U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION

HEARING CHARTER

Supporting Innovation in the 21st Century Economy

Wednesday, March 24, 2010
10:30 a.m. – 12:30 p.m.
2318 Rayburn House Office Building

1. Purpose

Innovation, "the development of new products, services, and process,"[1] has had an indelible impact on the lives of Americans and is increasingly important for ensuring the well-being of the Nation's economy. While new technology like the Internet dramatically changed society in a short period of time, such profound innovation has remained elusive in sectors like energy, where fossil fuels have dominated for over a century. This hearing will examine factors that drive innovation, as well as those that impeded it. In addition, this hearing will discuss the role of the Federal Government in promoting the innovation that is crucial for American prosperity.

2. Witnesses

- **The Honorable Aneesh Chopra** is the Chief Technology Officer of the United States at the White House Office of Science and Technology Policy.
- **Dr. Mark Kamlet** is the Provost at Carnegie Mellon University.
- **Dr. Rob Atkinson** is the President of the Information Technology and Innovation Foundation.
- **Dr. Daniel Breznitz** is an Associate Professor at the Sam Nunn School of International Affairs at Georgia Institute of Technology.
- **Mr. Paul Holland** is a General Partner at Foundation Capital.

3. Background

First developed in the late nineteenth century, the telephone became one of the most important inventions in the twentieth century. The technology, made possible by previous research in sound and electricity, created a new industry and new infrastructure, and

[1] *A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs*, Executive Office of the President, National Economic Council, and the Office of Science and Technology Policy. September, 2009.

greatly enhanced productivity across the entire economy. However, it is notoriously difficult to predict the impact of technological advances on society and the U.S. economy. For instance, in 1983 prominent experts forecasted that the demand for mobile phones in the U.S. would total only one million by 1999. Instead, by that time, 70 million Americans had cell phones. Rapid improvements in technology and reductions in costs made the original predictions obsolete[2]. In contrast, a Massachusetts company started in 1998 with promising technology to revolutionize skin grafts suffered bankruptcy and near-collapse before solving the manufacturing and logistical problems that allowed it to finally succeed a decade later[3].

Regardless of the difficulty of predicting or creating it, economists have long studied the impact of innovation on the U.S. economy. Nobel Prize winner Robert Solow found that approximately 85 percent of the growth in the U.S. economy from the late nineteenth century to the mid-twentieth century was the result of forces beyond the traditional economic inputs of labor and capital. These "intangible" inputs—namely R&D and a more educated workforce—grew in importance in the twentieth century as innovations moved away from physical-capital intensive technology advancements, like railroads, to more research-intensive advancements, like DNA sequencing[4].

The increasingly competitive nature of the global economy has raised concerns among U.S. policy-makers and others that the U.S. has not sufficiently invested in maintaining leadership for the intangible inputs that drive innovation. The influential 2007 National Academies *Rising Above the Gathering Storm* report took note of factors such as declining federal investment in R&D, poor performance in math and science among American schoolchildren, and declining support for corporate R&D within the U.S. The authors recommended increasing support for science and engineering research and targeted action to improve American students' capacity and interest in science, math, and related fields. Congress acted upon the recommendations with the America COMPETES Act, which put the budgets of the National Science Foundation (NSF), the National Institute of Standards and Technology (NIST), and the Department of Energy Office (DOE) of Science on the path to doubling, and also provided for improvement in science and math education through teacher development.

President Obama's FY2011 budget request includes $147.7 billion for R&D across the Federal Government, and reflects the commitments made in COMPETES by increasing the budgets of NSF (by 8 percent), NIST (by 7.7 percent, core scientific and technical research services), and the DOE Office of Science (by 4.6 percent)[5]. In addition to increasing R&D expenditures (with the goal of reaching a total R&D investment of 3 percent of GDP as a nation), the Administration has identified a number of other priorities which are key to supporting innovation for economic growth and job creation, such as broadband coverage,

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[2] *Innovation and Economic Growth*, Nathan Rosenberg, Organization of Economic Cooperation and Development, 2004.
[3] *Innovation Interrupted*, BUSINESSWEEK, June 15, 2009.
[4] *The Search for the Sources of Growth: Areas of Ignorance, Old and New*, Moses Abramovitz, The Journal of Economic History, June 1993.
[5] *Federal Research and Development Funding: FY2011*, Congressional Research Service, March 2010.

strong protection for intellectual property, better support of entrepreneurs, and increased effort to open-up foreign markets to U.S. exports[6].

