Strategy for American Innovation* has six key elements. The Strategy recognizes the important role for the Federal Government to invest in the building blocks of innovation, to fuel the engine of private-sector innovation, and to empower a nation of innovators. The Strategy describes how the Obama Administration builds on these important ingredients for innovation through three sets of strategic initiatives that focus on creating quality jobs and lasting

economic growth, catalyzing breakthroughs for national priorities, and delivering innovative government with and for the people.



Investing in the Building Blocks of Innovation

The building blocks of the American innovation ecosystem are those areas where Federal investments provide the foundational inputs to the innovation process:

- Making World-Leading Investments in Fundamental Research
  The President has consistently called for sustaining America's long-term economic competitiveness and growth through robust investments in fundamental research.

- Boosting Access to High-Quality STEM Education
  The President's plan calls for cultivating the minds of tomorrow's engineers, scientists, and innovators through strong and sustained investment in science, technology, engineering, and mathematics (STEM) education that engage students from all backgrounds and underpin future economic competitiveness.

- Clearing a Path for Immigrants to Help Propel the Innovation Economy
  Recognizing the disproportionate role of immigrants in building an entrepreneurial society and pioneering world-changing discoveries, the President is helping to clear a path for them to continue making significant contributions to the American economy.

- Building a Leading 21st Century Physical Infrastructure
  The Administration is committed to making investments in our nation's physical infrastructure that will not only create jobs now but also foster innovation and economic growth for the long term.

- Building a Next-Generation Digital Infrastructure
  The Administration is committed to sustaining investments to ensure widespread access to broadband and to support the adoption of next-generation digital infrastructure.

Fueling the Engine of Private-Sector Innovation

The Federal Government can empower private-sector innovators by addressing the market failures that stymie innovative activity and by ensuring framework conditions friendly to experimentation and innovation, including:

- Strengthening the Research and Experimentation Tax Credit
  President Obama has proposed broadening, extending, and making permanent the Research and Experimentation Tax Credit, creating substantial and predictable incentives for U.S. businesses to innovate.

- Supporting Innovative Entrepreneurs
  To keep America's lead as the best place in the world to start and scale a great enterprise, the Administration is working to ensure all Americans have a fair shot at entrepreneurial success.

- Ensuring the Right Framework Conditions for Innovation
  The Federal Government can enable a thriving innovation economy by taking steps to ensure that those who strive to introduce new ideas to the marketplace encounter market conditions and rules that facilitate and incentivize their efforts.

- Empowering Innovators with Open Federal Data
  President Obama has articulated a vision of Federal data as a national asset to be made publicly available wherever possible in order to advance government efficiency, improve accountability, and fuel private-sector innovation, scientific discovery, and economic growth. The Administration has also worked to ensure that more digital data and publications resulting from Federally-funded research are freely accessible to innovators, scientists, and the general public.

- From Lab to Market: Commercializing Federally-Funded Research
  The Administration's Lab-to-Market Initiative is working to accelerate technology transfer for promising new innovations resulting from Federally-funded research that too often face a slow and uncertain path to commercial viability.

- Supporting the Development of Regional Innovation Ecosystems
  The Federal Government is playing a critical role in supporting regional efforts to strengthen local and regional innovation ecosystems that sustain economic growth and job creation.

- Helping Innovative American Businesses Compete Abroad
  The Administration is committed to a trade agenda that has significantly boosted exports, eliminated market-access barriers, and expanded intellectual property protections.

Empowering a Nation of Innovators

The Federal Government can help empower more Americans to be innovators:

- Harnessing the Creativity of the American People through Incentive Prizes
  The Administration will continue to build on the important steps the Federal Government has taken to make incentive prizes a standard tool in every agency's toolbox.

- Tapping the Talents of Innovators through Making, Crowdsourcing, and Citizen Science
  The Federal Government is finding new paths to tap the ingenuity of the public to address real-world problems, while also engaging more students in STEM

learning and entrepreneurship. These efforts include making, crowdsourcing, and citizen science, among other initiatives.

Creating Quality Jobs and Lasting Economic Growth

Technological innovation is the key source of economic growth for the United States. Coordinated Federal efforts can have large impacts on jobs and economic growth in the following priority areas:

- Sharpening America's Edge in Advanced Manufacturing
  Leading in manufacturing will strengthen America's edge in both traditional and high-tech products, and ensure that if it is invented in the United States, it can be made in the United States. The Administration will launch new efforts to support manufacturing startups and to increase the innovative potential of America's small manufacturers and manufacturing supply chains. The Administration has also set a goal of creating a network of 45 Manufacturing Innovation Institutes within ten years, and has already provided funding for ten.

- Investing in the Industries of the Future
  Emerging technologies today promise to enable a wide range of transformative products with broad economic impact, just like path-breaking innovations of the past, such as the steam engine and the Internet, transformed the U.S. economy in earlier times. The President is committed to investing in these emerging technologies.

- Building an Inclusive Innovation Economy
  The Administration is taking action to ensure that Americans from all backgrounds can participate in the 21st century innovation economy.

Catalyzing Breakthroughs for National Priorities

Maximizing the impact of innovation on national priorities means identifying those areas where focused investment can achieve transformative results to meet the challenges facing our nation and the world:

- Tackling Grand Challenges
  The Administration is supporting targeted efforts to meet Grand Challenges, which 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.

- Targeting Disease with Precision Medicine
  The Administration is investing in a Precision Medicine Initiative to understand better the complex mechanisms underlying a patient's health, disease, or condition, and to predict better which treatments will be most effective.

- Accelerating the Development of New Neurotechnologies through the BRAIN Initiative
  The BRAIN Initiative is developing new technologies that will enable a deeper understanding of brain functions, improving the ability of researchers and physicians to diagnose, treat, and prevent diseases of the brain. The BRAIN Initiative could also lead to breakthroughs in computing that are inspired by human perception and cognition.

- Driving Breakthrough Innovations in Health Care
  Innovations in health care delivery, growing from collaboration across purchasers, providers, and patients, promise to help improve quality of care, prevent medical errors, and reduce costs. Through the Center for Medicare and Medicaid Innovation, the Administration is testing new care delivery models that seek to deliver the same or better care at significantly lower cost.

- Dramatically Reducing Fatalities with Advanced Vehicles
  Accelerating the development and deployment of advanced vehicle technologies could save thousands of lives annually. The Administration is launching new efforts to accelerate the path to deployment for these promising technologies.

- Building Smart Cities
  Making our cities "smarter" means equipping them with the tools to address the pressing problems that their citizens care most about. The Administration has launched a new research and deployment initiative that will invest over $160 million in Federal research and leverage the efforts of a broad network of cities, universities, companies, and nonprofits to achieve real results, such as urban

traffic management systems that can reduce commuting times by 25 percent or more.

- Promoting Clean Energy Technologies and Advancing Energy Efficiency
  The Federal Government is investing in technologies to enable the development of renewable and other clean energy sources, make energy go further through energy efficiency, and reduce carbon pollution, while helping to improve America's energy security.

- Delivering a Revolution in Educational Technology
  With the technological conditions ripe for the development of advanced educational technologies that can transform teaching and learning, the Federal Government is making critical investments in the development of next-generation educational software.

- Developing Breakthrough Space Capabilities
  The Federal Government is developing new space technologies and leveraging partnerships with the private sector to dramatically lower the cost of accessing and operating in space, while enabling ambitious new missions. Such technologies are helping to create a burgeoning U.S. private space sector.

- Pursuing New Frontiers in Computing
  Guided by the recently launched National Strategic Computing Initiative, Federal departments and agencies will work together to advance the state of high-performance computing in order to drive economic competitiveness, scientific discovery, and innovation.

- Harnessing Innovation to End Extreme Global Poverty by 2030
  The Administration is advancing a new model of development grounded in evidence-based evaluation, rapid iteration, country engagement, and partnership that catalyzes talent and innovation everywhere to accelerate efforts to end extreme poverty by 2030.

Delivering Innovative Government with and for the People

With the right combination of talent, innovative thinking, and technological tools, government can deliver better results with and for the American people:

- Adopting an Innovation Toolkit for Public-Sector Problem-Solving
  The Administration is creating an "Innovation Toolkit" that will increase the ability of agencies to deliver better results at lower costs for the American people. These approaches can increase the effectiveness and agility of the government through improvements in its core processes and ability to solve problems.

- Fostering a Culture of Innovation through Innovation Labs at Federal Agencies
  A network of Innovation Labs can foster a culture of innovation at Federal agencies by empowering and equipping agency employees and members of the public to implement their promising ideas to more effectively serve the American people.

- Providing Better Government for the American People through More Effective Digital Service Delivery
  It should be as easy and intuitive for American citizens and businesses to engage with government services online as it is for them to conduct online transactions with the most IT-savvy businesses. The Administration is creating U.S. Digital Service teams across government to speed the adoption of private-sector best practices for designing, building, and deploying easy-to-use online services.

- Building and Using Evidence to Drive Social Innovation
  The Administration is committed to improving our ability to solve societal problems by using evidence about "what works" where it exists and developing it where it does not. The Administration is also using Pay-For-Success approaches to pay for outcomes as opposed to inputs, and to scale-up evidence-based interventions.

Introduction

"We know that the nation that goes all-in on innovation today will own the global economy tomorrow. This is an edge America cannot surrender."

- *President Barack Obama, January 28, 2014*

America has long been a nation of innovators. American scientists, engineers and entrepreneurs invented the microchip, created the Internet, invented the smartphone, started the revolution in biotechnology, and sent astronauts to the Moon. And America is just getting started. Today, America's innovators are:

- Engineering white blood cells in cancer patients to destroy tumors while leaving healthy cells untouched;

- Eliminating barriers to global commerce and collaboration with real-time language translation;

- Creating the technological foundations for a civilization that goes to outer space not just to visit, but to stay;

- Developing solar energy technologies, with the goal of making solar energy as cheap as coal by the end of the decade;

- Democratizing the tools needed to design and make just about anything; and

- Enabling working Americans to acquire new skills that are a ticket to middle-class jobs—at their preferred time, place, and pace.

The United States is in a strong position to lead the world in the development of these and countless other equally exciting innovations. This country has 16 of the world's top

20 research universities, an entrepreneurial culture, and flexible labor markets.[1] America's entrepreneurs attract 40 percent of the global investment in venture capital, and America's "hot spots" of innovation are the envy of the world. Continued leadership in innovation will spur faster economic growth, increased productivity, and the creation of high-wage jobs.

But the United States cannot afford to be complacent. Our economic competitors are dramatically increasing their research and development (R&D) investments. The United States needs to do much more to inspire and prepare young people from all backgrounds to excel in science, technology, engineering, and mathematics (STEM) fields. Comprehensive immigration reform is needed to ensure that immigrants can continue making contributions to our economy. And new public and private initiatives are needed to ensure that more Americans are participating in and benefiting from the innovation economy.

Last year U.S. businesses created jobs faster than at any time since the 1990s. Now is the time to increase American investment in innovation to drive economic growth and shared prosperity for decades to come. Now is the time to support the efforts of the private sector to create the industries and jobs of the future that will underpin shared prosperity.

Why Innovation Matters

For an advanced economy such as the United States, innovation is essential for economic growth. While many countries can grow by adopting existing technologies and business practices, America must continually innovate, because our workers and firms are generally already operating at the technological frontier.

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[1] U.S. News & World Report, "Best Global Universities Rankings 2016," (October 2015), available at http://www.usnews.com/education/best-global-universities/rankings.

Economists have consistently found that innovation and technological change are the most important drivers of productivity growth and, in turn, long-run economic growth.[2] To put the importance of productivity growth in perspective, the President's Council of Economic Advisers recently calculated that if the United States had maintained the rapid pace of post-World War II productivity growth to the 1970s up to today, the average American household would have an additional $30,000 in income.[3]

Science, technology, and innovation are also powerful tools for addressing many of our nation's most important challenges. For example, these tools can:

- Allow Americans to lead longer, healthier lives;
- Accelerate the transition to a sustainable, low-carbon economy to reduce the risks of climate change;
- Enable a government that is more transparent, efficient and responsive, and that routinely taps the expertise of its citizens to solve problems and make better decisions;
- Create new learning opportunities for students that eliminate disparities in educational opportunity and achievement;
- Address new threats to our national security and strengthen the technological superiority of our military; and
- Expand the frontiers of human knowledge about ourselves and the world around us.

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[2] Over half of the total increase in productivity comes from innovation and technological progress, with the remainder due to improvements in the composition of labor (primarily greater educational attainment), and increases in the amount of capital used per worker. Bureau of Labor Statistics, *Productivity and Costs, Multifactor Productivity Statistics*.

[3] In practice, productivity growth slowed in the 1970s, and picked up (though not to post-war levels) in the 1990s.

What Exactly is Innovation, Anyway?

Innovation refers to an idea, embodied in a technology, product, or process, which is *new and creates value*. To be impactful, innovations must also be scalable, not merely one-off novelties. The President's *Strategy for American Innovation* focuses on two broad categories of innovation:

- *Innovation to drive economic growth and address national priorities:* New technologies, products, processes, and business models can drive economic growth, job creation, and increases in productivity. These innovations flow not only from the development of new technologies (e.g. cloud computing, the integration of IT with objects in the physical world through the "Internet of Things," predictive data analytics, advanced materials, energy storage, life-saving drugs), but also from novel applications of these technologies and new business models that create economic and societal value.

- *Institutional and public-sector innovation:* Historically, some of the most important innovations have been institutional innovations, such as the creation of the patent system, the agricultural extension service, the modern research university, and the peer-review system for supporting basic research. Institutional innovation and experimentation are needed both to improve the performance of the Federal Government and to create a better environment for innovation for the private sector and civil society. Examples of public-sector innovations include paying for results as opposed to paying for inputs; tapping the ingenuity of the American people to solve problems using incentive prizes; using a "test-validate-scale" approach to find and fund what works; and bringing entrepreneurs and world-class technical experts into the Federal Government to transform digital services for the American people.

A Strategy Focused on Shared Prosperity

The Administration's *Strategy for American Innovation* is guided by the goal of achieving shared prosperity. This involves giving all Americans access to the tools and opportunities to contribute to and share in the prosperity created by the emerging sectors of the 21st century innovation economy. Creating a more innovative America will require investments to ensure that the opportunity to enjoy the fruits of the 21st century economy is broadly shared. This means:

- Increasing the diversity of all aspects of the innovation ecosystem;

- Supporting thriving regional innovation ecosystems across the United States;

- Empowering more Americans to upgrade their skills, using new approaches such as online learning, advanced training technologies, competency-based assessment, and skill-based hiring;

- Facilitating the ongoing rebound of advanced manufacturing in America, securing an important source of high-quality, well-paying jobs for American workers; and

- Ensuring the framework conditions that facilitate the introduction of new innovations to the marketplace, boosting the prosperity of all American consumers through new products and services and lower prices.

The Federal Government's Foundational Role

When U.S. companies develop a breakthrough product like a smartphone, it is appropriate to celebrate American firms and workers. But it is also important to recognize the value of the decades of Federal investment in R&D that provided these new products' scientific and technological foundations, such as the Internet, the Global Positioning System, speech recognition, electronic design automation for advanced microprocessors, and artificial intelligence for virtual assistants. Although companies must ultimately invest a great deal to commercialize emerging technologies, the new insights, early prototypes, and the first markets for them are often supported by the Federal Government. Absent Federal investment, many new products would not ever reach the market, let alone reach world-changing scale.

The American innovation ecosystem requires not only the risk-taking and vision of the entrepreneur and the ability of the corporation to scale these innovations, but also the foundational "building blocks" of innovation in which the Federal Government invests. For instance, Federally-funded research at universities and Federal laboratories creates a stream of new insights and technological breakthroughs, some of which will ultimately be commercialized by the private sector. These investments also prepare the next generation of scientists and engineers, many of whom will pursue careers in

private companies. Indeed, the Federal Government has an important role in ensuring the development of a skilled technical workforce crucial for innovation through supporting the widespread availability of high-quality STEM education.

Moreover, Federal investments underpin the physical and digital infrastructure that is not only fundamental to economic activity but also enables new products and business models. For example, the Federal Government plays an essential role in ensuring widespread access to broadband and fostering the development and supporting the adoption of next-generation digital infrastructure.

In addition, creating the right Federal policy and regulatory environment is essential to stimulating private-sector investment, whether it is providing patent protection for life-saving drugs, maintaining a free and open Internet, enforcing our antitrust laws, governing the commercial introduction of emerging technologies, or making it easier for startups and rapidly-growing firms to raise capital.

Although the Federal Government's role of creating the right "rules of the road" and investing in the building blocks of long-term economic growth is less visible than that of the entrepreneur, it is critical to America's economic future.

The Research and Development Investment Imperative

As the 2011 update to the *Strategy for American Innovation* detailed, government support for R&D is crucial because such research often produces large "spillover" benefits; that is, a portion of the returns to the investment accrues to parties other than the investor, diminishing the incentive for investment. In other words, R&D has the characteristics of a public good. Recent empirical analyses that measure spillover effects suggest that the socially optimal level of R&D investment—the amount that would produce the greatest rate of economic growth—is two to four times greater than our actual spending,[4] and that underinvestment is particularly acute in the area of basic research.[5] As a result,

[4] Jones, C.I., and J.C. Williams, "Measuring the Social Return to R&D," *Quarterly Journal of Economics* 113 (1998): 1119–1135; Bloom, N., et al., "Identifying Technology Spillovers and Product Market Rivalry," Centre for Economic Performance (December 2012): 1-81.
[5] Akcigit, U., et al., "Back to Basics: Basic Research Spillovers, Innovation Policy and Growth," National Bureau of Economic Research, Working Paper 19473 (2013).

Federal funding for R&D and especially Federal support for basic research is more important than ever.

The Innovation Ecosystem: Characteristics and Challenges

The United States possesses strengths across all of the core components of the innovation ecosystem. For example, thanks in part to a legacy of public R&D expenditures, research at American universities leads the world: according to one recent ranking the United States is home to 16 of the world's top 20 research universities.[6] Meanwhile, America's culture of entrepreneurial risk-taking drives a dynamic economy in which innovators consistently bring new ideas to the marketplace. In fact, in 2013, more than two-thirds of all venture capital investment in the world was invested in the United States.[7] The U.S. economy also has the highest concentration of knowledge-intensive and technology-intensive industries as a share of total economic activity among major economies at 40 percent of U.S. gross domestic product. And in high-technology manufacturing, the United States leads the world with a global share of 27 percent.[8]

Yet the U.S. innovation ecosystem faces important challenges. These include the need to rebuild a "commons" for advanced manufacturing in the wake of decades of offshoring, and the challenge of incorporating all Americans and all regions of the country into the innovation process.

Facilitating an Advanced Manufacturing Resurgence

The nation's innovation capacity is closely tied to a strong advanced manufacturing sector, as innovation spillovers in the manufacturing process across firms are critical for seeding the next generation of products and processes.

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[6] U.S. News & World Report, "Best Global Universities Rankings 2016," (October 2015), available at http://www.usnews.com/education/best-global-universities/rankings.
[7] EY, *Adapting and Evolving: Global Venture Capital Insights and Trends 2014* (2014).
[8] National Science Board, *Science and Engineering Indicators 2014*, National Science Foundation, NSB 14-01 (2014).

After a decade of decline in the 2000s, American manufacturing is experiencing a new resurgence as companies re-shore to the United States and new factories open their doors. The significant rebound in American manufacturing since the trough of the recession is impressive under any circumstances, but even more so after decades of offshoring have made scarce some of the domestic R&D, engineering, and production capabilities on which manufacturing depends. This so-called "industrial commons" is provided by universities, large firms, industrial consortia, suppliers, manufacturers, and technical research centers. The industrial commons is critical to turn ideas and inventions into high-quality, cost-competitive products that are manufactured domestically.

To fully recover the capacity for future innovation across a variety of industries including biotechnology, pharmaceuticals, advanced materials, and clean energy that comes from the unique knowledge gained in the process of manufacturing, the United States needs to rebuild its industrial commons.

The Need to Ensure that All Americans Can Participate in the Innovation Economy

America's innovation economy is the envy of the world, but the Nation is nowhere near tapping its full potential. The U.S. economy would benefit from even broader participation in the innovation process, giving everyone an opportunity to share in the fruits of the innovation economy.

This country's growing need for technology talent is an important opportunity to broaden access to the innovation economy. America has about 5.8 million open jobs today. Over half a million of those job openings are in information technology (IT) fields like software development, network administration, and cybersecurity—many of which did not even exist just a decade ago. The average salary in a job that requires IT skills—whether in manufacturing, advertising, retail or banking—is 50 percent higher than the average private-sector American job. And increasingly, the training required for these roles can be acquired not just through traditional university and community college curricula, but also through nontraditional means, such as coding boot camps and high-quality online courses that can rapidly train individuals for high-wage jobs.

Yet the entrepreneurial ecosystem would benefit from broader participation. Venture-backed startups are concentrated in relatively few regions of the country, and women lead fewer than three percent of them, even though women currently earn nearly 60

percent of college and master's degrees.[9] Women are comparably underrepresented in the venture capital partnerships that invest in these firms. Further, according to surveys, 87 percent of U.S. venture capital-backed business founders are white, 12 percent are Asian, and less than one percent are African American.[10] Venture capital investment is also concentrated in a small number of coastal regions, including Boston, Los Angeles, New York City, San Francisco, and Silicon Valley. In too many other parts of the country, access to capital is often a major challenge for aspiring entrepreneurs.

By including more Americans in the innovation process, the United States can best sustain American innovation for the long-term while growing the economy.

A Changing Innovation Process

Even the innovation process is changing. Two trends in the innovation process that the Administration's *Strategy for American Innovation* embraces are open innovation and declining barriers to entrepreneurship.

Open Innovation

Traditionally, corporate innovation has concentrated on internal R&D as the primary source of new ideas and products. But increasingly, companies are looking to co-create new products and services with startups, university researchers, and leading-edge users. They are sponsoring hackathons and accelerators, establishing venture capital units, and making it easier for other companies to license intellectual property that they have developed internally. Facilitating these efforts are online innovation marketplaces that reduce the costs of connecting "seekers" with a specific problem to "solvers" with a novel solution. These kinds of approaches have gained widespread acceptance: almost half of the manufacturing firms that created a new product between 2007 and 2009 reported that their most important new product was generated by an outside source.[11]

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[9] Brush, C, et al., *Women Entrepreneurs 2014: Bridging the Gender Gap in Venture Capital*, Babson College Diana Project (September 2014).
[10] CB Insights, *Venture Capital Human Capital Report* (August 2010), available at https://www.cbinsights.com/blog/venture-capital-human-capital-report/.
[11] Arora, A., et al., "The Acquisition and Commercialization of Invention in American Manufacturing: Incidence and Impact," *National Bureau of Economic Research*, Working Paper No. 20264 (2014).

Declining Barriers to Entrepreneurship

Several trends in the IT industry, including cloud computing and open source software, have dramatically lowered the cost of starting an Internet or software-based business. Startups which might have previously required millions of dollars to launch can now be self-financed by founders. Incubators, accelerators, and business plan competitions are also making it easier for entrepreneurs to start new businesses. These organizations not only provide seed funding, they also enable first-time entrepreneurs to learn from peers and mentors. Online courses and "boot camps" covering topics such as programming, app development, and data science are making it easier for individuals to gain the skills they need to perform important functions at new firms.

Barriers to entrepreneurship are declining in other sectors as well. For example, in manufacturing, the tools that are necessary to design and make just about anything, such as computer-aided design software, computer numerically-controlled machine tools, laser cutters, and 3D printers, are becoming more affordable and easier to use. Many communities now have a "maker space," which offer affordable access to these tools and the skills needed to use them. Crowdfunding websites have provided a funding platform for entrepreneurs developing innovations such as intelligent light bulbs, electric bikes, and wearable devices.

In the life sciences, companies have created web-based automated laboratories that allow anyone with a laptop to run experiments remotely. This has the potential to reduce the cost of launching a life sciences startup, to give life scientists the freedom to design experiments without being constrained by the equipment to which they currently have access, and to increase the reproducibility of their results.

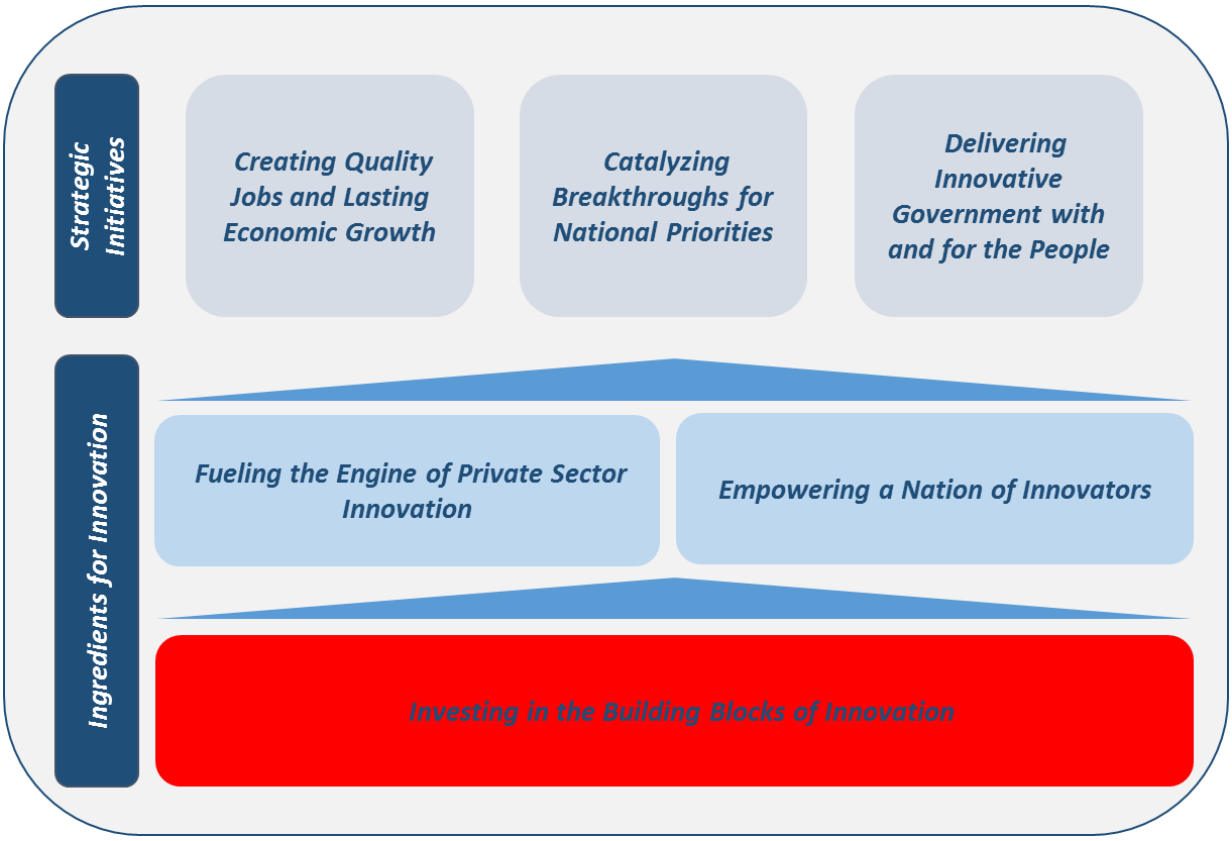
A Strategy to Last beyond this Administration

Together, these elements compose a coordinated approach designed not only to deliver the immediate benefits of innovation, but also to lay the groundwork for shared prosperity for decades to come. The subsequent chapters articulate in detail the elements of the *Strategy for American Innovation*.

Investing in the Building Blocks of Innovation

"Twenty-first century businesses will rely on American science and technology, research and development….I want Americans to win the race for the kinds of discoveries that unleash new jobs."

- *President Barack Obama, State of the Union Address, January 20, 2015*



From fundamental research to STEM education, the building blocks of the American innovation ecosystem are those areas where Federal investments provide the foundational inputs to the innovation process.

Making World-Leading Investments in Fundamental Research

If America is to continue to lead the world in innovation, American universities, Federal and national labs, and industrial laboratories must continue to do the research that will lead to breakthrough products, improved services, and new companies. Federal Government funding for research and development (R&D) is essential to drive innovation and economic competitiveness, and address societal needs in areas in which the private sector does not have sufficient economic incentive to make the required investments. A key focus of Federal R&D investment is fundamental, curiosity-driven research that has been a hallmark of the American research enterprise and a powerful driver of serendipitous technological advances, but is also less likely to attract private-sector investment than shorter-term product development. The President has consistently called for sustaining America's long-term economic competitiveness through robust, world-leading investments in fundamental research with an emphasis on high-risk, high-reward research that can potentially lead to transformational advances. This will also require sustained investments in our research infrastructure to ensure that our scientists and engineers have the facilities and tools required to make these transformational advances.

"Basic research, by definition, will sometimes lead us down blind alleys, but it will also tell us what we don't know, which then helps us figure out new pathways. And when things do pay off, then they create economic opportunities in ways that we could never imagine."

- President Barack Obama, January 30, 2015

Building on a Strong Record of Achievement

The President has set a goal for America to invest more than three percent of our GDP in public and private R&D, surpassing the level achieved at the height of the space race.

The President's 2016 Budget targets resources to areas most likely to contribute directly to the creation of transformational knowledge and technologies that can benefit society and create the businesses and jobs of the future. The Administration has made world-leading investments in fundamental research a priority: the Budget proposes $67 billion for basic and applied research, a three percent increase from 2015 enacted levels. This includes continuing to increase total Federal investment in the combined budgets of

three key basic research agencies: the National Science Foundation (NSF), the Department of Energy (DOE) Office of Science, and the laboratories of the Department of Commerce (DOC) National Institute of Standards and Technology (NIST).

Improving Scientific Reproducibility to Support Innovation

The Federal Government funds more than $130 billion a year in R&D that generates tremendous economic and social benefit to the nation. Recently, a number of examples have emerged that highlight serious challenges in reproducing scientific research results. Pharmaceutical companies have reported notable difficulties in reproducing published research on experimental results in oncology, and a study on the reproducibility of published psychology research results found that only 39 out of 100 experimental findings could be replicated.[12] While the focus to date has mostly been on reproducibility of biomedical and behavioral research, similar challenges extend to virtually every field of science. Federal agencies have begun to take steps to address concerns about the reliability and reproducibility of research results. For example, the National Institutes of Health (NIH) launched an effort to address the reproducibility issue in biomedical research,[13] and NSF has developed a framework for improving reproducibility, replicability, and robustness in NSF-funded research.[14] The White House Office of Science and Technology Policy (OSTP) plans to work with these and other Federal science agencies to better understand the extent of reproducibility problems in the sciences and explore options for addressing them in Federally-funded research. This work will build upon OSTP's ongoing efforts to improve access to the results of Federally-funded R&D, including digital data and scholarly publications.

[12] Baker, M., "First Results from Psychology's Largest Reproducibility Test," *Nature News* (30 April 2015), available at http://www.nature.com/news/first-results-from-psychology-s-largest-reproducibility-test-1.17433.
[13] Collins, F., and Tabak, L., "NIH Plans to Enhance Reproducibility," *Nature* 505.7485 (2014): 612–613.
[14] National Science Foundation, "A Framework for Ongoing and Future National Science Foundation Activities to Improve Reproducibility, Replicability, and Robustness in Funded Research," (December 2014), available at https://www.nsf.gov/attachments/134722/public/Reproducibility_NSFPlanforOMB_Dec31_2014.pdf.

Encourage High-Risk, High-Reward Research and Transformative Approaches

The 2016 Budget continues to encourage Federal support of high-risk, high-reward research and potentially transformative, breakthrough approaches to research:

- *The Budget includes $325 million for the Advanced Research Projects Agency–Energy (ARPA-E)*, a program that accelerates innovation by investing in transformative energy technologies in order to create a more secure, affordable and sustainable energy future.

- *The 2016 Budget also maintains the Department of Defense's (DOD) critical role in fostering breakthrough approaches for discovering promising technologies* with $3 billion for the Defense Advanced Research Projects Agency (DARPA), which promotes advanced research to create breakthrough technologies for national security. President Obama has urged Congress to provide full funding for DARPA, given that it has been a source of "cutting-edge breakthroughs from that early Internet to stealth technology."

- *NIH has created a number of funding mechanisms to support high-risk, high-return research*. For example, the NIH Director's New Innovator Award provides up to five years of funding to exceptionally creative, early career investigators who propose high-impact projects.

- *The President has made the National Aeronautics and Space Administration's (NASA) investments in space technology a top priority*. The creation of the Space Technology Mission Directorate is allowing NASA to invest in breakthrough technologies, such as the ability to communicate in space using lasers and to deploy more efficient solar arrays, both of which can be used in applications from Earth-circling communication satellites to spacecraft exploring the edge of the solar system.

Boosting Access to High-Quality STEM Education

A key building block for American innovation in the 21st century is a workforce that can succeed in an increasingly knowledge-intensive economy. Having adults trained in science, technology, engineering, and mathematics (STEM) has long been central to our Nation's ability to manufacture better and smarter products, improve health care, develop cleaner and more efficient domestic energy sources, preserve the environment, safeguard national security, and grow the economy.

That's why the President believes that the United States must not only lead the world in science and technology, but also STEM education. Three major trends have motivated the Administration to focus on improving STEM education:

- *The jobs of the future are STEM jobs*. A recent report by the President's Council of Advisors on Science and Technology (PCAST) estimates there will be one million fewer STEM college graduates over the next decade than U.S. industries will need.[15] The demand for STEM graduates may actually be higher, given that PCAST also estimated that STEM competencies are increasingly required for workers both within and outside specific STEM occupations.

- *Our K-12 system is "middle of the pack" in international comparisons*. According to a number of different analyses of Organization for Economic Cooperation and Development (OECD) countries, U.S. students and adults rank in the middle of the pack or worse in math and science. For example, in the 2012 Programme for International Student Assessment (PISA) study, which measures students' ability to apply what they have learned in reading and mathematics in real-life situations, students in 19 countries had higher average scores than did U.S.

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[15] President's Council of Advisors on Science and Technology, "Engage to Excel: Producing One Million Additional College Degrees in Science, Technology, Engineering, and Mathematics," *Report to the President*, Executive Office of the President (February 2012), available at https://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf.

students in science and 26 countries had higher scores in mathematics.[16] PCAST estimates that these deficiencies will become all the more problematic if the strong inflow of foreign-born STEM professionals to the United States decreases due to growing opportunities in their home countries.[17]

- *Progress on broadening access to STEM education is critical to achieving America's full potential*. Women and members of some minority groups are substantially underrepresented in particular STEM fields, even as these fields grow in importance as a source of high-paying jobs.[18] While earning a STEM degree is one important milestone in pursuing a STEM career, just 2.2 percent of Hispanics and Latinos, 2.7 percent of African Americans, and 3.3 percent of Native Americans and Alaska Natives have earned a first university degree in the natural sciences or engineering by age 24. While women constitute the majority of students on college campuses and roughly 46 percent of the workforce, they represent less than one in five bachelor degree recipients in fields like computer science and engineering, and hold only 28 percent of STEM jobs.

"We don't want to just increase the number of American students in STEM. We want to make sure everybody is involved. We want to increase the diversity of STEM programs, as well…and that means reaching out to boys and girls, men and women of all races and all backgrounds. Science is for all of us. And we want our classrooms and labs and workplaces and media to reflect that."

– President Barack Obama, March 23, 2015

[16] OECD Programme for International Student Assessment, "United States Country Note: Results from PISA 2012," (2012), available at http://www.oecd.org/unitedstates/PISA-2012-results-US.pdf.
[17] President's Council of Advisors on Science and Technology, "Engage to Excel: Producing One Million Additional College Degrees in Science, Technology, Engineering, and Mathematics," *Report to the President*, Executive Office of the President (February 2012): 2, available at https://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_feb.pdf.
[18] National Science Board, *Science and Engineering Indicators 2014*, National Science Foundation (2014): 3-43; and Vilorio, D, "STEM 101: Intro to Tomorrow's Jobs," *Occupational Outlook Quarterly*, Bureau of Labor Statistics (Spring 2014), available at http://www.bls.gov/careeroutlook/2014/spring/art01.pdf.

In response to these trends, the President has called for cultivating the minds of tomorrow's engineers, scientists, and engineers through strong and sustained investment in STEM education to underpin future economic competitiveness.

Building on a Strong Record of Achievement

Since 2009, the Administration has pursued several key strategies to improve STEM education:

- *Setting and making progress on ambitious national goals*. These goals include moving American kids from the middle to the top of the pack of international rankings in science and math, preparing 100,000 excellent STEM teachers, producing one million more STEM college graduates over a decade, and broadening participation and success in STEM fields for women and underrepresented minorities. These goals have been incorporated into the Federal STEM Education 5-Year Strategic Plan released in May 2013, and have resulted in major Federal investments.[19] For example, in support of the 100,000 STEM teachers goal, in 2014 the Department of Education announced more than $35 million in STEM-focused five-year grants under the Teacher Quality Partnership Grant program. These grants are expected to total $175 million and will support more than 11,000 new teachers, primarily in STEM fields, in high-need schools.

- *Maintaining a strong investment in STEM education and increasing coordination of Federal investments*. The President's 2016 Budget maintains a strong priority for STEM education by requesting $3 billion, an increase of 3.8 percent over the 2015 enacted level. Furthermore, the Administration has made progress to increase coordination of STEM education programs. Over the past two years, as funding has stayed level, the overall number of individual STEM programs has been reduced by 40 percent, while Federal agencies have worked together on a coordinated approach to investment.

[19] The *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan* is available at https://www.whitehouse.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf.

- *Incorporating STEM education into the Administration's overall education reform strategy*. The Administration has looked for opportunities to embed STEM into its broader education efforts. For example, the Department of Education's $4 billion Race to the Top program gave preference for states with proposals emphasizing innovation in STEM education. In the 2016 Budget, the President has proposed a $125 million competitive program at the Department of Education to help communities across America launch Next-Generation High Schools. This initiative is part of the President's broader call for whole-school transformation of the high school experience, and will target funding to schools that serve as laboratories for cutting-edge STEM teaching and learning.

- *Building a strong "all hands on deck" effort that includes business, nonprofits, foundations, and others*. The President launched the Educate to Innovate campaign in 2009 to mobilize a broad coalition of citizens, educators, companies, professionals, foundations, and nonprofits to improve STEM education. Over the past six years, that has resulted in more than $1 billion in direct and in-kind support for STEM programs. For example, more than 230 organizations have formed a coalition called 100Kin10 in response to the President's goal of preparing 100,000 excellent STEM teachers over a decade. To date, its partner organizations have made over 350 measurable commitments, including recruiting and preparing more than 40,000 STEM teachers in the first five years of the initiative. Institutions and organizations made more than 100 individual commitments as part of two White House College Opportunity Days of Action to attract and retain tens of thousands more students on a pathway to STEM degrees to support the President's goal of one million more STEM college graduates. Leading companies and the Department of Defense have worked together to commit funds to expand AP STEM courses to more than 170 high schools with large numbers of military-impacted students. Change the Equation, a coalition of CEOs, has committed to expanding high-quality STEM programs to more than one million students by 2016.

- *Harnessing the President's personal commitment to inspire more students to excel in STEM education*. The President established the first-ever White House Science Fair, which celebrates student winners of math, science, and robotics competitions, and has hosted five science fairs to date. As the President has noted, "If you win the NCAA championship, you come to the White House. Well, if you're a young person and you produce the best experiment or design,

the best hardware or software, you ought to be recognized for that achievement, too."

In addition, the President hosted the first-ever White House Maker Faire in 2014, which showcased students and adults accessing the tools and skills necessary to design and make just about anything, and the White House followed up with a "Week of Making" in 2015. President Obama also participated in the "Hour of Code" during Computer Science Education Week, making him the first President to ever write a line of computer code, and he marked the occasion by issuing a video calling on students, parents, and teachers across the country to get involved in computer programming.

Clearing a Path for Immigrants to Propel the Innovation Economy

The President is pursuing common-sense immigration reform to improve the immigration system across the board, including for high-skilled workers, graduates, and entrepreneurs who are so integral to the American innovation economy. Immigrants have always played a pivotal role in the dynamism of the American economy. In fact, immigrant entrepreneurs are responsible for one of every four small businesses and high-tech startups across America, and more than 40 percent of Fortune 500 companies—from GE and Ford to Google and Yahoo!—were founded by immigrants or the children of immigrants.[20] Not only do they create jobs in America, but immigrant entrepreneurs are strongly positioned to create products that are marketable abroad.

But the value of highly-skilled immigrants to the American economy extends far beyond entrepreneurship. Economists have found that boosting high-skilled immigration leads to productivity increases, not only because these workers represent an important source of innovation, but also indirectly through positive spillovers that benefit nonimmigrant workers.[21] In other words, high-skilled immigration helps the American economy produce more efficiently, with widespread benefits accruing to all American workers in the form of higher wages. According to an analysis by the President's Council of Economic Advisers, the executive actions announced by the President last November, if fully implemented, would boost the nation's GDP by $100 billion to $250 billion in annual GDP in ten years, while the economic growth caused by the actions would shrink the annual Federal deficit by $30 billion to $65 billion in ten years.[22]

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[20] Partnership for a New American Economy, "The 'New American' Fortune 500" (June 2011).
[21] Council of Economic Advisers, "The Economic Effects of Administrative Action on Immigration," Executive Office of the President (February 2015), available at https://www.whitehouse.gov/sites/default/files/docs/economic_effects_of_immigration_ea_february_2015_update_final_v2.pdf.
[22] *Id.*

"Are we a nation that educates the world's best and brightest in our universities, only to send them home to create businesses in countries that compete against us? Or are we a nation that encourages them to stay and create jobs, businesses, and industries right here in America?"

- President Barack Obama, November 20, 2014

Taking Action on Common-Sense Immigration Reform

Recognizing the fundamental role of immigrants in the fabric of our economy and society, the President announced several executive actions in November 2014 that will help clear a path for them to make significant economic contributions to the American economy. The steps to facilitate high-skill immigration include:

- *Unlocking the talents of highly skilled Americans-in-waiting*. Most high-skilled immigrants get started on their U.S. careers under a temporary work visa (typically the H-1B visa), and if there are no American workers qualified and available to do the job, the employer can sponsor that worker for lawful permanent residence—commonly called a "green card." But the wait for that green card can last years, even decades, even after an application is approved. During this time, the worker is effectively locked into one position at the sponsoring company. The Administration's actions will make it possible for more highly-skilled workers and certain spouses to obtain a portable work authorization, allowing them to accept promotions, change positions or employers, or start new companies while they and their families wait to receive their green cards and ultimately become Americans.

- *Clearing the path for job-creating entrepreneurs*. The Administration will, for the first time, issue detailed guidance and rules for entrepreneurs who seek to start and grow their companies here as lawful permanent residents or through a temporary immigration status. More than ever before, these pathways will allow the world's most promising and innovative entrepreneurs to innovate and hire here in America.

- *Retaining the scientists and engineers we educate here*. American universities train some of the world's most talented students in science, technology, engineering, and mathematics (STEM), but the broken U.S. immigration system compels

many of them to take their skills back to their home countries. The Administration's actions will strengthen and extend on-the-job training for foreign STEM graduates from U.S. universities, known as Optional Practical Training, giving them additional time to gain the skills they need to further their education.

Together these steps promise to augment significantly the innovation capacity and productivity of the American economy, while giving those who have earned it a shot at the American dream.

Building a Leading 21st Century Physical Infrastructure

The President is committed to making investments in the nation's physical infrastructure that will not only create jobs now but also foster innovation and economic growth in the long term, expand opportunity, and improve the overall competitiveness of the U.S. economy. Modern infrastructure enables goods and services to move at the pace of demand, helps American manufacturers to export, draws jobs to American shores, and enables the expansion of businesses.

The Administration has launched a number of initiatives to help strengthen infrastructure investment and economic growth. Since the President took office, the Recovery Act financed $50 billion in infrastructure improvements in thousands of American communities.

To help support manufacturing, the President has called on Congress to increase investment in the nation's freight network to ensure that businesses have dependable supply chains. The President's agenda also includes increased support for innovative transit systems—like bus rapid transit—that encourage regional interconnectivity and worker mobility, as well as support for the Federal Aviation Administration's Next Generation Air Traffic System (NextGen) modernization. Through the Build America Investment Initiative, the Administration is also bringing private capital and expertise into infrastructure development itself, so that the transportation sector can benefit from private-sector innovation in design, engineering and construction.

"First-class infrastructure attracts first-class jobs. Business owners don't want a crumbling road or a bridge because then they can't move out their stuff, and their workers aren't as productive because it's harder for them to get to work. They want to set up shop where there's high-speed rail and high-speed broadband, high-tech schools, self-healing power grids, new ports, tunnels."

- President Barack Obama, May 14, 2014

<u>Building on a Strong Record of Achievement</u>

A July 2014 Presidential Memorandum launched the Build America Investment Initiative in an effort to increase investment in infrastructure, spur economic growth, and engage state and local governments and the private sector in productive public-

private partnerships. The Build America Investment Initiative includes the launch of the Build America Transportation Investment Center, which serves as a Department of Transportation resource for state and local governments and private and public developers to engage in innovative financing for transport-infrastructure projects. Alongside the Initiative, a Build America Interagency Working Group was also launched to expand infrastructure investment beyond the transportation sector. In September 2014, the Build America Infrastructure Investment Summit was hosted by the Treasury Department, which convened over a hundred leaders from the private and public sectors around innovative financing opportunities and support and resources for project development.

Not only is the Administration working to increase infrastructure investment across the country, it is also taking steps to make American infrastructure smarter, improving efficiency and saving lives. From sensor-enabled water and sewer systems that improve efficiency through automatic flow management and leak detection to sensor-enabled continuous monitoring of bridges' structural health, smart infrastructure can deliver better results, often at considerable savings. The Administration is promoting smarter infrastructure through a range of mechanisms, including encouraging states and localities to incorporate innovative approaches into their pre-planning processes through the Build America Investment Initiative and through the Economic Development Administration's efforts to fund and offer technical assistance to regions investing in smart infrastructure.

The Administration is also working to modernize the Federal permitting and environmental review process for infrastructure projects. Among other actions is the expanded use of the Federal Infrastructure Permitting Dashboard tool for publicly tracking agency progress on completing review processes for proposed infrastructure projects.

Building a Next-Generation Digital Infrastructure

Robust access to the digital world has rapidly become a necessity for citizens and businesses in the 21st century — driving job creation, promoting innovation, and creating new markets for American businesses. The infrastructure to support both this access and the development of next-generation networks requires significant broadband investments and smart, efficient allocation of telecommunications spectrum that

balances the need for additional broadband spectrum with the needs of other spectrum users.

> "While high-speed Internet access is a given, it's assumed for millions of Americans, it's still out of reach for too many people – especially in low-income and rural communities….Fewer than half of households with less than a high school education are plugged into the Internet. So, in other words, the people who could benefit the most from the latest technology are the least likely to have it."
>
> - President Barack Obama, July 15, 2015

Building on a Strong Record of Achievement

The Administration has awarded over $7 billion in broadband grants and loans under the Recovery Act and freed up spectrum for more extensive and robust wireless broadband networks in both urban and rural areas.

Wireless

To promote economic growth and unleash the potential of wireless broadband, President Obama unveiled an initiative in 2010 to reform spectrum policy and improve America's wireless infrastructure, and in 2011 he announced a National Wireless Initiative to make available high-speed (4G) wireless services to at least 98 percent of Americans. These efforts are paying dividends: in 2015, the Administration announced that the U.S. had reached the 98 percent goal.

The President also called for the National Telecommunications and Information Administration (NTIA), in collaboration with the Federal Communications Commission (FCC), to make 500 megahertz of Federal and non-Federal spectrum available for fixed and mobile wireless broadband by the year 2020. NTIA and the FCC have already reached nearly the halfway point of this goal, making 245 megahertz of spectrum available to date. These efforts will spur innovation, stimulate economic growth, and result in significant job creation for America's future.

To achieve the President's spectrum goal, the Administration is also moving beyond the traditional approach of clearing government-held spectrum of Federal users in order to auction it off to the private sector for exclusive use. The President's Council of Advisors

on Science and Technology (PCAST) has recommended the Federal Government also increase the availability of spectrum for innovative applications through new models of spectrum sharing.[23] The Administration is taking important steps to make this vision a reality to enhance efficiency among all users and expedite commercial access to additional spectrum bands where technically and economically feasible. For example, the FCC and NTIA recently worked together to make 100 MHz of spectrum available for shared small cell use in the 3.5 GHz Federal band. In addition, the FCC and NTIA are working to establish a "Model City" program for demonstrating and evaluating advanced spectrum sharing technologies, which may include relevant next-generation 5G technology trials.

Broadband

More than five years ago, the Administration invested more than $4 billion in broadband grants through NTIA's Broadband Technology Opportunities Program as part of the Recovery Act to build network infrastructure, establish public computer centers, and develop digital literacy training. Program grantees have built or upgraded more than 114,000 miles of fiber and connected more than 26,000 community anchor institutions, such as schools and libraries. They have also established or upgraded 3,000 public computer centers, trained more than four million people, and helped roughly 671,000 households sign up for broadband service.

The Administration has also supported high-speed network deployment in rural areas. In 2009, the Recovery Act provided $2.5 billion through the U.S. Department of Agriculture's Rural Utilities Service (RUS) for rural broadband. In 2011, the FCC began updating the universal service program to extend broadband infrastructure in sparsely populated, isolated rural areas where it is expensive to deploy networks. The FCC announced in September 2015 that it will make available from the Connect America Fund (CAF) Phase II—a total of $ 9 billion over the next six years to ten

[23] President's Council of Advisors on Science and Technology, "Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth," *Report to the President*, Executive Office of the President (July 2012), available at https://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_spectrum_report_final_july_20_2012.pdf.

telecommunications carriers to build high-speed networks that will expand broadband to nearly 7.3 million rural residents.

High-speed, low-cost broadband is paving the way for economic revitalization in places like Chattanooga, TN; Kansas City, MO; Ammon, ID; and Lafayette, LA—all of which have Internet speeds nearly 100 times faster than the national average and deliver it at an affordable price. And the Administration has taken a series of steps to make networks like these and the applications that rely on them a reality. For example, the Administration has called on the private and nonprofit sectors to support expansion of ultra-fast broadband across America's communities, and cities are stepping up (see box).

Yet challenges remain. Approximately 67 million Americans do not have a high-speed Internet connection at home and 55 million Americans cannot purchase a wired broadband connection with download speeds of at least 25 megabits per second.[24]

To address these challenges, the Administration has taken steps that include supporting community broadband projects with technical assistance through a new program called BroadbandUSA, unveiling new grant and loan opportunities for rural providers, and removing Federal regulatory barriers to broadband build-out and competition. In addition, the President has called for an end to laws that undermine broadband service competition, including those that prevent municipalities from creating their own networks.

Further, in March 2015 the President announced the Broadband Opportunity Council, a whole-of-government effort to expand broadband deployment and adoption, with a focus on bringing broadband to underserved communities and encouraging new entrants and new investments to improve broadband quality and service. Upon the recommendation of the Council, the Administration took new steps in September 2015, including modernizing Federal programs valued at approximately $10 billion to include

[24] U.S. Census Bureau, American Community Survey (2013); Federal Communications Commission, "FCC Finds U.S. Broadband Deployment Not Keeping Pace" (January 29, 2015), available at https://www.fcc.gov/document/fcc-finds-us-broadband-deployment-not-keeping-pace.

broadband as an eligible program expenditure, streamlining application processes for programs and broadband permitting to support deployment, and more.

Creating a Gigabit Future

Nonprofit organizations like US Ignite, Inc. are encouraging the development and deployment of a new class of "gigabit" applications in communities with next-generation networks. These apps can help transform healthcare, education, public safety, transportation, advanced manufacturing, and clean energy.

Three years ago, Chattanooga, Tennessee began running a gigabit network through its local public utility, while also developing a broad set of community programs that take advantage of this network. These programs include smart grid applications to greatly reduce power outages and a distance learning application that connects students in the STEM high school with professors at the University of Southern California. Students can control a high-end microscope that is 2,000 miles away to study micro-organisms from the Pacific Ocean. With the help of its advanced fiber infrastructure, the city has also hosted app-developer hackathons, created a startup accelerator and attracted over 6,000 new jobs to the city from global companies like Amazon and Volkswagen.

Efforts like Chattanooga's are proliferating across the country, as many more cities, from San Leandro, California to Wilson, North Carolina, have announced gigabit initiatives in recent months.

The Federal Government has also prioritized investments to bring high-speed broadband to important underserved community locations.

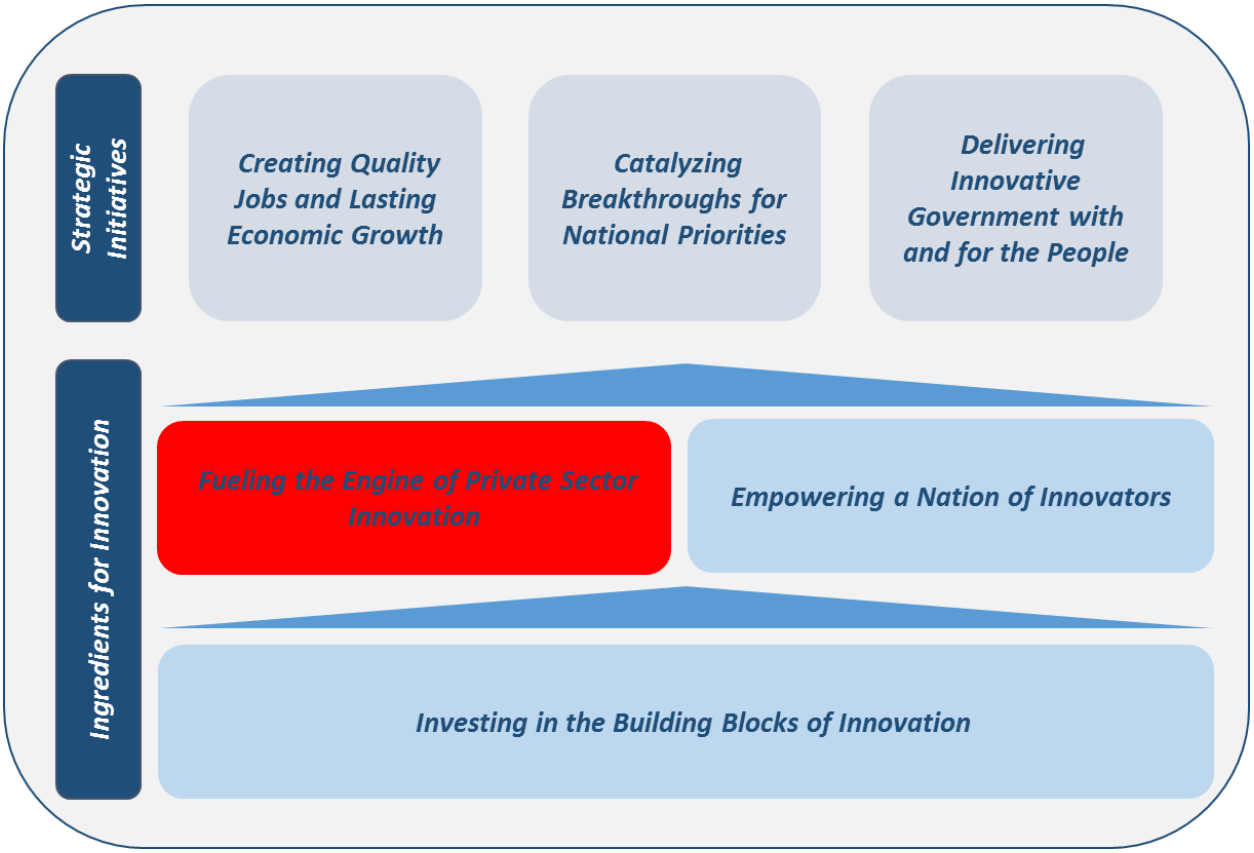
- *Funding connectivity at schools and libraries*. The FCC, an independent agency, has recently modernized its universal service E-rate program—the nation's largest program supporting education technology—to assist schools and libraries in gaining access to robust high-speed broadband connections. This effort involved increasing the annual E-rate funding cap to $3.9 billion per year, making additional program funds available, increasing purchasing flexibility for schools and libraries, and clearing the path for Wi-Fi investments.

- *Ensuring access to high-speed Internet, no matter where you live*. Announced in July 2015, the Administration's ConnectHome Initiative brings together Internet Service Providers, nonprofits and the private sector to offer broadband access, technical training, digital literacy programs, and devices for residents in assisted housing units.

Fueling the Engine of Private-Sector Innovation

"So no one knows for certain which industries will generate the jobs of the future. But we do know we want them here in America. We know that. And that's why the third part of middle-class economics is all about building the most competitive economy anywhere, the place where businesses want to locate and hire."

- *President Barack Obama, State of the Union Address, January 20, 2015*



The Federal Government can empower private-sector innovators by addressing the market failures that stymie innovative activity and by ensuring framework conditions friendly to experimentation and innovation.

Strengthening the Research and Experimentation Tax Credit

Private-sector investments in R&D are critical for long-term economic growth, job creation and productivity. Yet economists have found significant knowledge spillovers result from private R&D activity, meaning that any firm investing in the development of new knowledge will fail to capture the full benefits of that investment.[25] Accordingly, the social returns to R&D will exceed the private returns that any individual firm can capture, and as a result, firms tend to underinvest in R&D. Since 1981, the United States has had the Research and Experimentation (R&E) Tax Credit to provide incentives for private-sector innovation and to correct this market failure. But amid intensified international competition over tax treatment of R&D, the R&E Tax Credit is less generous than the incentives offered by at least 21 other OECD countries.[26]

Broadening, Extending, and Making Permanent the R&E Tax Credit

President Obama's proposals to reform the R&E tax credit would ensure substantial and predictable incentives for U.S. businesses to innovate. The credit already provides a valuable incentive, as the evidence suggests that it produces approximately a dollar-for-dollar increase in research spending.[27] The following changes promise to make it an even stronger incentive.

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[25] U.S. Treasury Office of Tax Policy, *Investing in U.S. Competitiveness: The Benefits of Enhancing the Research and Experimentation (R&E) Tax Credit* (March 2011), available at http://www.treasury.gov/resource-center/tax-policy/Documents/Research%20and%20Experimentation%20report%20FINAL.PDFhttp://www.treasury.gov/resource-center/tax-policy/Documents/Research%20and%20Experimentation%20report%20FINAL.PDF.

[26] OECD R&D Tax Incentives Indicators; based on the 2013 OECD-NESTI data collection on tax incentives support for R&D expenditures, available at http://www.oecd.org/sti/rd-tax-stats.htm#designhttp://www.oecd.org/sti/rd-tax-stats.htm#design.

[27] U.S. Treasury Office of Tax Policy, *Investing in U.S. Competitiveness: The Benefits of Enhancing the Research and Experimentation (R&E) Tax Credit* (March 2011), available at http://www.treasury.gov/resource-center/tax-policy/Documents/Research%20and%20Experimentation%20report%20FINAL.PDFhttp://www.treasury.gov/resource-center/tax-policy/Documents/Research%20and%20Experimentation%20report%20FINAL.PDF.

Broaden and Extend

In the 2016 Budget, the Administration proposes to make the credit more generous and available to a broader range of innovative firms. Specifically, the proposal would: (1) increase the rate of the alternative simplified credit (ASC) from 14 to 18 percent; (2) streamline the credit calculations that businesses must perform; (3) allow the credit to offset Alternative Minimum Tax liability to expand its availability to young research-intensive firms; and (4) increase the generosity for collaborative research by allowing 75 percent of payments to nonprofits for research to be counted toward the credit.

Make Permanent

Uncertainty about the future availability of the R&E tax credit diminishes its incentive effect because it is difficult for taxpayers to factor the credit into decisions to invest in research projects that will not be initiated and completed prior to the credit's expiration. Until now, the R&E tax credit has been authorized and extended only a few years at a time. To give American innovators an enduring incentive, the President's proposal would make the R&E credit permanent.

Supporting Innovative Entrepreneurs

Startups bring new products and processes to market and hence are a key source of the innovations that improve our lives and boost the productivity of the American economy. They also represent an important source of new jobs. According to one recent analysis, startup firms account for three percent of employment but almost 20 percent of gross job creation.[28]

Yet America's entrepreneurial ecosystem would benefit by drawing on talented Americans from all backgrounds and locations. Just three percent of America's venture capital-backed startups are led by women, and only around one percent are led by African Americans. And capital for innovative startups is predominantly available in just a few places, making high-growth business creation a challenge outside of a handful of metro hubs.

Other challenges loom. The rates of both new firm formation and economic dynamism in the United States have declined over the past several decades. As a result, the share of employment created by young firms has declined by 30 percent over the last 30 years.[29] Because new firms are a key source of jobs and economic growth, reversing these trends is critical.

These challenges underscore the important role of public policy to help overcome some of the barriers to startup entrepreneurship, particularly among underrepresented populations and in geographies and sectors where entrepreneurial activity is lagging. To keep America's lead as the best place in the world to start and scale a great company, the Administration is working to ensure all Americans have a fair shot at entrepreneurial success.

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[28] Haltiwanger, J., et al., "Who Creates Jobs? Small vs. Large vs. Young" U.S. Census Bureau Center for Economic Studies, Paper No. CES-WP- 10-17 (August 2010).
[29] Decker, R, et al., "The Secular Decline in Business Dynamism in the U.S.," *Working Paper* (2013).

"With technological advancements like cloud computing and big data and 3D printing, the fact is there has never been a better time to launch an idea and bring it to scale right here in the United States, right now. But we've got to make sure that we're taking full advantage of this moment by tapping all the talent America has to offer, no matter who they are or where they set up shop."

- President Barack Obama, Remarks at the White House Demo Day, August 4, 2015

Building on a Strong Record of Achievement

The Administration has made innovative entrepreneurship a key component of its innovation agenda, led by the White House Startup America Initiative. In January 2011, President Obama launched the Startup America Initiative when he issued an all-hands-on-deck call to Federal agencies, Congress, and the private sector to celebrate, inspire, and accelerate high-growth entrepreneurship throughout the nation. This effort led to bipartisan Congressional action on the JOBS Act (see box), as well as executive actions and private-sector entrepreneurship initiatives, including:

- *Executive actions to unlock access to capital and accelerate innovation*. The Small Business Administration (SBA) has committed $2 billion in Federally-guaranteed leverage for private Small Business Investment Company (SBIC) funds that invest in underserved markets, sectors of national priority such as clean energy and education, or early-stage innovative companies, while the Treasury Department has simplified New Markets Tax Credits for investment in entrepreneurs revitalizing low-income communities.

- *State Small Business Credit Initiative*. Created by the Small Business Jobs Act President Obama signed into law in 2010, Treasury's State Small Business Credit Initiative (SSBCI) has allocated $1.5 billion to state programs that support small businesses. Crucially, the program gives states flexibility in allocating these resources. Over 30 states have allocated nearly half-a-billion SSBCI dollars to venture-capital programs—a dramatic increase in funding for the programs that are critical to expanding high-growth entrepreneurship into diverse regions around the country.

- *Private-sector entrepreneurship initiatives*. In response to the President's call to action, the Case Foundation and the Kauffman Foundation launched the Startup America Partnership, an independent alliance of entrepreneurs, foundations, and companies dedicated to strengthening entrepreneurial networks all across the country by empowering grassroots leaders who create action-oriented local programs. The Startup America Partnership is now operating around the world as UP Global, which announced at the October 2013 Global Entrepreneurship Summit a commitment to support and train 500,000 entrepreneurs in 1,000 cities over the next three years.

Jumpstart Our Business Startups (JOBS) Act

Signed into law in April 2012, the JOBS Act enacts three key ideas the President proposed to help startups and small businesses access the capital they need to grow and create jobs.

IPO On-Ramp: A new class of "Emerging Growth Companies" are already taking advantage of a streamlined "IPO On-Ramp" that reduces the cost of going public by phasing in certain regulatory requirements after their early post-IPO years.

Regulation A+: "Mini public offerings" will be available for companies raising up to $50 million per year under recently finalized Securities and Exchange Commission (SEC) regulations.

Crowdfunding: A national framework for securities-based "crowdfunding" will allow entrepreneurs to raise up to $1 million per year in small-dollar investments through regulated online platforms, pending SEC implementation of its Oct. 23, 2013 proposed rule.

Tapping America's Full Entrepreneurial Potential

To maintain America's lead as the best place on the planet to start and scale a great company, the United States must ensure that vibrant startup ecosystems emerge in every corner of America and that all Americans, including those underrepresented in entrepreneurship like women and people of color, are both encouraged and able to fully contribute their entrepreneurial talents and access resources.

White House Demo Day

On August 4, 2015, the President held the first-ever White House Demo Day to showcase stories of entrepreneurial success from across the country that demonstrate the importance of including everyone in America's startup economy. At the White House Demo Day, the President outlined new Federal steps to support entrepreneurial efforts in diverse communities, including the announcement of 116 winners of the Small Business Administration's Growth Accelerator Fund to support accelerators and other entrepreneurial ecosystem models across the country. In addition, in answer to the President's call to action, outside organizations are stepping up their efforts, including over 40 leading venture capital firms announcing their commitment to specific actions that advance opportunities for women and underrepresented minorities in the entrepreneurial ecosystem.

Startup in a Day Initiative

As any entrepreneur or small business owner knows, starting or expanding a business often entails dealing with considerable red tape, from setting up a legal business structure to acquiring various permits and licenses. But simple and affordable technological solutions exist to digitize the process, dramatically shortening the time required. In June 2015, the President called on mayors across the country to develop online tools that let entrepreneurs discover and apply for—in less than a day—local, state, and Federal requirements needed to start a business. To support this effort, the Small Business Administration will offer a $1.5 million competition for seed grants to cities committed to building Startup in a Day solutions.

Extend the State Small Business Credit Initiative and Reward Best Practices

In the 2016 Budget, the President calls on Congress to pass legislation that would extend Treasury's expiring State Small Business Credit Initiative with a further $1.5 billion to allocate among states for capital programs that finance entrepreneurs and small businesses. Under the President's proposal, $1 billion of that sum would be awarded on a competitive basis to states best able to target local market needs, promote inclusion, attract private capital for startup and scale-up businesses, strengthen regional entrepreneurial ecosystems, and evaluate results.

Unlock Additional Capital for Early-Stage and Impact Investments across the Country

The Small Business Administration (SBA) has already made its Impact Investment Fund a permanent feature of the Small Business Investment Company (SBIC) program and in the last 12 months quadrupled assets under management to about $650 million. SBA is undertaking an effort to propose additional changes to the Impact Investment Fund as well as new changes to the SBIC Early Stage capital program in order to unlock additional capital for early-stage companies. These proposals aim to at least double the amount of funds and assets under management in next 24 months.

Make Government Work for Entrepreneurs

SBA's SBA One is an interactive online platform that streamlines the process through which lenders participate in and small businesses apply to its capital support programs. The platform is designed to enable banks to approve loans more efficiently, including those totaling $150K or less. Making it easier, smarter, and less cumbersome for banks and entrepreneurial companies to transact is critical to small businesses across the country.

Support Entrepreneurship Skill Building through Workforce Training Programs

The Workforce Innovation and Opportunity Act, signed by President Obama last year, and administered by the U.S. Department of Labor includes an increased emphasis on entrepreneurship skill building for youth, individuals with disabilities, Indian and Native Americans, and unemployed adults and includes new provisions to allow training resources for entrepreneurship training. These new provisions will allow the public workforce system to more systematically train youth and adults who are out of work to start their own businesses.

Expand and Make Permanent Zero Capital Gains on Small Business Investments

The Administration supports improving and making permanent a tax cut on capital gains for key investments in small businesses. This capital gains exclusion, designed to incentivize "patient" capital investments in emerging businesses, was signed into law in 2010 but expired in 2014.

From Lab to Market: Commercializing Federally-Funded Research

The Federal R&D enterprise must continue to support fundamental research that is motivated primarily by human interest in expanding the frontiers of human knowledge, and continue to support diffusion of this knowledge through open data and publications. At the same time, some research discoveries show near-term potential for commercial products and services. The President is committed to accelerating these promising technologies from the laboratory to the marketplace. The fruits of this lab-to-market process, also known as "technology transfer" or "R&D commercialization," are everywhere. For example, Federal laboratories developed much of the battery technology that makes electric vehicles possible, university researchers helped bring to market a breakthrough drug that effectively cures certain forms of leukemia, and Google grew out of Federally-funded research on digital libraries at Stanford University.

"We have always been about research, innovation, and then commercializing that research and innovation so that everybody can benefit. And then we start selling our stuff all around the world, we start exporting it. And we create good jobs, and middle-class families then are able to buy the products that result from this innovation. And you get a virtuous cycle where everybody is doing better, and nobody is left behind."

- President Barack Obama, January 15, 2014

Building on a Strong Record of Achievement

The Administration's Lab-to-Market Initiative is working to accelerate technology transfer for promising new innovations resulting from Federally-funded research that too often face a slow and uncertain path to commercial viability. The Initiative is the core of Administration efforts to promote R&D commercialization, including a 2011 Presidential Memorandum directing all Federal research agencies to speed up R&D awards to small businesses, facilitate partnerships with industry, and track concrete commercialization goals. Agencies such as NSF, DOE, and NIH have expanded efforts to encourage the formation of new companies based on university research and to allow startups to more easily obtain licenses for government-owned intellectual property.

Some recent examples of progress include:

- *DOE announced the National Incubator Initiative for Clean Energy (NIICE)*, a $3 million program to fund up to five specialized business incubators that help entrepreneurs commercialize clean-energy technologies. NIICE will also support a national organization to coordinate these efforts.

- *DOE also recently implemented a $20 million pilot program across several National Labs to provide vouchers to small businesses*. These vouchers, redeemable for technical assistance at participating Labs, are targeted at those small businesses developing promising clean-energy technologies.

- *The Department of Defense recently launched the Furnace Technology Transfer Accelerator*. The Accelerator is an intensive nine-month program designed to incubate new companies that license technologies developed at the Air Force Research Lab in Rome, New York. Furnace provides mentorship, office space, and seed funding, and will roll out in other DOD labs to come.

- *NIH has teamed up with the Center for Advancing Innovation and the Avon Foundation for Women to establish the Breast Cancer Startup Challenge and accelerator*. This is an opportunity for multidisciplinary teams to develop business plans and start new companies based on ten unlicensed breast-cancer inventions developed at NIH's National Cancer Institute or at an Avon Foundation-funded university lab.

- *NSF's Innovation Corps (I-Corps) program has demonstrated early success*. The President has proposed $30 million in his 2016 Budget to grow the NSF I-Corps program, which is detailed in the box below. The Administration is committed to working with agencies, universities, states, and other stakeholders to significantly increase the number of teams that can participate in this program.

Innovation Corps (I-Corps)

The NSF Innovation Corps (I-Corps) program provides entrepreneurship training for Federally-funded scientists and engineers, pairing them with business mentors for an intensive curriculum focused on discovering a demand-driven path from their lab work to a marketable product. This experiential learning curriculum is based on the "Lean Launchpad" methodology developed by serial entrepreneur Steve Blank.

Teams are required to interview 100 potential customers, which helps them test the key hypotheses of their business model and more effectively identify viable market opportunities.

Since NSF launched the I-Corps program in 2011, nearly 600 teams have completed this 10-week experiential education, and approximately half have decided to form companies as a result. The success rate for follow-on funding, both from Federal agencies and private capital, has been promising. And over 115 educational institutions from 45 states have participated in the I-Corps curriculum, with seven major "nodes" (university consortia) providing entrepreneurial learning environments and curriculum development.

Over the past year, other Federal agencies have adapted this program for other types of teams, including an NIH I-Corps pilot for biomedical Small Business Innovation Research (SBIR) grantees, as well as a DOE "Lab-Corps" program for researchers at the DOE National Laboratories.

Further Accelerating from Lab to Market

In addition to developing these promising innovative approaches, this Administration has made Lab-to-Market an important piece of the President's Management Agenda to accelerate and improve the transfer of new technologies from the laboratory to the commercial marketplace. These ongoing efforts include:

- Optimizing the management, discoverability, and ease-of-license of the 100,000+ Federally-funded patents;

- Increasing the utilization of Federally-funded research facilities by entrepreneurs and innovators;

- Ensuring that relevant Federal institutions and employees are appropriately incentivized to prioritize R&D commercialization;

- Identifying steps to develop human capital with experience in technology transfer, including by expanding opportunities for entrepreneurship education;

- Maximizing the utilization and economic impact of the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs through more effective commercialization.; and

- Creating a Technology Transfer Playbook to share and promote best practices.

The Administration continues to advance its Lab-to-Market goals through these steps and by supporting continued agency efforts to experiment with new pilot programs to identify what works.

Ensuring the Right Framework Conditions for Innovation

The Federal Government can enable a thriving innovation economy by taking steps to ensure that those who introduce new ideas to the marketplace encounter market conditions that facilitate and incentivize their efforts. Every time a startup or established company brings a new innovation to the marketplace, it is experimenting, and taking a risk on a speculative venture with uncertain results.[30] Because the societal benefits of these experimental efforts are significant in aggregate, but the success of any particular effort cannot accurately be predicted in advance, public policy should facilitate as many promising "shots on goal" as possible. Setting proper framework conditions means ensuring that America's regulatory regime not only safeguards important priorities, but also minimizes the barriers and frictions faced by those who endeavor to bring ideas to the marketplace.

Ensuring the right framework conditions for innovation requires guaranteeing that American innovators benefit from the best policy framework, or "rules of the game," in the world.

An Intellectual Property Regime that Incentivizes Innovators

As enshrined in the Constitution, America's patent system is designed to encourage innovation. The U.S. patent system and other intellectual property laws create incentives for innovation by establishing enforceable property rights for the creators of new and useful products and processes. In other words, America's intellectual property laws protect the ability to earn a return on the investments necessary to innovate. A robust intellectual property regime incentivizes not only inventors, but also attracts critical capital investments and provides incentives for follow-on investments in commercialization and subsequent inventions, ensuring incentives for risk-takers at all stages of the innovation process while allowing for the emergence of competitive markets through clearly delineated boundaries of protection.

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[30] Kerr, W., et al., "Entrepreneurship as Experimentation," *Journal of Economic Perspectives*, Vol. 28, 3 (2014).

The Administration's intellectual property agenda builds on the landmark 2011 America Invents Act, which improves patent quality and the efficiency of the patent system (see box). Over the past four years, the U.S. Patent and Trademark Office (USPTO) has taken steps to improve accessibility and transparency of the patent system.

America Invents Act

On September 16, 2011, President Obama signed into law one of the most significant legislative reforms to the patent system in our Nation's history. The America Invents Act was passed with the President's strong leadership after nearly a decade of effort. It provides:

- A model of sustainable funding that has enabled USPTO to engage in longer-term planning to reduce the patent backlog and pendency and make investments in initiatives to improve quality;
- New post-grant proceedings before the USPTO's Patent Trial and Appeal Board that provide a new, less costly avenue to challenge the validity of patent claims;
- Fee reductions for small and micro entities that make it easier for independent and under-resourced inventors to obtain intellectual property protections;
- Increased harmonization with international patent systems to simplify the process by which inventors acquire IP rights across the globe; and
- A "fast track" for applications to allow innovations to reach the economy faster.

But more needs to be done to strengthen the patent system as a mechanism for fostering and incentivizing innovation. In addition to calling for meaningful legislative action to reduce the incentives for engaging in abusive patent litigation practices, the Administration has taken a series of executive actions that are already improving the patent system and addressing the problem of abusive patent litigation. These include steps to improve patent quality through training and long-term investments, and to

promote transparency through new USPTO initiatives that make patent information more accessible and usable.

Through these actions, the Administration is ensuring that innovators reap the rewards of their efforts and consumers benefit from both the fruits of innovation and competition in the marketplace.

Balanced Antitrust Enforcement that Protects Innovation

Antitrust laws serve the fundamental goals of enhancing consumer welfare and promoting innovation, including by ensuring that innovative new firms can enter a fair marketplace and by ensuring that incentives for existing firms to innovate are preserved. Properly balanced, these laws work to bring new and better technologies, products, and services to consumers at lower prices. Antitrust laws foster competition and innovation by prohibiting anticompetitive mergers, collusion, and exclusionary uses of monopoly power.

Developed jointly by the Department of Justice (DOJ) and Federal Trade Commission, the 2010 Revised Horizontal Merger Guidelines recognize more explicitly the role of innovation in merger review. Under these revised guidelines, enforcement agencies consider, among other factors, both a proposed merger's effect on incentives for innovative activity and whether a merger would bring together complementary capabilities that might augment innovation capacity. An early example of merger review under the revised guidelines is the DOJ Antitrust Division's challenge to the proposed merger between AT&T and T-Mobile in 2011.

Particularly in industries where innovation drives dynamic market structures, balanced antitrust enforcement plays a critical role in preserving competition and innovation for consumer benefit.

Cybersecurity

Digital networks provide a key platform for the innovation that underpins economic growth and prosperity in the 21st century. But growing reliance on the digital world also creates risks that threaten national security, privacy, private enterprises and individual rights. Cyber threats to individuals, businesses, critical infrastructure, and national security have grown more diffuse, acute, and destructive. Malicious actors

ranging from sophisticated nation states to common criminals take advantage of the anonymity and reach that cyberspace offers.

To ensure that these critical digital networks remain safe and secure, the Administration has developed a comprehensive strategy to bolster defenses in government, while also working in partnership with the private sector to share information and best practices.

This cybersecurity agenda includes the following four focus areas:

- *Support for private-sector efforts to enhance cybersecurity*. The Administration developed in 2013 a Cybersecurity Framework to provide best practices and a flexible benchmarking tool to help the non-governmental organizations responsible for much of the nation's critical infrastructure. Additionally, the Administration is supporting important information sharing and exchange of best practices across organizations. This includes a recent Executive Order to encourage the development of Information Sharing and Analysis Organizations to serve as the hubs for sharing critical cybersecurity information and to promote collaboration for analyzing this information both within and across industry sectors.

- *Enhanced Federal cybersecurity*. The Federal Chief Information Officer will continue to accelerate efforts to increase security on Federal networks, and establish a dedicated "E-Gov Cyber" team to enhance oversight of agency and government-wide cybersecurity programs, as well as to address urgent cyber-related requests.

- *New policies and capabilities to identify, defend against, and counter malicious cyber threats to the nation*. A new Cyber Threat Intelligence Integration Center will act as a single entity to analyze and integrate cyber threat intelligence across government, informing national security decision-making and enabling relevant departments and agencies to respond accordingly. This year, the Department of Defense also released the Department of Defense Cyber Strategy to guide the development of the U.S. military's cyber forces and strengthen the United States' cyber deterrence posture.

- *International engagement*. The Administration is taking steps to strengthen America's global leadership on cybersecurity issues by bolstering participation in

regional and multilateral venues, fostering international law enforcement cooperation, strengthening NATO's cyber defense capability, and more.

Because cybersecurity is about managing risk throughout the entire enterprise over the long-term, not through isolated, one-off actions, the Administration will continue to build on these efforts in the future.

Net Neutrality to Preserve an Open Internet

The President has put his support behind Net Neutrality rules that ensure the Internet stays open and non-discriminatory, adhering to the same principles that have made the Internet such a powerful force for unlocking possibilities no one could have imagined a mere generation ago. Net neutrality means that no matter the source, Internet traffic is treated equally – giving fledgling startups the same access to consumers as established corporations.

"An open Internet is essential to the American economy, and increasingly to our very way of life. By lowering the cost of launching a new idea, igniting new political movements, and bringing communities closer together, it has been one of the most significant democratizing influences the world has ever known."

- President Barack Obama, November 10, 2014

After a Federal Appeals Court in January 2014 struck down the Federal Communications Commission's 2010 net neutrality rules, in May 2014 the FCC issued a notice of proposed rulemaking on internet regulatory structure, opening a period during which the public could submit comments on the rules.

Nearly four million Americans responded to this call by submitting comments. Many of these voices shared the President's publicly articulated view: keep the Internet free and open with the strongest possible rules. In February 2015, the FCC responded to these collective voices by reclassifying broadband service under Title II of the Telecommunications Act. This means a regulatory framework that supports a strong net neutrality rule to keep the Internet open and free and a strong platform for innovation.

Empowering Innovators with Open Federal Data

President Obama has articulated a vision of Federal data as a national asset to be made publicly available wherever possible in order to advance government efficiency, improve accountability, and fuel private-sector innovation, scientific discovery, and economic growth. The value of facilitating access to government data is enormous – one estimate puts the value of this data at more than $3 trillion per year in added value throughout the global economy.[31]

> "Finally, for the first time in history, we've opened up huge amounts of government data to the American people, and put it on the Internet for free. At Data.gov, you can search through and download…data on everything from what different hospitals charge for different procedures, to credit card complaints, to weather and climate measurements. And what's happening is entrepreneurs and business owners are now using that data—the people's data—to create jobs and solve problems that government can't solve by itself or can't do as efficiently."
>
> - President Barack Obama, July 8, 2013

But simply making data available is not enough. Innovators must be able to use the data, and in an information-driven society, making information available in a machine-readable format allows innovators to create new tools and services that benefit the public. That's why in 2013 the President signed an Executive Order to make open and machine-readable data the new default for government information. This historic step is helping to make government-held data more accessible to the public and to entrepreneurs while appropriately safeguarding sensitive information and rigorously protecting privacy.

[31] Manyika, J., et al., *Open Data: Unlocking Innovation and Performance with Liquid Information*, McKinsey Global Institute Report (October 2013).

The Impact of Open Data

Publicly-available Federal data has enabled the emergence of not only new businesses, but also entirely new industries, providing valuable products and services to consumers in often unexpected new ways. Some examples include:

- *Weather forecasting*: The weather forecasting industry, which is underpinned by data provided by the National Weather Service, includes more than 350 companies and continues to grow rapidly, with combined annual revenues in the last two years increasing by 50 percent to an estimated $3 billion.

- *Agriculture*: Companies are using data from the U.S. Geological Survey, National Oceanic and Atmospheric Administration, U.S. Census Bureau, U.S. Department of Agriculture, and other Federal sources to help farmers and ranchers better plan, manage, and track everything from crop yields and livestock markets.

- *Healthcare:* In May 2013, the Centers for Medicare & Medicaid Services released data making it possible for the first time to compare the charges for services provided by hospitals across the country for the 100 most common Medicare inpatient stays, helping to drive better health outcomes at lower cost.

- *Healthcare:* In June 2014, the Food and Drug Administration began making some of its publicly-available data also available in a new format using an Application Programming Interface (API) through openFDA (open.fda.gov). This allows anyone to develop and offer an application that can automatically access the API data in real time. So far, it has been used over 42 million times, has more than 6,600 registered API users, and a large number of new applications have been developed by a worldwide community of software developers and researchers.

Over the past few years, the Administration has launched a number of Open Data Initiatives in health, energy, climate, education, finance, public safety, and global development. The White House also launched Project Open Data, designed to share best practices, examples, and software code to assist Federal agencies with opening data. In addition, the Administration has directed Federal agencies that fund more than $100 million per year in research and development to develop plans to increase access

to the scholarly publication and digital data that result from their funded research to catalyze innovative breakthroughs that can drive the economy. These efforts have helped unlock troves of valuable data and information—that taxpayers have already paid for—and are making these resources more open and accessible to innovators and the public.

But there is more work to be done, and Federal agencies are taking additional steps to unlock the highest-value assets that still are not yet open and machine-readable. For example, DOC has expanded efforts to unlock new data assets across its diverse agencies, from NOAA to USPTO, which will newly empower citizen innovators, entrepreneurs, and businesses.

Federal agencies are also finding new ways to leverage data more effectively to meet their mission goals, for example by using it to target programs more effectively and review outcome metrics measuring impact. In addition, DOC is currently exploring ways to collect and analyze data related to industrial competitiveness and innovation. Global supply chains and digitization, in particular, are becoming increasingly important to the U.S. economy. The Department is working closely with both internal and external stakeholders to determine best practices in tracking these changes and to increase the Federal Government's capabilities in this area.

Supporting the Development of Regional Innovation Ecosystems

The resources, institutions, infrastructure, and people that sustain the development of new ideas into products, processes, and services form an "innovation ecosystem." At a regional level, these ingredients support clusters of economic activity, often around research institutions that supply technical talent and a stream of commercially-relevant inventions.

Firms cluster together within a region because proximity promotes positive spillovers, labor market specialization, and the sharing of industry-specific inputs, which drives productivity growth and creates cost advantages. And in these clusters, innovation is a key source of competitive advantage.

A thriving regional innovation ecosystem requires not only fundamental capabilities, but also the right connective tissue—those institutions and actors devoted to building the "bridging social capital" and knowledge sharing that link academic researchers, entrepreneurs, established firms, and investors. States and regions have become increasingly focused on building this connective tissue, often modeled after the thriving regional innovation ecosystems in Silicon Valley and Route 128 around Boston.

But not every region can develop the same unique mix of assets these regions possess, nor does replicating a narrow focus on the IT or biotechnology sectors make sense for regions whose strengths lie elsewhere. Instead, there is no single approach to a successful innovation ecosystem, and it is crucial that communities leverage their regional resources and build on their unique assets to create a foundation for economic agility, resilience, and growth through innovation. Regional clusters exist in a wide range of industries and technologies, such as wireless communications (San Diego), medical devices (St. Paul/Minneapolis), and modeling and simulation (central Florida).

The Federal Government plays a critical role in supporting regional efforts to strengthen these innovation ecosystems that sustain economic growth and job creation. For example, the Economic Development Administration funds projects like the Regional Innovation Accelerator Network, which supports a virtual nationwide community of organizations that promote regional growth by promoting commercialization and the development of new high-growth firms. And states and localities are experimenting with promising approaches, including Oklahoma's state-affiliated nonprofit i2E, which provides a range of programs that support

commercialization and entrepreneurship, and Ben Franklin Technology Partners, an economic development program funded by the state of Pennsylvania that provides promising emerging companies with funding, expertise, and networks to nurture their development. Regions are also increasingly working to cultivate "innovation districts," where research institutions, companies, startups, incubators, and accelerators all coexist in close proximity. This proximity may facilitate knowledge spillovers across institutions, while also supporting open innovation efforts that tap into sources of diverse expertise. To cultivate these innovation districts, some cities are even taking new approaches to the spatial layout of entire geographic areas.

As regions continue to experiment with a range of approaches to "economic gardening"—cultivating growth from within rather than attempting to persuade large firms to relocate to a region through costly incentives—the Federal Government's support for evidence-based models to develop regional innovation ecosystems is critical.

Building on a Strong Record of Achievement

The Administration has made substantial investments to promote regional innovation clusters that draw together industry, university, and government resources by supporting efforts to build innovation infrastructure in diverse regions throughout the country. In particular:

- *DOC's Economic Development Administration (EDA) has led four i6 Challenge competitions*. Together these have made 36 awards totaling over $30 million for proof-of-concept and commercialization centers that are integral to the development of thriving regional innovation ecosystems. These centers help clear the path to commercialization for promising innovations by demonstrating commercial potential while assembling the building blocks to create high growth, successful companies, including business-model support and access to investors, mentors, and potential customers.

- *EDA's Jobs and Innovation Accelerator Challenge Initiative involved a series of multi-agency competitions that in 2011 and 2012 awarded nearly $50 million in grants.* Funding was distributed to over 40 total winning consortia for cluster-building projects across a range of focus areas from advanced manufacturing to rural community clusters.

- *The Small Business Administration's Clusters Initiative connects and enhances innovation assets so that small businesses can effectively leverage them to commercialize new technologies and expand into new markets*. Since 2010 SBA has provided over $27 million in funding to over 40 clusters across the country in sectors that include aeronautics, clean energy, advanced materials, aerospace, music, food processing, water, agribusiness, biotechnology, and automotive, among others.

Sustaining Regional Innovation Ecosystems

Under a new program called Regional Innovation Strategies, the EDA is supporting several different cluster development activities. These include an expanded i6 Challenge, grants for planning and feasibility of science and research parks, and more. Nearly $15 million was awarded in 2015 in 39 grants across the country, and the President's 2016 Budget proposes to allocate an additional $25 million for the program, providing support for emerging innovation ecosystems across the country.

Helping American Businesses Compete Abroad

Opening markets abroad for innovators maintains U.S. global leadership in innovation, grows American jobs, and unlocks opportunities for international sales, commercialization, and collaboration. Because 95 percent of the world's consumers are outside U.S. borders, when innovative companies seek to scale up, it can be critical to access foreign markets to expand their consumer base. More sales overseas also means more American jobs at home.[32]

> "Twenty-first century businesses, including small businesses, need to sell more American products overseas. Today, our businesses export more than ever, and exporters tend to pay their workers higher wages."
>
> - President Barack Obama, January 20, 2015

Building on a Strong Record of Achievement

The Administration is committed to sustaining a trade agenda that has significantly boosted exports, eliminated market-access barriers, and expanded intellectual property protections. The trade agenda advances market conditions that enable U.S. innovators to commercialize products, services, ideas, and business models on an international stage and derive full benefit from the competitive advantage earned through ingenuity, efforts, and investments. In addition, negotiations with China yielded in November 2014 a breakthrough that led to an agreement by 53 nations in July 2015 to support an expanded Information Technology Agreement to eliminate customs duties on over 200 information technology products, benefiting manufacturers and consumers of cutting-edge IT products.

The Trans-Pacific Partnership (TPP) has been a major focus of the Administration's trade agenda. The TPP will write the rules for global trade—rules that will help increase Made-in-America exports, grow the American economy, support well-paying American jobs, and strengthen the American middle class. TPP will make it easier for American

[32] U.S. Census Bureau, "U.S. and World Population Clock," available at http://www.census.gov/popclock/.

entrepreneurs, farmers, and small business owners to sell Made-In-America products abroad by eliminating more than 18,000 taxes and other trade barriers on American products across the 11 other countries in the TPP—barriers that put American products at an unfair disadvantage today. Strong and balanced IP standards reflected in the TPP are critical for driving innovation and protecting American jobs.

Ongoing Domestic Efforts

Facilitating exports by innovative U.S. companies means giving them the tools to navigate foreign markets effectively. Ongoing Administration efforts involve expanding Federal Government programs for startups and other early-stage innovators on how to protect business assets internationally. Additionally, the International Trade Administration within DOC has created customized export assistance service solutions specifically targeted to promote business development for startups and early-stage companies in international markets. The National Export Initiative has also focused its efforts on U.S. startups through the Startup Global initiative. This initiative engages with business incubators and their startup communities across the country to help entrepreneurs think "global" at their earliest stages of growth.

In addition, the President's Export Control Reform Initiative is designed to reform an overly complicated and overbroad system of export controls for sensitive military equipment that diminishes the ability to focus efforts on the most critical national security priorities. This effort has meant replacing overly broad generic controls with detailed, enumerated lists that impose controls based on the sensitivity of the item and the destination. For example, reforms the Administration made in 2013 to the export control lists for aircraft and gas turbine engines affect licensed shipments of almost $21 billion a year, boosting the competitiveness of the domestic defense industrial base by easing restrictions on less-sensitive components.

Ongoing International Trade Policy Objectives

Abroad, facilitating exports from innovative U.S. companies requires ensuring a level playing field for U.S. goods, services, and investments in foreign markets. Specific objectives include:

- Insulating against and eliminating localization barriers that require U.S. producers and service providers to locate facilities, intellectual property, or other assets in a country as an investment or market entry condition;

- Promoting transparency, anti-corruption measures, and good regulatory practices, including basing decisions on a sound analysis of potential impacts, mechanisms for integrating industry and other stakeholder views in government and regulatory processes, and transparent decision-making;

- Encouraging expansion and enhancement of safeguards against the misappropriation and misuse of trade secrets and other proprietary information acquired through illicit means; and

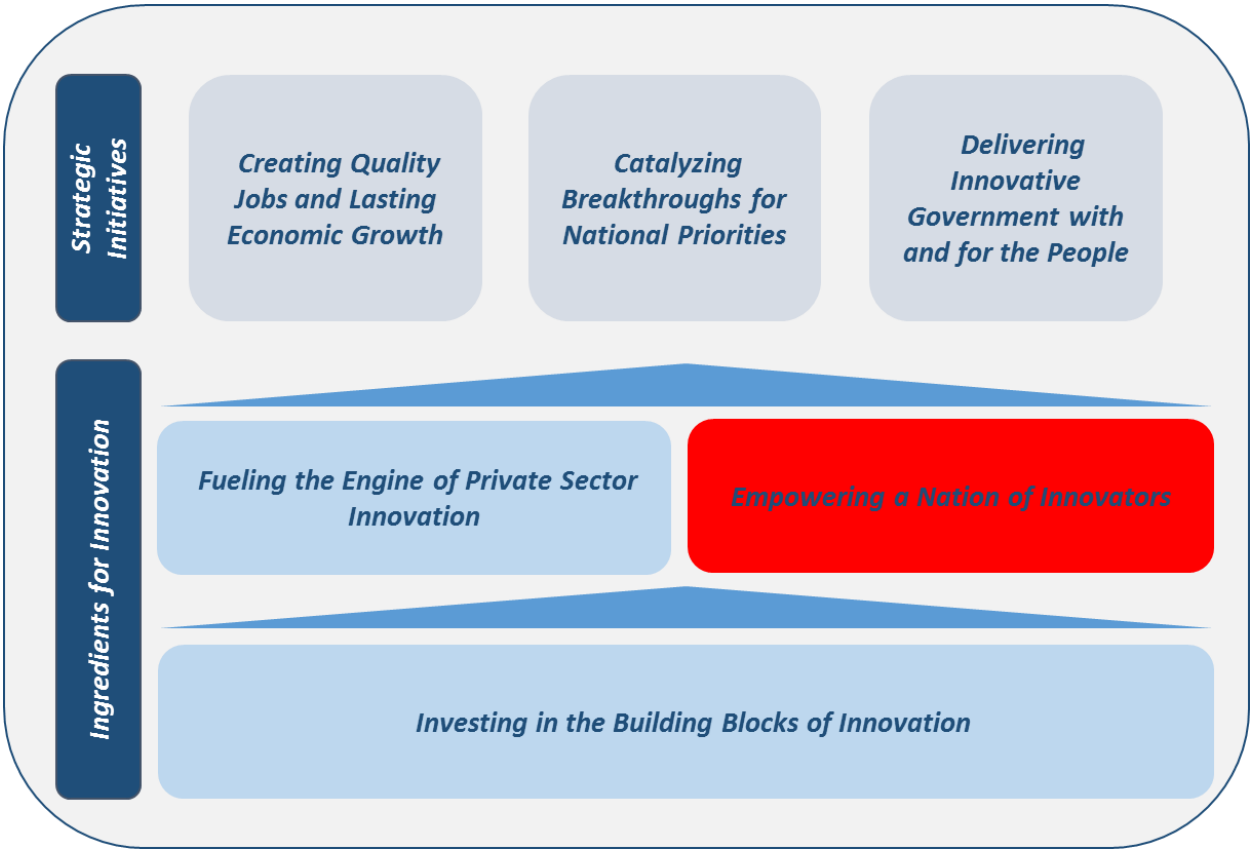
- Ensuring protection for new and emerging technologies and new methods of transmitting and distributing products embodying intellectual property in a manner that facilitates legitimate trade.

These objectives find expression in the ongoing work of the U.S. Trade Representative and International Trade Administration to expand opportunity for American businesses and workers through trade agreements.

Empowering a Nation of Innovators

"This is a country that imagined a railroad connecting a continent, imagined electricity powering our cities and towns, imagined skyscrapers reaching into the heavens, and an Internet that brings us closer together. So we imagined these things, then we did them. And that's in our DNA. That's who we are. We're not done yet."

- *President Barack Obama, Remarks at the White House Maker Faire, National Day of Making, June 18, 2014*



President Obama's Administration has taken more steps than any prior Administration to involve new communities in the innovation process and empower a broad range of innovators to help solve the nation's pressing challenges. The Administration has done this through support of "open innovation" approaches such as incentive prizes and

crowdsourcing, and through its support of the Maker Movement. These initiatives are also important for their role in inspiring more young people to excel in STEM subjects.

Harnessing the Creativity of the American People through Incentive Prizes

Like the patent system, incentive prizes and challenges promote innovation. Incentive prizes offer a reward upon the achievement of a particular technical, scientific, social, economic or creative performance objective. Over the past six years, the Administration has taken important steps to make incentive prizes a standard tool in every Federal agency's toolkit. Agencies have sponsored more than 440 public-sector prize competitions on Challenge.gov, a one-stop shop where tens of thousands of entrepreneurs and citizen solvers have participated and been awarded over $150 million in prizes.

Prizes provide several unique benefits. They allow an agency to pay only for success and establish an ambitious goal without having to predict which team or approach is most likely to succeed – a dramatic departure from traditional authorities like contracts, grants, and cooperative agreements. They also mean reaching beyond typical participants to increase the number of minds tackling a problem, often including out-of-discipline perspectives. Finally, prizes allow agencies to increase cost-effectiveness to maximize the return on taxpayer dollars, with competitor investments often exceeding the prize purse by an order of magnitude.

Improving Identification of Asteroid Threats

The Asteroid Grand Challenge is a NASA-coordinated global effort to find all asteroid threats to human populations and know what to do about them. The Asteroid Data Hunter Challenge, a series of contests with a $55,000 total prize purse, was the first open innovation project to be conducted in support of this Grand Challenge. It had two objectives: (1) to develop a more computationally efficient, general-purpose algorithm to detect moving objects using imagery captured by ground-based telescopes; and (2) develop a software application that is so easy to use that citizen scientists, hobbyist astronomers, and even professional organizations/institutions will want to download it.

Throughout the ten months of the challenge, over 1,200 solvers participated in submitting 700 solutions that resulted in the development of both a new algorithm and software package. The algorithm developed as a result of the challenge has resulted in a 15 percent improvement over the current method of identifying asteroids in the main belt of asteroids that orbit between Mars and Jupiter.

Furthermore, these results were obtained for a total project cost of less than $200,000, less than the cost of salary for one full-time engineer for the same time period.

Building on a Strong Record of Achievement

In December 2010, Congress passed the America COMPETES Reauthorization Act, providing all Federal agencies broad authority to conduct prize competitions as called for by the Administration's *Strategy for American Innovation* in 2009.

Over the past five years, Federal agencies have taken advantage of this new approach to problem-solving. Agencies including the Department of Health and Human Services (HHS), NASA, the Department of the Interior (DOI), the Department of Agriculture (USDA), the Department of Homeland Security (DHS), DOE, and the Environmental Protection Agency (EPA) have established strategies and policies to accelerate widespread use of the new prizes and challenges. Some agencies, such as NASA, HHS, EPA, DHS, and the U.S. Agency for International Development (USAID), have personnel dedicated to lead prize design and administration efforts at their agencies and to provide internal support to program managers interested in making use of prizes. To support ongoing efforts at all Federal agencies, the White House Office of Science and Technology Policy, the General Services Administration, and NASA's Center of Excellence for Collaborative Innovation have supported training opportunities for over 2,000 agency staff through workshops, online resources, and an active community of practice.

Tackling New Frontiers with Prizes

There still exists significant untapped potential for using incentive prizes in creative ways to solve novel, ambitious, and important problems. In part, tapping this potential will require continuing to build the awareness and expertise throughout the Federal workforce about when and how to use prizes to solve problems.

In addition, while many well-known incentive prizes have focused on catalyzing technology R&D, there is an opportunity to further deploy incentive prizes to drive market adoption of existing solutions and interventions, and progress in areas of social policy such as health, energy use, and education.

Tapping the Talents of Innovators through Making, Crowdsourcing, and Citizen Science

This Administration is taking significant steps to empower the public and tap into communities of expertise in novel ways to help address national priorities.

Championing the Maker Movement

President Obama convened the first-ever White House Maker Faire in June 2014 to celebrate and promote a grassroots, community-based movement of innovators using 21st century tools to design and make just about anything. The Maker Movement signifies a renewed interest in do-it-yourself projects and activities, involving everything from robotics and sewing to wearable technology and 3D printing. The democratization of these technologies, in combination with freely available information about how to use these tools and the availability of crowdfunding, is making it easier for adults and students to realize their ideas. Maker spaces, where users can find 3D printers, laser cutters, desktop machines to print circuit boards, and more, are popping up around the country with support from community groups, schools, libraries, and museums.

The Maker Movement is important for a number of reasons. First, it has the potential to increase student engagement, inspire students to excel in STEM, and revitalize career and technical education. Second, it can help adults gain the skills they need for jobs in fields such as design and advanced manufacturing. Third, it is lowering the barriers to entrepreneurship in hardware and manufactured products, in the same way that cloud computing and open source software have lowered the costs of launching an Internet-based startup. Fourth, it accelerates the timeline from concept to finished product by enabling citizens to quickly explore and address unmet needs by developing impactful improvements. Would-be entrepreneurs no longer have to own sophisticated machine tools to develop a prototype of their invention since maker spaces are providing shared access to these tools. Finally, the Maker Movement promotes important values, such as curiosity, tinkering, collaborative problem-solving, and self-efficacy.

Communities across the country have answered the President's call to promote making. For instance, more than 125 libraries and 150 universities and colleges have pledged to create more opportunities for making. Over 100 mayors have joined the Mayors Maker Challenge, which aims to engage local government in building vibrant maker

ecosystems. In addition, companies are making significant investments to support making and dozens of Federal agencies have gotten involved as well. For example, the Institute for Museum and Library Services and the Department of Education's 21st Century Community Learning Center program are teaming up to bring making and tinkering activities to 25 communities in California, Florida, New York, Pennsylvania, and Texas. The Corporation for National and Community Service and companies have partnered with the Maker Education Initiative to bring exciting educational opportunities to over 143,000 youth and families in 24 states.

The Administration will continue to build a broad coalition of Federal agencies, companies, state and local elected officials, universities, schools, libraries, museums, nonprofits, labor organizations, philanthropists, and skilled volunteers to:

- Increase the number of schools and after school programs that are embracing making;

- Increase opportunities for all individuals, including women and under-represented minorities, to participate in the Maker Movement;

- Help maker entrepreneurs manufacture their products in the United States;

- Increase the value and variety of what individuals and small teams can design, prototype, and manufacture through continued advances in technologies such as desktop manufacturing; and

- Enable collaboration between Federal agencies and makers.

Tackling Societal and Scientific Problems with Crowdsourcing and Citizen Science

By enabling and scaling the use of open innovation methods such as citizen science and crowdsourcing, the Federal Government is increasingly harnessing the ingenuity of the public to accelerate science and technology innovation, and improve the efficiency and effectiveness of government. Crowdsourcing and citizen science are tools that educate, engage, and empower the public to apply their curiosity and contribute their talents to a wide range of real-world problems. Crowdsourcing is an online, distributed problem-solving and production model whereby organizations submit an open call for voluntary assistance from a large group of individuals. Through citizen science, members of the

public participate voluntarily in the scientific process, addressing real-world problems in ways that may include formulating research questions, conducting scientific experiments, collecting and analyzing data, interpreting results, making new discoveries, developing technologies and applications, and solving complex problems. Members of the public are contributing to a wide range of scientific and societal problems, including public health, disaster response, biodiversity research, and astronomy.

Citizen science and crowdsourcing are important for many reasons. First, citizen science and crowdsourcing help enhance and accelerate scientific research through group discovery and co-creation of knowledge. For instance, volunteers can collect data over large areas and long periods of time—and sometimes increase the frequency of observations—in ways that Federal agencies may not be able to do, given geographic and resource constraints. Second, citizen science and crowdsourcing projects not only augment and enhance the scientific process, but also address other societal needs while drawing on a vast reservoir of untapped resources—the skills, dedication, and ingenuity of the American people. Diverse participation by all parts of society helps bring in new ideas and insights to contribute to solutions. Citizen science and crowdsourcing can address a range of societal needs and Federal agency goals, ranging from enhancing the accuracy of prediction markets to tagging and transcribing National Archive records. Finally, whether as youth or as adults, participants in crowdsourcing and citizen science projects have the opportunity to acquire a life-long enthusiasm for science, along with valuable skills in science, technology, engineering, and mathematics (STEM). For students, working on "real-world" problems can make classroom learning experiences more exciting. For adults, working on crowdsourcing or citizen science projects can help them advance their knowledge and skills while contributing to the larger scientific enterprise.

Using Design Strategies to Co-Create With the Public

Across the Federal Government, agencies are developing breakthroughs to complex public and cross-sector challenges using a design strategy-based approach to innovation. It blends design, qualitative and quantitative research, entrepreneurial thinking, and rapid prototyping to move quickly from root causes to tactical solutions. This approach enables Federal employees to engage with the public as co-designers to identify and address the root causes of problems, rather than the symptoms. Agencies that are successfully applying this approach include DOD, the Office of Personnel

Management (OPM), the Department of State, and the Department of Veterans Affairs (VA). At OPM, the Innovation Lab partners with agencies to train their staff by co-conducting design-based projects that tackle challenges within their programs and services. The Lab also serves as a hub for Federal employees to learn human-centered design innovation techniques so they can become the champions of change needed to foster innovation across the government.

The Impact of Citizen Science and Crowdsourcing

Open innovation approaches such as crowdsourcing and citizen science can be highly cost-effective. For example, after analyzing 338 citizen science biodiversity projects around the world, researchers at the University of Washington estimated that the in-kind contributions of 1.3–2.3 million citizen science volunteers to biodiversity research have an economic value of up to $2.5 billion per year.[33] Other benefits include providing hands-on learning in science, technology, engineering, and mathematics (STEM), and connecting members of the public directly to Federal agency missions and to each other.

Real-world examples of citizen science and crowdsourcing include:

- *Tagging and Transcribing National Archival Records.* National Archives and Records Administration's Citizen Archivist Dashboard coordinates crowdsourcing for tagging archival records and transcribing documents. More than 170,000 volunteers indexed 132 million names from the 1940 Census in five months, something that the National Archives could not have done alone. Similarly, the Smithsonian Transcription Center's 5,250 digital volunteers have completely transcribed and reviewed over 113,016 pages — a total that includes 859 projects shared by 13 Smithsonian archives, museums, and libraries. The "pages" include biodiversity specimens, from which data have been transcribed and used to create 27,004 new collection records for bumble bees and 23,488 new records for U.S. National Herbarium sheets.

[33] Theobald, E.J., et al., "Global Change and Local Solutions: Tapping the Unrealized Potential of Citizen Science for Biodiversity Research," *Biological Conservation,* 181: 236-244 (2014).

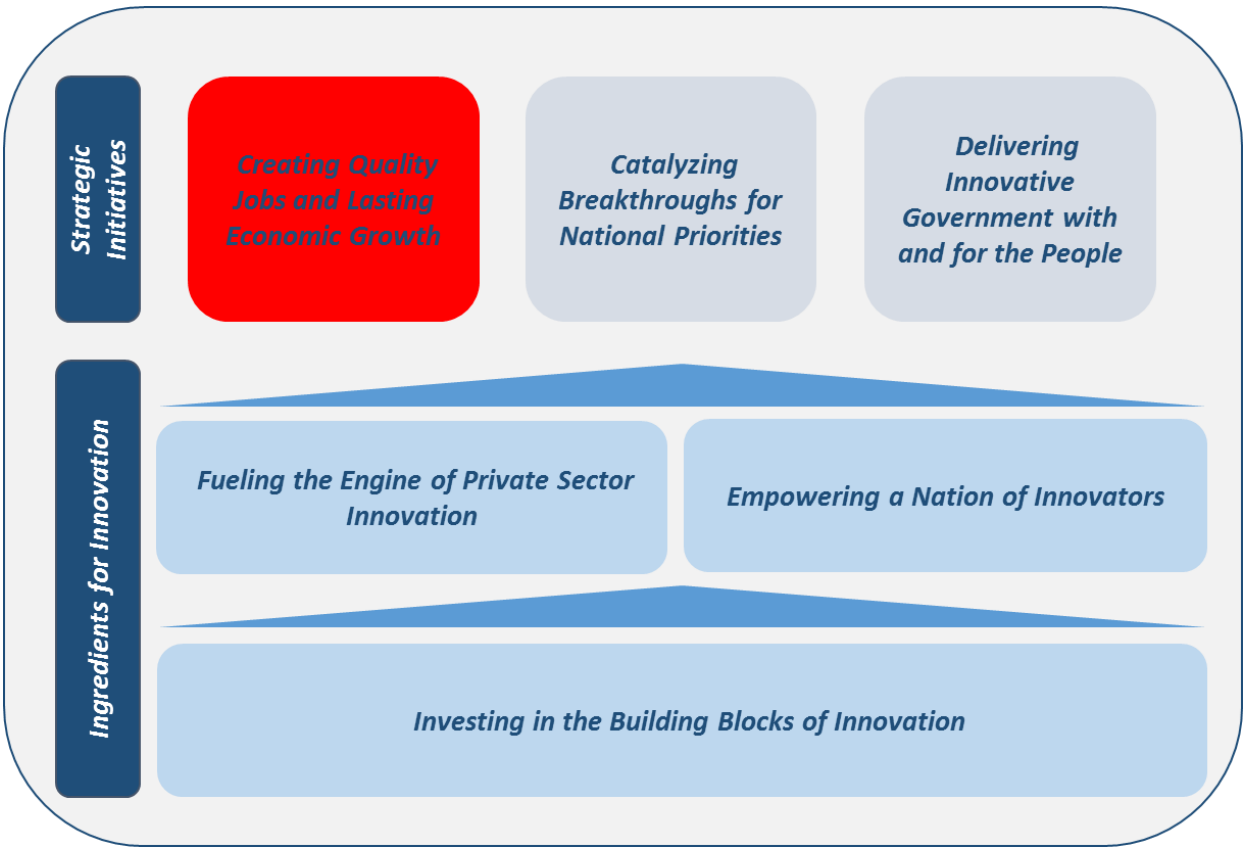
- *Monitoring Pollution in Communities*. The EPA Air Sensor Toolbox gives concerned citizens technical information on next-generation air monitoring devices, including a description of new low-cost, real-time monitoring technologies and how to use them to meet a wide range of needs. The toolbox contains training materials, such as video and slide presentations, that are specifically designed for users of the new technologies. In the coming years, EPA will continue to update the toolbox based on its research on emerging technologies for air quality monitoring. By using the Air Sensor Toolbox, citizen scientists can help fill knowledge gaps about the quality of their local air, helping lead to technology improvements and less air pollution.

The Administration made citizen science and crowdsourcing a component of the 2013 Second Open Government National Action Plan, in which President Obama called on agencies to harness the ingenuity of the public by accelerating and scaling the use of open innovation methods such as citizen science and crowdsourcing. A grassroots effort called the Federal Community of Practice on Crowdsourcing and Citizen Science, founded in 2013, has grown to a network of nearly 200 members from more than 42 Federal departments, agencies and bureaus who share lessons learned, develop best practices, provide training, and also built the new Federal Citizen Science and Crowdsourcing Toolkit in collaboration with OSTP. Additionally, in September 2015, OSTP released a policy memo on Addressing Societal and Scientific Challenges through Citizen Science and Crowdsourcing to encourage the use of citizen science and crowdsourcing by Federal agencies.

Creating Quality Jobs and Lasting Economic Growth

"Keeping America at the cutting edge of technology and innovation is what is going to ensure a steady stream of good jobs into the 21st century."

- *President Barack Obama, Remarks on Manufacturing Innovation Institutes, February 25, 2014*



Technological innovation is the key source of economic growth for the United States. Coordinated Federal efforts can have large, positive impacts on jobs and economic growth in strategic priority areas where the Federal Government can catalyze an ecosystem approach, speed the development of next-generation technologies, cultivate new industries that meet national priorities, or ensure the development of an inclusive

innovation economy. The following strategic initiatives are designed to take action to create quality jobs and lasting economic growth.

Sharpening America's Edge in Advanced Manufacturing

The Vision

American manufacturing, which supplies two-thirds of all U.S. private-sector research and development, is central to American innovation, both to discoveries being made today and our ability to drive productivity and job growth in the future. New technologies are lowering the cost and reducing the time required for businesses and entrepreneurs to design, test, and produce new products, facilitating new domestic manufacturing startups. Winning the next generation of advanced manufacturing promises to deliver significant economic benefits.

The Challenge

A decade of decline in the 2000s, however, threatened manufacturing's contribution to the foundations of American innovation. From 2000 to 2010, U.S. manufacturing production and investment in new capacity stagnated, resulting in the offshoring and shuttering of thousands of American factories and the loss of millions of jobs, raising doubts about the future of manufacturing's contribution to American innovation. Since the end of the recession, U.S. manufacturing is once again on the upswing, buoyed by the United States' growing competitiveness for manufacturing jobs and investment. With this strengthening of U.S. manufacturing has come a fundamental strengthening of America's innovation enterprise. At the same time, emerging manufacturing technologies are introducing a new source of advantage for U.S. manufacturing, spurring entrepreneurship in U.S. manufacturing by reconnecting the nation's historical leadership in invention and innovation with growing competitiveness in production. However, more is needed to rebuild the U.S. industrial commons and position the U.S. to capture the next generation of cutting-edge manufacturing.

The Path Forward

The President and his Administration have put forward a comprehensive agenda to strengthen U.S. manufacturing, including restoring the nation's lead at the cutting-edge of manufacturing innovation by:

- *Launching the Full National Network for Manufacturing Innovation (NNMI)*. Recent bipartisan legislation formally authorized the creation of the NNMI, a nationwide network of public-private manufacturing innovation institutes that

bring together companies, Federal agencies, universities, and others to develop key advanced manufacturing technologies, help businesses develop and adopt these technologies, and build a highly-skilled manufacturing workforce. Nine manufacturing innovation institutes have been launched to date, collectively representing more than $1 billion in public-private investment in manufacturing technologies. The President has set a goal of launching 15 institutes by the end of his term to invest in cutting-edge advanced manufacturing research, ranging from materials that are twice as light but three times as strong as steel to industrial-scale and industrial-speed 3D printing. In the 2016 Budget, the President calls for a $2 billion commitment from Congress to build out a full 45-institute Network over ten years.

- *Reinvesting in Supply-Chain Innovation*. After two decades of offshoring and underinvestment, America's industrial commons—the networks of small businesses, capabilities, and supply chains that undergird U.S. strength in manufacturing—need reinvestment. Today's typical small manufacturer is only 60 percent as productive as a large multinational company, with many small manufacturers in need of access to capital and expertise to adopt the latest innovations in manufacturing—like 3D printing, advanced sensors, and digital design – that can help sharpen their edge. The White House Supply Chain Innovation Initiative will organize DOC's Hollings Manufacturing Extension Partnership centers, DOE National Laboratories, and DOD's Military Industrial Base Program to provide more than 30,000 small and medium-sized manufacturers in the United States with new tools for adopting technologies and for bringing innovations to market. This effort reaches a third of America's small and medium-sized manufacturers.

- *Supporting the Scale Up of Technology-Intensive Manufacturing Startups.* Technology-intensive manufacturing startups face unique challenges in accessing the capital and capabilities that they need to scale successfully from first prototype into first commercial production. Other nations' sovereign wealth funds and government-linked corporations are increasingly providing startup capital and assistance, and as a result, more American inventions are being scaled-up overseas. The 2016 Budget calls on the Congress to work together with the President to launch the $10 billion public-private Scale-Up Manufacturing Investment Fund, with $5 billion of public investment matched by $5 billion or more of private funds. The fund will help emerging American-made advanced

manufacturing technologies reach commercial-scale production so that if a technology is invented in the United States, it can be made in the United States. This public-private investment fund will be administered by the Small Business Administration and will encourage more private investment in the first commercial production facilities for American-made technology-intensive manufacturing startups.

Investing in the Industries of the Future

The Vision

Some innovations have a pervasive impact on America's economy and society, such as the steam engine, electricity, interchangeable parts, the transistor, and the Internet. Economists call these "general-purpose technologies." The United States should aspire to lead in the development and application of these technologies because of their potential to create entirely new industries, create jobs, and increase productivity.

The Challenge

The United States is far more likely to lead in the industries of the future if we continue to be the birthplace of new general purpose technologies such as the microchip and the Internet. Federal support for the ARPANET, the precursor to today's Internet, began in the late 1960s. At that time, leading telecommunications companies dismissed the ARPANET and packet-switched networking as being irrelevant to the future of communications. Sustained investment by agencies such as the Defense Advanced Research Projects Agency and the National Science Foundation improved computer networking, developed new applications, and connected a critical mass of users. In the mid-1990s, commercial investment in the Internet began to explode.

The United States should be making R&D investments in areas that have the potential to be general-purpose technologies, particularly investments that are beyond the time horizons of individual firms. Multi-agency research initiatives are particularly useful because they allow the government to provide complementary and mutually-reinforcing kinds of support, including:

- Fundamental research at universities;
- Applied research to support agency missions in areas such as health, energy, space, transportation, and national and homeland security;
- Industry-led consortia to invest in pre-competitive research;
- The development of standards;

- Shared facilities for research;

- The development of a specialized workforce;

- Exploration of the ethical, legal, and societal implications of emerging technologies; and

- Early adoption of the technology by government agencies.

The Path Forward

The Administration has prioritized R&D investments in areas that have the potential to become the industries of the future and have a transformative impact on America's economy and society. Examples of some of these research initiatives and priority areas include:

- *The National Nanotechnology Initiative is improving America's ability to understand and control matter at the nanoscale*. Examples of potential applications include smart anticancer therapeutics that can destroy tumors while leaving healthy cells untouched and two-dimensional materials that are one atom thick, which could allow for the continuation of Moore's Law beyond the limit of today's silicon-based technology.

- *The Materials Genome Initiative is designed to reduce the time and cost required to discover and manufacture new materials by at least 50 percent*. The Initiative aims to achieve this goal through advanced techniques such as modeling and simulation, high-throughput experimentation, and materials informatics.

- *The National Robotics Initiative seeks to accelerate the development and use of "co-robots."* These are robots that work beside or collaboratively with people. The DARPA Robotics Challenge has improved the state of the art of human-supervised ground robots, which can contribute to disaster relief in dangerous environments.

- *The Big Data Research and Development Initiative is improving the ability to extract insights from large, heterogeneous data sets*. For example, the National Institutes of Health is seeking to integrate data sets from multiple sources such as genome

sequencing, electronic health records, medical imaging, and wearable sensors, to improve patient care and help develop new therapies.

- *Agency investments in Cyber-Physical Systems (CPS) are creating a "science" of the integration of computing, networking, and physical systems, such as in self-driving cars and smart buildings*. Research is needed to develop systems that have much higher levels of capability, reliability, security, usability, adaptability, and resiliency. CPS research is creating a foundation for many of the markets that companies are pursuing, such as the Internet of Things and the Industrial Internet.

- *A growing number of researchers are developing the tools and fundamental understanding required to engineer biological systems*. Agency R&D investments could expand the bioeconomy by reducing the time and cost associated with designing, building, testing, and learning from engineered biological systems. These investments could lead to applications such as renewable chemicals and cell-based therapies—an entirely new class of therapeutics.

- *The Advanced Research Projects Agency – Energy (ARPA-E) is driving the development of transformational energy technologies*. ARPA-E has invested approximately $1.1 billion across more than 400 such projects, which have generated over $850 million in follow-on funding and resulted in the formation of 30 new companies.

These and other investments will help create the industries and jobs of the future, and boost America's long-term economic growth and productivity.

Building an Inclusive Innovation Economy

The Vision

Every American should have access to the opportunities and resources of the innovation economy.

The Challenge

Almost every city and town in America has poor, under-resourced neighborhoods alongside thriving technology and innovation sectors. The resources available to those in innovative sectors are rarely accessed by those in neighboring communities that struggle with unemployment, high dropout rates, the impact of bias, and high rates of crime and incarceration. Lack of resources presents a challenge for many innovators to obtain access to systems that could enable all people to take part in, contribute to, and benefit from the economy of the future, especially those who are currently left behind. Such local inequalities are only the most visible manifestation of the broader distributional challenges inherent in the highly competitive 21st century innovation economy.

The Path Forward

America must do more to tap into the Nation's full innovation potential. From inclusive STEM education and forward-looking workforce training and job placement efforts, to accessible maker spaces and inclusive entrepreneurship efforts, the Administration is working across the innovation ecosystem to ensure that the benefits of the 21st century innovation economy are broadly shared.

These efforts include working to dissolve connectivity deserts within the United States, increasing access to technology jobs and training for all who want them, making volunteer patent attorneys available to low income inventors across the country through the USPTO's Patent Pro Bono Program, and bringing technology hubs and innovation centers to historically-disadvantaged communities. They also include partnering with the Administration's "place-based initiatives" to ensure that the most disadvantaged neighborhoods, cities, and regions in America also have access to best-in-class technology tools and innovations to improve their capacity to revitalize their communities. In addition, through the first-ever White House Demo Day in August

2015, the Administration has showcased stories of entrepreneurial success that demonstrate the importance of including everyone in America's startup economy.

The TechHire Initiative

The Administration's recently announced TechHire Initiative is designed to create pathways to better, high-paying technology jobs for those who need them most, while meeting urgent employer demand across the United States.

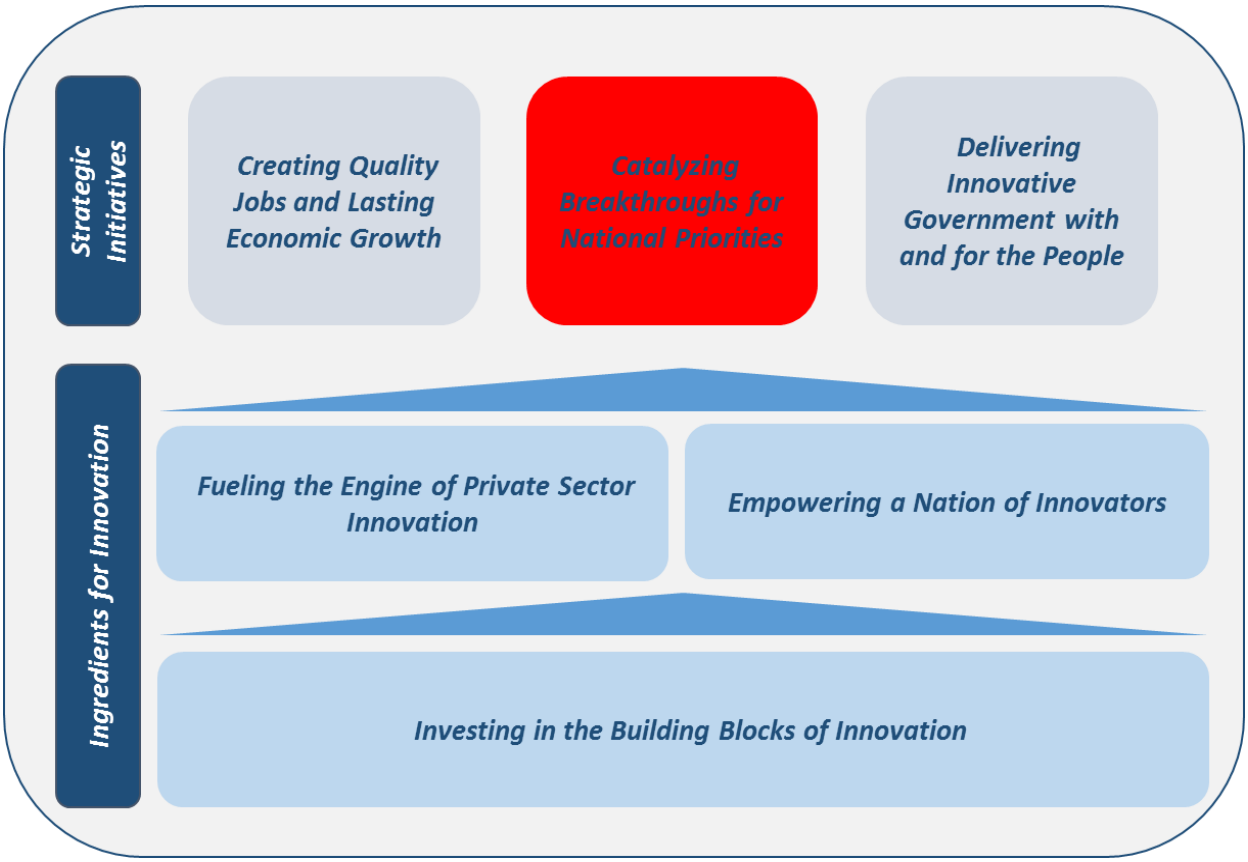
This multi-sector initiative and call to action is empowering Americans with the skills they need, through universities and community colleges, and also nontraditional approaches like "coding boot camps" and high-quality online courses that can rapidly train workers for a well-paying jobs, often in just a few months. This gives Americans the opportunity they deserve, and the skills they need to be competitive in a global economy.

To kick off TechHire in early 2015, 21 regions, with over 120,000 open technology jobs and more than 300 employer partners in need of skilled workers, announced plans to work together to create new ways to recruit and place applicants based on their actual skills and to create more fast-track tech-training opportunities. In August 2015, an additional 10 communities joined the TechHire Initiative, bringing the total to 31 TechHire communities.

Catalyzing Breakthroughs for National Priorities

"We shouldn't just celebrate innovation. We have to invest in innovation. We have to nurture innovation. We have to encourage it and make sure that we're channeling it in ways that are most productive."

- *President Barack Obama, Remarks on Precision Medicine, January 30, 2015*



From self-driving cars to precision medicine and smart cities, focused investment on innovation can achieve transformative impact on national priorities to meet the challenges facing the Nation and the world. The following strategic objectives are designed to catalyze breakthroughs to make progress on key national priorities.

Tackling Grand Challenges

The Vision

As President Kennedy once observed, "By defining our goal more clearly, by making it seem more manageable and less remote, we can help all peoples to see it, to draw hope from it, and to move irresistibly towards it."

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. These can have a major impact in domains such as health, energy, sustainability, education, economic opportunity, national security, and human exploration. Also, as various technologies such as biotechnology, information technology, and nanotechnology become more and more powerful—the question "what should we do" is arguably as or more important than "what can we do." This is not just a technical question, it is a question that relies on imagination, creativity, values, as well as individual and shared views on how we define progress.

The Path Forward

A number of agencies are supporting Grand Challenges related to their missions. For example, DOE's SunShot Grand Challenge seeks to make solar energy cost competitive with coal by the end of the decade, and NASA's Asteroid Grand Challenge aims to find and address all asteroid threats to human populations. USAID has six active Grand Challenges for Development that address challenges in infant mortality, energy for agriculture, water, reading, fighting Ebola, and improving government performance and accountability.

President Obama has also issued a call to action to encourage companies, foundations, universities, and other organizations to join the Administration in the identification and pursuit of Grand Challenges. Over 120 Deans of Engineering have committed to expand initiatives such as the Grand Challenges Scholars Program, which empower undergraduate students to make a Grand Challenge the organizing principle of their coursework, research, service learning, and international experiences. Universities have set ambitious campus-wide goals. Companies are also pursuing ambitious goals, such as:

- Making humanity a multi-planetary species (SpaceX);

- Dramatically reducing traffic fatalities with self-driving cars (Google);

- Developing a "tricorder" – a mobile device that can diagnose 15 diseases as accurately as a board-certified physician (Qualcomm); and

- Driving advances in artificial intelligence by building computers that have defeated Gary Kasparov at chess and Ken Jennings at Jeopardy (IBM).

Targeting Disease with Precision Medicine

The Vision

Precision medicine gives clinicians tools to better understand the complex mechanisms underlying a patient's health, disease, or condition, and to better predict which treatments will be most effective.

The Challenge

Most medical treatments have been designed for the "average patient." As a result of this "one-size-fits-all" approach, treatments can be very successful for some patients but not for others. This is changing with the emergence of precision medicine, an innovative approach to disease prevention and treatment that takes into account individual differences in people's genes, environments, and lifestyles.

The Path Forward

Advances in precision medicine have already led to powerful new discoveries and several new treatments that are tailored to specific characteristics of individuals, such as a person's genetic makeup, or the genetic profile of an individual's tumor. This is leading to a transformation in the way we can treat diseases such as cancer. Patients with breast, lung, and colorectal cancers, as well as melanoma and leukemia, for instance, routinely undergo molecular testing as part of patient care, enabling physicians to select treatments that improve chances of survival and reduce exposure to adverse effects. The potential for precision medicine to improve care and speed the development of new treatments has only just begun to be tapped.

Translating initial successes to a larger scale will require a coordinated and sustained national effort. To support just such an effort, the President has launched the Precision Medicine Initiative that will bring together Federal agencies in collaboration with participant advocates, academia, healthcare organizations, and a variety of industries to accelerate biomedical discoveries related to precision medicine. The Precision Medicine Initiative will leverage advances in genomics, emerging methods for managing and analyzing large data sets, and health information technology while protecting privacy. The Initiative will also engage a million or more Americans to volunteer to contribute their health data to improve health outcomes, fuel the development of new treatments, and catalyze a new era of data-based and more precise medical treatment.

The 2016 Budget proposes $215 million to launch the Precision Medicine Initiative. Through this initiative:

- The National Cancer Institute is using genomics to accelerate the design and testing of effective, tailored treatments for cancer;

- The National Institutes of Health is leading the creation of a new million or more cohort of volunteers to propel understanding of health and disease and set the foundation for approaching research through engaged participants and open, responsible data sharing;

- The Food and Drug Administration is leading a multi-sector partnership to foster modernization of the methods of developing and regulating tools for detecting patients' genomic patterns relevant to disease development, progression, and treatment choices. This includes the development of precisionFDA (precision.fda.gov), a crowd-sourced, cloud-based platform designed to advance the science needed to assure that genomic tests provide reliable and accurate genetic results; and

- The Office of the National Coordinator for Health IT is developing interoperability standards and requirements that address privacy and enable secure exchange of data across systems.

Accelerating the Development of New Neurotechnologies through the BRAIN Initiative

The Vision

In April 2013, President Obama unveiled the BRAIN Initiative, a multi-agency Grand Challenge to accelerate development of new technologies that advance understanding of the brain, enabling researchers to produce dynamic pictures of the brain that show how individual brain cells and complex neural circuits interact at the speed of thought.

The Challenge

Researchers have long desired new ways to treat, cure, and even prevent brain disorders. The social and economic burden of neurological disorders and diseases is overwhelming, and developing new treatments is critical to addressing these burdens. For example, the current cost of caring for the five million Americans with Alzheimer's disease is over $200 billion per year, including $150 billion from Medicare and Medicaid. Being able to map the circuits of the brain and measure the fluctuating patterns of electrical and chemical activity flowing within those circuits will help us to understand how their interplay creates an individual's unique cognitive and behavioral capabilities. A deepened knowledge of how brains work will help scientists and doctors diagnose and treat diseases more incisively, educate children more effectively, and develop novel technologies and devices to help alleviate the burdens of illness and injury.

In the last fifteen years alone, scientists have made a number of landmark discoveries that now create the opportunity to unlock the mysteries of the brain. Discoveries include the sequencing of the human genome, the development of new tools for mapping neuronal connections, the increasing resolution of imaging technologies, the maturation of nanoscience, and the rise of biological engineering. These breakthroughs have paved the way for unprecedented collaboration and discovery across scientific fields. While these technological innovations have contributed substantially to the expanding knowledge of the brain, significant breakthroughs in the treatment of neurological and psychiatric disease will require a new generation of tools to enable researchers to record signals from brain cells in much greater numbers and at even faster speeds. Great promise for developing such technologies lies at the intersections of nanoscience, imaging, biological engineering, informatics, and other rapidly emerging fields of science and engineering.

The Path Forward

The BRAIN Initiative has the potential to do for neuroscience what the Human Genome Project did for genomics by unlocking a dynamic understanding of brain function. It aims to help researchers better understand brain disorders, such as Alzheimer's and Parkinson's diseases, depression, Post-Traumatic Stress Disorder, and traumatic brain injury.

The President's 2016 Budget includes over $300 million to support the BRAIN Initiative, with investments from the National Institutes of Health, the National Science Foundation, the Defense Advanced Research Projects Agency, the Intelligence Advanced Research Projects Activity, and the Food and Drug Administration. The private sector is also making commitments of hundreds of millions of dollars to support the BRAIN Initiative.

Driving Breakthrough Innovations in Health Care

The Vision

Innovations in health care delivery, growing from collaboration across purchasers, providers, and patients, promise to help improve care quality, prevent medical errors, and reduce costs.

The Challenge

For years the U.S. health care system has not spent its resources wisely, has rewarded the provision of tests and services over the achievement of high-quality outcomes, and has not delivered the best possible care for patients on a consistent basis.

The Path Forward

The centerpiece of the Administration's strategic initiative to drive breakthrough innovations in health care is the Center for Medicare and Medicaid Innovation (CCMI), established by the Affordable Care Act with $10 billion in budget authority to test new care-delivery models designed to deliver the same or better care at lower cost. The Center's work involves development and deployment of new models, rapid and rigorous evaluation, and identification and diffusion of best practices based on results.

CMMI supports innovation in care delivery through initiatives like Partnership for Patients that provide for learning and technical assistance to change practice and improve patient safety on a national scale. Using evidence and tools developed by the Agency for Healthcare Research and Quality, the Partnership for Patients Initiative is a public-private collaboration involving more than 3,800 hospitals and thousands of other stakeholders to identify patient-safety problems—such as excessive rates of adverse drug interactions and other medical errors—and drive nationwide improvement through implementation of best practices and continual measurement. Thanks to Partnership for Patients and other initiatives, estimated harms to patients have declined by 17 percent between 2010-2013, saving $12 billion and 50,000 lives.

CMMI's new initiatives include the Transforming Clinical Practice Initiative, designed to help clinicians achieve large-scale health transformation. The Initiative will support over 140,000 clinician practices over the next four years in sharing, adapting, and further developing their comprehensive quality-improvement strategies.

Dramatically Reducing Fatalities with Advanced Vehicles

The Vision

Connected and autonomous vehicles have the potential to dramatically improve the safety of America's public roadways. Breakthroughs in sensing, computing, and data science have brought vehicle-to-vehicle communication and cutting-edge autonomous technology safety features into commercial deployment, while vehicles approaching full autonomy—self-driving cars—are already being tested on public roads. Accelerating the development and deployment of advanced vehicle technologies could save thousands of lives annually by applying the split-second reaction times and precision decision-making of machine intelligence to the more than 90 percent of crashes involving human error.

The Challenge

Connected and autonomous vehicle technologies have advanced dramatically in recent years. But accelerating the development of these technologies while ensuring their safe testing and introduction onto roadways and into interactions with humans presents a multifold challenge. This challenge only increases given the many public, private, state, and Federal entities that will need to partner to shape and define the paradigm for these advanced vehicles to take to the roadways.

The Path Forward

The Federal Government has a significant role to play by collaborating with industry to ensure that these technologies are brought to market safely and effectively. By partnering with industry to carefully test and facilitate the deployment of advanced vehicle technologies—many of which are already on the road today—the Administration will accelerate the reduction in traffic fatalities already underway. The Administration will undertake several initiatives to accelerate the deployment of technologies and help achieve this goal:

- The 2016 Budget calls for doubling Federal investments in autonomous vehicle technology research to develop performance and safety standards for autonomous, connected, and self-driving vehicles on public roads;

- Advancing connected-vehicle technology to ensure every lightweight vehicle has the ability to communicate critical life-saving information;

- Partnering with industry to reward consumers for adopting life-saving autonomous technologies that are road ready today, like front- and rear-end collision avoidance systems that are already reducing crashes by more than 15 percent in cars in which they are installed;

- Convening external groups to address the thorniest liability, privacy, and insurance issues hindering the deployment of these technologies and working with states to ensure a consistent approach that recognizes that these important technologies are still in the early days of their evolution; and

- Commissioning and publicly demonstrating connected and autonomous vehicles across a range of environments and applications to hasten their adoption and acceptance.

The revolution underway in autonomous and connected vehicles has the potential to reshape America and save thousands of lives. Smart partnerships between the government and industry can remove roadblocks and accelerate the use of these technologies.

Building Smart Cities

The Vision

Making American cities "smarter" means equipping them with the tools to address the pressing challenges that their citizens care most about, such as traffic congestion, crime, sustainability, and delivery of important city services. An emerging community of civic leaders, data scientists, technologists, and companies are joining forces to build "Smart Cities." These communities are building an infrastructure to continuously improve the collection, aggregation, and use of data to improve the lives of their residents—by harnessing the growing data revolution, low-cost sensors, and research collaborations, and doing so securely to protect safety and privacy.

Cities are already finding creative ways to do this. For example, by coordinating adjacent traffic signals to optimize local traffic throughput, a pilot project in Pittsburgh has reduced commuting travel times by nearly 25 percent on average. In Louisville, the city is using data gathered from sensor-equipped asthma inhalers to understand the connection between asthma "hotspots" and air quality levels and other environmental factors in order to inform policymaking and community-level interventions.

The Challenge

Developing and deploying innovative new approaches requires focused research, particularly to develop and testbed new "Internet of Things" technologies, as well as multi-sector collaborations to deploy new approaches and knowledge sharing across communities. It also requires the efforts of civic hackers—a growing community of individuals, entrepreneurs, and nonprofits interested in harnessing IT to tackle local problems and work directly with city governments.

The Path Forward

In September 2015, the Administration announced a new Smart Cities Initiative to invest over $160 million in Federal research and leverage the efforts of more than 20 cities participating in new multi-city collaborations that help communities tackle key challenges such as reducing traffic congestion, fighting crime, fostering economic growth, managing the effects of a changing climate, and improving the delivery of city services.

The initiative will focus on four key strategies: creating test beds for "Internet of Things" applications and developing new multi-sector collaborative models; collaborating with the civic tech movement and forging intercity collaborations; leveraging existing Federal activity; and pursuing international collaborations.

The initiative includes:

- More than $35 million in new grants and over $10 million in proposed investments to build a research infrastructure for Smart Cities by the National Science Foundation and National Institute of Standards and Technology;

- Nearly $70 million in new spending and over $45 million in proposed investments to unlock new solutions in safety, energy, climate preparedness, transportation, health, and more, by DHS, Department of Transportation, DOE, DOC, and EPA; and

- More than 20 cities participating in major new multi-city collaborations that will help city leaders effectively collaborate with universities and industry, including the new MetroLab Network, through which more than 20 U.S. cities and universities are committed to launch more than 60 smart city projects over the next year and share best practices across communities.

Promoting Clean Energy Technologies and Advancing Energy Efficiency

The Vision

Investing in clean-energy technologies can enable development of renewable and other clean energy sources, make energy go further through energy efficiency, and reduce carbon pollution, while helping to improve America's energy security.

The Challenge

The U.S. energy landscape has dramatically changed in recent years, with new sources of energy supply and changes in energy consumption, amid growing concern about the challenge presented by global climate change. All these trends can be improved through innovation stimulated by policies and programs at the Federal level that are well coordinated with—and draw on the strengths of—all other levels of government, the private sector, and universities.

The Path Forward

Over the past six years, American inventors and innovators have made significant progress in developing and deploying key clean energy technologies, supported by Administration policies. The Administration is determined to sustain this momentum through the following steps:

- *The United States will continue to build on its progress in developing and deploying clean electricity technologies*. These technologies have helped to triple the amount of electricity generated from wind power and have increased electricity generation from solar photovoltaic power by more than 20-fold since 2008. Through programs such as the SunShot Initiative, the Federal Government will continue to work to bring down the costs of these new technologies so that they can be deployed even more widely.

- *The Administration's Clean Energy Investment Initiative has catalyzed more than $4 billion in independent commitments*. The funding, by major foundations, institutional investors, and other long-term investors, will support climate-change solutions, including innovative technologies with breakthrough potential to reduce carbon pollution. These mission-driven investors can play an important catalytic role in accelerating the transition to a low-carbon economy, and this effort is critical to help

clean energy investors reduce transaction costs, spread promising investment models, and increase their climate mitigation impact.

- *The United States will continue to improve the fuel efficiency of its vehicle fleet, building on tough Federal fuel-economy standards that promise to double the average fuel efficiency for cars and trucks by 2025*. The Federal Government will also work to increase the deployment of advanced vehicles, such as plug-in electric vehicles, where advances in battery research are bringing down costs, opening up markets, and encouraging infrastructure expansion.

- *The Federal Government will continue to update and improve energy efficiency standards*. These standards for buildings, commercial equipment, and consumer appliances are part of a goal to double U.S. energy productivity—the amount of economic activity generated per unit of energy used—by 2030.

- *The Federal Government will continue its systematic effort to expand the sustainable production and use of biomass*. The United States currently uses about 400 million dry tons of biomass annually with the potential to sustainably increase this use up to three-fold, to over a billion dry tons per year, with significant environmental and economic benefits. To help achieve this increase, the Administration will continue to support research and development activities intended to accelerate a renewable bioeconomy— including genomic research on bioenergy feedstock crops and unique microbes for bioproducts, exploration of sustainable management systems, development of biomass conversion processes, and expansion of bioenergy infrastructure, as well as cost/benefit estimates and sustainability analyses of renewable energy production.

- *The Administration also finalized the Nation's first-ever carbon emissions standard on existing power plants, which will cut carbon pollution from the nation's power sector by 32 percent from 2005 levels by 2030*. The EPA's Clean Power Plan will drive more investment in clean energy technologies resulting in 30 percent more renewable energy generation in 2030 and continuing to lower the costs of renewable energy.

- *The Administration will continue to support clean energy R&D at the frontiers of science and technology*. Clean-energy R&D investments helped launch five energy innovation hubs spanning more than $1 billion in public-private investment to pursue advances in clean energy technologies. The 2016 Budget proposes $7.6 billion across the

Federal Government for clean energy, sustainable transportation technologies to increase the affordability and convenience of advanced vehicles and domestic renewable fuels, programs to increase the use and reduce the costs of clean renewable electrical power, modernization of the U.S. electric grid through smart grid R&D and other new technologies, programs, and infrastructure to support nuclear energy technologies, and support for transformative applied energy research through the DOE's Advanced Research Projects Agency—Energy (ARPA-E).

- *The Federal Government will continue to lead by example in its own deployment and use of clean energy technologies*. The Administration has set a bold goal for at least 30 percent of the electric power consumed in Federal buildings to come from renewable energy by 2025, and a requirement for agencies to purchase at least 50 percent zero emission or plug-in hybrid vehicles for Federal fleets by 2025 while reducing fleet greenhouse gas emissions by 30 percent.

Delivering a Revolution in Educational Technology

The Vision

With growing access to broadband, cloud computing, digital devices, and software, the technological conditions are ripe for the development of advanced educational technologies that can transform teaching and learning. In just the past five years, DARPA has showed that Navy IT students trained with a DARPA-developed digital tutor can outperform 98 percent of the students trained with a traditional instructor. Substantial increases in America's investment in advanced learning technologies are needed to create more such success.

The Challenge

Currently, a large gap remains between the relatively modest impact that technology has had on education, particularly in grades K-12, and the transformative impact that technology has had on other parts of life. PCAST estimates that less than two-tenths of one percent of overall education spending goes to R&D, unlike knowledge-intensive sectors like biotechnology which allocate 15-20 percent of revenue to R&D. In addition, with over 13,500 school districts, lengthy adoption cycles, and modest per-pupil expenditures on software, the nature of the K-12 market limits the willingness of companies to invest in R&D and rigorous evaluation for educational software and next-generation learning environments.

The Path Forward

Through the President's ConnectED Initiative, the United States is now on the path to give 99 percent of students access to high-speed broadband by 2018. In addition to this major investment in hardware and physical infrastructure for digital learning, the Administration is committed to making complementary investments in educational software that can improve student learning outcomes in key academic subjects. Important next steps include:

- *Increasing R&D in learning software*. The 2016 Budget includes $50 million for the creation of an Advanced Research Projects Agency for Education (ARPA-ED). In the same way that DARPA's investments in high-risk high-return research have led to the Internet and speech recognition, an ARPA-ED would pursue breakthroughs in learning technology, such as software that is as effective as a

personal tutor and as engaging as the best video game that will continue to improve as more students use it.

- *Creating more "demand pull" mechanisms, so that schools can obtain better learning software*. The K-12 education market in total is over $1.3 trillion a year. There is substantial potential to use "demand pull" approaches that harness this market as a source of demand for innovation to drive major breakthroughs in learning technology. However, more needs to be done to support the creation of markets for school districts to procure high-impact, rigorously-evaluated learning technologies. OSTP issued a Request for Information on this topic and the Department of Education is exploring ways to support school districts that want to reform their procurement systems.

Developing Breakthrough Space Capabilities

The Vision

The Federal Government can develop new space technologies and leverage partnerships with the private sector to dramatically lower the cost of accessing and operating in outer space, while enabling ambitious new missions. Such technologies are helping to create a burgeoning U.S. private space sector.

The Challenge

Investments in space often require substantial funding commitments and long development periods, which can make it difficult for them to attract adequate support from either the Federal Government or the private sector.

The Path Forward

NASA is investing over $6 billion to develop a U.S. commercial crew space transportation capability by 2017. This will give the United States safe, reliable and cost-effective access to and from the International Space Station and low-Earth orbit. NASA's partnerships with commercial companies have already resulted in multiple missions to deliver science experiments and supplies from U.S. soil to the International Space Station, and has strengthened the competitiveness of America's space launch industry. As part of this ongoing effort, the 2016 Budget proposes $1.2 billion for NASA's Commercial Spaceflight program.

President Obama has also emphasized the importance of investing in space technology and a long-term goal in space of venturing "out into the solar system, not just to visit but to stay," as he articulated in the 2015 State of the Union Address. NASA is increasing its support for longer-term research projects with ambitious goals, such as protecting astronauts from radiation in space, developing advanced propulsion systems, and allowing humans to "live off the land" by producing fuel, oxygen, and water on other planets. These investments will create the foundations for a space-faring civilization. The 2016 Budget proposes $725 million for NASA's Space Technology Mission Directorate.

Federal agencies are also beginning to leverage the potential of "CubeSats" and other small satellites for meeting their research, remote sensing, and communications needs.

These satellites, which take advantage of recent advances in the miniaturization and commodification of information technology and communications equipment, can often provide space-based services at a fraction of the cost of traditional satellites. Agencies such as DARPA are supporting the development of technologies for cheaper, faster, and easier small-satellite launches.

Pursuing New Frontiers in Computing

The Vision

Advances in high-performance computing (HPC) have the ability to improve public services, grow the economy, improve the health and safety of communities, and promote scientific discovery.

The Challenge

A coordinated effort for HPC is needed to address increasing computing demands, growing international competition, and emerging technological challenges. These challenges include the end of Moore's Law as a predictor of increases in system performance, the rise of extremely large data sets and attendant computational challenges, and the coming end of a two-decade period of stability in HPC architecture.

The Path Forward

In July 2015, the President created a National Strategic Computing Initiative (NSCI) by Executive Order to meet these challenges and create a cohesive, multi-agency strategic vision and Federal investment strategy for HPC. This strategy, executed in collaboration with industry and academia, will spur the creation and deployment of computing technology at the leading edge, helping to advance Administration priorities for economic competitiveness, scientific discovery, and national security.

The initiative includes five strategic goals:

- *Create systems that can apply exaflops of computing power to exabytes of data*. The NSCI seeks to drive the convergence of compute-intensive and data-intensive systems, while also increasing performance overall, through the development and deployment of new approaches to hardware, system architectures, and programming tools.

- *Keep the United States at the forefront of HPC capabilities*. The Nation must preserve its leadership role in creating HPC technology and using it across a wide range of applications. This involves continued focus on a Department of Energy-led effort to overcome the barriers to delivering exascale computers capable of achieving exaflop performance on important applications.

- *Improve HPC application developer productivity*. The level of expertise and effort required to develop HPC applications poses a major barrier to their widespread use. Government agencies will support research on new approaches to building and programming HPC systems that can circumvent the need for the careful measurement and tuning currently required to achieve maximum performance on a specific machine.

- *Make HPC readily available*. Agencies will work with both computer manufacturers and cloud providers to make HPC resources more available so that scientific researchers in both the public and private sectors have ready access.

- *Establish hardware technology for future HPC systems*. There are many possible successors to current semiconductor technology, but none that are close to being ready for deployment. A comprehensive research program is required to ensure continued improvements in HPC performance beyond the next decade. The Government will sustain fundamental, precompetitive research on future technologies to ensure ongoing improvements in HPC, such as neuromorphic computing.

Harnessing Innovation to End Extreme Global Poverty by 2030

The Vision

The United States is in a unique position to help lead efforts to resolve one of humanity's most entrenched and difficult challenges by the year 2030—persistent extreme poverty. USAID's new model of development, grounded in evidence-based evaluation, rapid iteration, country ownership, sustainability, and strategic partnership, which catalyzes talent and innovation everywhere is an important component of these efforts.

The Challenge

Efforts to aid and empower the world's poorest people too often lack sufficient coordination, resource alignment, engagement with stakeholders and participants, and decision-making informed by evidence. Moreover, technical innovation tools and the efforts of talented innovators are infrequently targeted at problems affecting these populations.

The Path Forward

The USAID Vision for Ending Extreme Poverty emphasizes the importance of partnership with a range of actors, including host-country governments, civil society, and the private sector, and harnessing scientific and technological advances to spur innovation and seek transformative change. In support of this vision, the USAID Global Development Lab, established in April 2014, is a new effort dedicated to using science, technology, innovation, and partnerships to accelerate the impact of development, and to do it more cheaply and sustainably. The Lab helps enable USAID bring a diverse set of partners together to discover, test, and scale breakthrough development innovations that can improve or save the lives of hundreds of millions of people.

Using a new open innovation approach and global engagement, USAID has sourced more than 10,000 ideas over the past few years to address some of humanity's greatest challenges, including maternal and child mortality and morbidity, access to energy, food security, and water scarcity, among others. This new approach has already led to over 300 innovations related to food security, health, climate change, energy, and economic growth challenges that are in various stages of testing around the world. 10,000 innovators, entrepreneurs, small and medium business owners, researchers, and

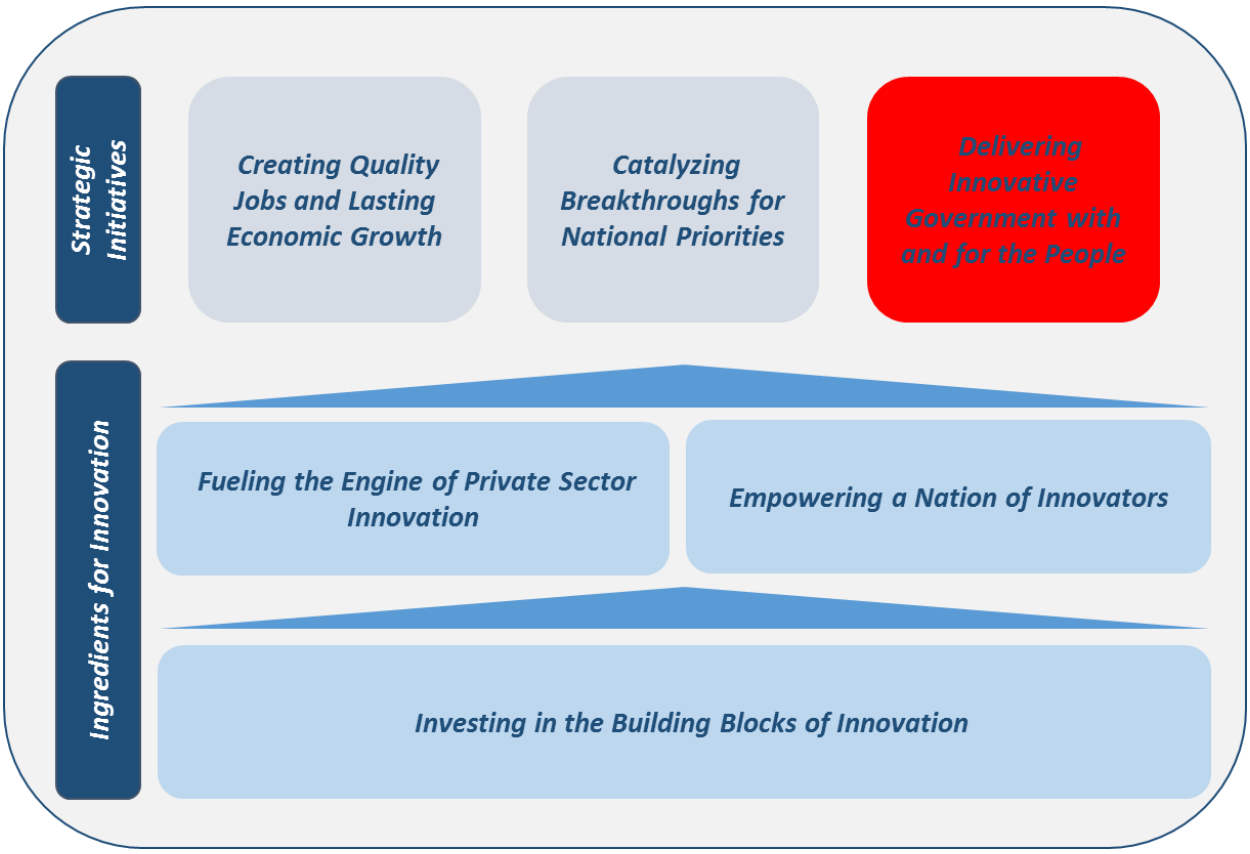
students have applied for funding through various pioneering open source development mechanisms, 60 percent of whom have never worked with USAID before.

For example, the Lab's Development Innovation Ventures (DIV), a year-round grant competition for innovative ideas, uses a tiered-funding model inspired by venture capital. DIV invests comparatively small amounts in relatively unproven concepts and continues to support only those that are proven to work. DIV assists innovators and entrepreneurs in piloting and testing these concepts using cutting-edge analytical methods, and in scaling solutions that demonstrate widespread impact and cost-effectiveness.

Delivering Innovative Government with and for the People

"We need the best and brightest of coming generations to serve. And that's why those of us who believe that government can and must be a force for good; those of us that believe that together, we can keep our country safe, and guarantee basic security, and make sure everybody has a shot at success; those of us who believe, as President Lincoln did, that there are some things we should and must do on our own, but there are some things that we can and should do better together; those of us who believe in both individual initiative, but also the common good—we've got to work harder to make sure that government works."

- *President Barack Obama, Remarks to Senior Leaders of the Federal Workforce, December 9, 2014*



With the right combination of talent, innovative thinking, and technological tools, government can deliver better results with and for the American people. The Administration is pursuing the following strategic initiatives to continue delivering innovative government with and for the people.

Adopting an Innovation Toolkit for Public-Sector Problem-Solving

The Vision

The Obama Administration has sought to increase the effectiveness and agility of the government through improvements in its core processes, including people and culture, procurement, grant-making, digital services, performance management, and internal and external collaboration. In these areas and others, Federal agencies have pioneered new approaches that can deliver better results at lower cost for the American people, and widespread adoption of these approaches can significantly improve government effectiveness.

The Challenge

A growing number of Federal employees are using new approaches to solve problems, improve the core processes of government, and foster innovation. However, adoption of these approaches is still low relative to their potential. Many Federal employees do not know that these approaches exist or lack the support needed to use them effectively.

The Path Forward

The Administration is creating an Innovation Toolkit to facilitate the broader adoption and awareness of a core set of innovative approaches. The Innovation Toolkit will consist of high-quality online resources that explain how and why these approaches can yield important results for the American people.

The effort also includes the formation of "communities of practice" that allow Federal employees to address common challenges that many agencies face and to share expertise.

The Innovation Toolkit will include resources that help Federal employees deploy new approaches in areas such as the following:

- Rapidly hiring top talent using flexible hiring authorities and accelerated hiring practices, particularly for areas where there is a significant gap between world-class performance and current public-sector practices;

- Developing high-impact innovation labs like the HHS IDEA Lab that support employee efforts to experiment with new approaches to meeting agency missions;

- Making open and machine readable the default for government data, and encouraging entrepreneurs and developers to create compelling applications that take advantage of it;

- Designing incentive prizes that serve as magnets for good ideas from startups and citizen inventors;

- Identifying and pursuing the "Grand Challenges" of the 21st century;

- Paying for outcomes through Pay for Success and innovative approaches to contracting that only pay for what works;

- Enabling government to serve as an early customer for new firms with breakthrough technologies;

- Funding what works by building and using evidence – e.g. the "tiered evidence" framework used by the Department of Education's Investing in Innovation program;

- Using human-centered design and the Lean Startup methodology to improve delivery of government services;

- Launching high-impact multi-sector collaborations involving companies, foundations, nonprofits, researchers, regional initiatives, and skilled volunteers; and

- Designing Federal policies and programs in ways that are informed by what people really need and how they actually make decisions by, for example, partnering with the Social and Behavioral Sciences Team or the Innovation Lab at the Office of Personnel Management.

Fostering a Culture of Innovation through Innovation Labs at Federal Agencies

The Vision

A network of Innovation Labs can foster a culture of innovation at Federal agencies by empowering and equipping agency employees and members of the public to implement their promising ideas to more effectively serve the American people.

The Challenge

In many cases, the best ideas for improving the effectiveness and efficiency of government operations, from hospital patient intake processes to benefits processing, come from tapping the expertise of Federal employees. But front-line workers are not always empowered to develop and test their most promising ideas for improving the way agencies meet their missions. In addition, agencies may not have mechanisms for tapping specialized external expertise.

Furthermore, the ability of the Federal Government to promote breakthrough innovation varies widely across agencies. This means that the Nation is underutilizing science, technology, and innovation as a tool to meet important national challenges such as dramatically improving student learning outcomes, providing more workers with skills that are tickets to middle-class jobs, and increasing the affordability of housing.

The Path Forward

To increase Federal capacity for innovation, the Administration is supporting the development of Innovation Labs at Federal agencies. These labs provide the resources and support for employees and members of the public to develop, test, and scale new approaches to meeting agency goals, resulting in significant improvements to the effectiveness and efficiency of the Federal Government.

Several agencies have made significant strides in developing their internal innovation capacity through Innovation Lab models. These include the HHS IDEA Lab, the USAID Global Development Lab, the OPM Innovation Lab, the VA Center for Innovation, and the National Security Agency (NSA) Incubation Cell.

For example, the HHS IDEA Lab operates with the premise that many of HHS's 90,000 career employees have creative ideas for improving the way it does business.

Accordingly, the IDEA Lab empowers HHS teams to pursue these ideas by providing time, training in innovation methodologies such as human-centered design, mentorship, and small amounts of funding. Teams that generate promising initial results are eligible to compete for follow-on funding to scale their ideas.

Building on the cohort of agencies that have already developed Innovation Labs, the 2016 Budget includes funding for several other agencies – including the Department of Commerce, Department of Education, Department of the Treasury, and the Small Business Administration – to create their own versions of an IDEA Lab, tailored to their unique missions and operations. Together, these efforts have the potential to drive lasting change in how government does business.

Providing Better Government for the American People through More Effective Digital Service Delivery

The Vision

Accessing government services online should be as simple and intuitive as the best private-sector digital services that American citizens and businesses use every day.

The Challenge

American citizens and businesses expect to interact with their government through digital channels such as websites, email, and mobile applications. Until today, however, too many of our digital services have not worked well, were delivered late, or were over budget. By developing digital services that better meet the needs of American citizens and businesses, the Federal Government can make the delivery of policy and programs more effective.

The Path Forward

The success rate of government digital services is improved when agencies have digital service experts on staff who are experienced with the modern design, software engineering, and product-management techniques that have powered the growth in America's technology sector for the past decade.

To ensure agencies can effectively build and deliver important digital services, the 2016 Budget includes funding for several Federal agencies for staffing costs to build Digital Service teams. These teams will be composed of experts who will focus on transforming some of the country's most important citizen- and business-facing services so they are easier to use and more cost-effective to build and maintain.

These digital service experts will bring private-sector best practices in the disciplines of design, software engineering, and product management to bear on the agency's most important services. The positions will be term-limited, to encourage a continuous influx of up-to-date design and technology skills into the agency. The digital service experts will be recruited from among America's leading technology enterprises and startups, and will join with the agency's top technical and policy leaders to deliver meaningful and lasting improvements to the services the agency provides to citizens and businesses.

This effort builds on the success of the Administration's U.S. Digital Service and the General Service Administration's digital service team known as "18F," both created in 2014. Since their creation, these small teams have worked in collaboration with Federal agencies to implement cutting-edge digital and technology solutions to best serve the American people. Projects have included improvements to the Veterans Benefits Management System, green card replacements and renewals, the creation of the College Scorecard, and more. In addition to their work on these high-priority projects, these small teams of tech experts have worked to establish best practices (published in the U.S. Digital Services Playbook at playbook.cio.gov), to develop government-wide design standards (published at playbook.cio.gov/designstandards), and to recruit more highly-skilled digital service experts and engineers into government.

Building and Using Evidence to Drive Social Innovation

The Vision

The Federal Government's social innovation agenda seeks to identify and scale evidence-based solutions that effectively tackle entrenched social problems. Expanding our knowledge base and using existing evidence will advance important goals, such as strengthening communities and enabling upward economic mobility.

The Challenge

America faces an urgent need to continue and accelerate our progress tackling pressing social challenges ranging from school readiness to teenage pregnancy, recidivism to unemployment, and more. This requires understanding what's working, identify what's not, and invest in creative, new initiatives where the old way of doing things aren't working. The Federal Government has an enormous opportunity to grow this evidence base and rigorously study the effectiveness of those social interventions it funds, and develop tools for scaling those solutions that work best.

The Path Forward

The Administration has ushered in a new era of data-driven social innovation by piloting creative approaches to seemingly intractable problems. Highlights of agency efforts to promote evidence since 2011 include:

- *The Corporation for National and Community Service's Social Innovation Fund (SIF) has provided 11 grants, building on its 2010-2011 portfolios, to grow and further test community-based social interventions at 66 organizations*. Additionally, the SIF added a Pay for Success (PFS) grant program, selecting eight grantees to help communities study using this approach to tackle social problems ranging from childhood asthma to chronic homelessness. PFS strategies tie funding for an intervention to its impact in the community. Instead of paying for services regardless of their effects, government or other entities only pay if programs actually achieve positive outcomes for the people they are designed to benefit. As of June 2015, the SIF is funding 34 PFS feasibility studies and providing support for transaction structuring for five PFS projects, with more to come.

- *The Department of Education has awarded an additional 71 Investing in Innovation (i3) Program tiered-evidence grants*. These grants fund the development, validation, and scale-up of promising or proven interventions to dramatically improve student outcomes.

- *The Department of Labor in 2013 established and formalized a policy that requires rigorous, independent and transparent evaluations in all of its discretionary grant programs*. For example, the Workforce Innovation Fund's performance is measured in terms of outcomes for job seekers and employers, and in terms of cost effectiveness. Newer programs backed by less evidence are eligible for less funding, whereas more sizable grants to proven programs make possible the wider-scale expansion of these models.

- *The White House has launched an Administration-wide evidence and innovation process*. Through this process, all agencies will take concrete and meaningful steps to better build and use evidence to increase government effectiveness and social program impact.

The Administration is deepening its investment in evidence and social innovation. Among its priorities:

- *Make better use of existing data while protecting privacy to learn more about what works*. In the 2016 Budget, the Administration called on Congress to clear roadblocks so that government offices, such as the Department of Labor, can share basic data that could be used to assess the impact of public programs. For example, most Federal agencies cannot access basic wage data collected by states for Unemployment Insurance, even though billions of Federal dollars are invested in programs designed to help people earn more.

- *Create an incentive fund for Pay for Success approaches*. The Administration has called on Congress to pass legislation that would create a $300 million fund to incentivize state and local governments to explore Pay for Success (PFS) projects that generate Federal budget savings through preventive social interventions that result in better outcomes for individuals in need.

New Horizons for 2015 and Beyond

"Interesting stuff happens in the fourth quarter."

- *President Barack Obama, Year End Press Conference, December 20, 2014*

In addition to the current activities the President's *Strategy for American Innovation* describes, important new opportunities for action to be developed in 2015 and beyond include the following new horizons.

Designing Smart Regulation to Support Emerging Technologies

Even the innovation process is changing. Key trends include the drastic reduction in costs to launch and scale technology; the lack of regulatory pathways for the testing and pilot phases of emerging technologies; the reduced role of incumbent, regulated intermediaries; and the shift away from technologies that can be regulated in accordance with stable categories to technologies that enable and require more fluid approaches. As the innovation process evolves, the Federal Government needs to develop new regulatory approaches for both new and existing regulations that protect important public values like health and safety while fostering innovation. Smart regulation can also use cutting-edge technologies to reduce regulatory burden, aid in regulatory analysis, and better solicit public engagement in the regulatory process.

A 21st Century Call to Serve

The caliber of the people that Federal departments and agencies are able to recruit, hire, and retain has a decisive impact on public-sector performance. The Federal Government already draws on the efforts of a diverse and talented workforce, but could benefit by continuing to actively recruit individuals that can help build a more effective, efficient, and innovative government. Programs like the Presidential Innovation Fellows, the 18F team and the United States Digital Service have demonstrated the benefits of recruiting technical talent to significantly improve the delivery of digital services and experiment with new approaches to solving problems. A 21st Century Call to Serve would invite individuals with skills in areas such as innovation management, data science, financial

innovation, and human-centered design to consider a temporary "tour of duty" to serve their country. This will require:

- Adopting private-sector best practices for active recruiting of top talent into government;

- Highlighting the significant impact that individuals and small teams can have by addressing some of the most important national and global challenges;

- Increasing the use of flexible hiring authorities and redesigning the Federal hiring process so that it can be completed in weeks not months;

- Building collaborations between innovators and career Federal employees so that the influx of new talent serves as a "force multiplier" for the entire Federal workforce; and

- Ensuring that innovators have the support of the senior management of Federal departments and agencies.

Harnessing Financial Innovation for National Priorities

The tools of finance—including securitization, contract standardization, and other activities to spur formation of new markets—hold considerable power to overcome the market failures that deter investment in important societal priorities, including early stage research, renewable energy development, and areas of significant social impact. For example, DOE's Solar Access to Public Capital Working Group has completed development of standard residential lease and commercial power purchase agreement (PPA) contracts available for use by developers, customers, and third-party finance providers in the solar industry. These documents are designed to improve consumer transparency, reduce transaction costs in the solar asset contracting process, and facilitate the pooling of the associated cash flows so that they may be securitized and sold in the capital markets. Catalyzing additional private investment for other key national priorities by facilitating the emergence of financial innovations is a promising area for additional Federal and private-sector initiatives.

Increasing the Role of "Demand Pull" in America's Innovation Strategy

Traditionally, America's science, technology and innovation policy has emphasized "technology push" by funding R&D to address agency and national priorities. But agencies have started to experiment with approaches that help fuel demand for innovation rather than funding its supply. These "demand pull" approaches include milestone payments, incentive prizes, and advance market commitments. USAID has developed a primer on market-shaping approaches to accelerate the development and adoption of lifesaving products for global health. While some tools, such as incentive prizes, are already achieving significant adoption across the Federal Government, similar analysis is needed to identify opportunities to use other "demand pull" tools to address other national and global priorities.