A number of federal R&D programs use the word "innovation" within their titles or mission statements. For example, NSF spent nearly $50 million in FY2009 on Industrial Innovation and Partnership funding and the Emerging Frontiers in Research and Innovation program (with an additional $19 million for ARRA (P.L. 111-5) funding). These programs fund a wide range of activities from research to making more efficient use of radio frequencies to developing measurements for sustainable construction practices and the development of applied mathematical models for complex engineered systems. The Department of Energy also makes a number of awards for innovation, such as the Energy Innovation Hubs to fund research to bridge the gap between basic scientific breakthrough and industrial commercialization. However, the authors of *Boosting Productivity, Innovation, and Growth Through a National Innovation Foundation*[7] note that while the Federal Government invests billions in R&D, there is very little funding directed toward "firm-level" innovation. They identified only two programs that focused directly on stimulating commercial innovation, NIST's Manufacturing Extension Partnership Program and its Technology Innovation Program. Other federal programs, like the Defense Advanced Research Project Agency (DARPA) and the Small Business Innovation Research (SBIR) program focus on spurring technological development, but generally to accomplish a mission-related goal.

The authors of the *Boosting Productivity* report recommend that the Federal Government take a more active role in supporting innovation to help overcome some of the barriers faced by the private sector. These barriers, or market failures that disadvantage innovation, include the pressure to shift corporate R&D away from long-term breakthroughs, towards short-term development projects and the difficulties faced in aligning the needs of universities and the private sector to enable effective collaboration. The authors propose creating a National Innovation Foundation to remedy the shortcomings in federal innovation policy, which they view as ad-hoc, too focused at the federal-level, and too narrow (e.g., very little federal science and technology support directly for the service-sector). This Foundation, an independent federal agency, would fund industry-university research partnerships, make state-level grants to help promote regional industry clusters and technology commercialization, assist small firms in adopting new technologies, and support innovation throughout the Federal Government.

Investment in innovation is not confined to the federal level. Many states, recognizing that they now must compete globally, as well as with each other, are making investments to improve the innovation capacity of their economies. Collectively, states spend approximately $1.9 billion per year on technology-based economic development activity[8].

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[6] *A Strategy for American Innovation: Driving Towards Sustainable Growth and Quality Jobs*, Executive Office of the President, National Economic Council, and the Office of Science and Technology Policy. September, 2009.
[7] *Boosting Productivity, Innovation, and Growth Through a National Innovation Foundation*, ITIF & Brookings, April 2008.
[8] *Boosting Productivity, Innovation, and Growth Through a National Innovation Foundation*, ITIF & Brookings, April 2008.

These types of initiatives, like the Oregon Nanoscience and Microtechnologies Institute, provide funds, facilities, and other services to high-tech start-up companies. Some states are also investing directly in R&D and in recruiting top science and engineering talent, such as Maryland's $23 million per year investment in stem cell research and Kentucky's decade long $350 million investment in recruiting top faculty to its universities[9]. States make many of these investments not only to improve their economies over a range of sectors, but also in an effort to spur the development of specific-industry clusters. The rise of Silicon Valley demonstrates the powerful force of cluster development both to regional economic growth and to spurring innovation. The Council on Competitiveness has identified clusters as a critical element to advancing regional competitiveness and innovation capacity. The presence of related industries, though, is only one piece of a strong innovative economy. A multitude of factors, such as workforce, R&D capacity, demand conditions, availability of capital, and local governance all affect the innovation capacity of regional economies[10].

A study of Rochester, New York, by the Council on Competitiveness, illustrates the need for all of these factors to enable innovation. The study found that Rochester had the fundamental building blocks for an innovation economy, but lacked both the capital and culture to take the necessary risks to innovate. The area, dominated by Eastman Kodak and Xerox, has two well-regarded universities, a strong K-12 educational system, a skilled workforce, and a good transportation and communications infrastructure. However, despite the fact that workers there produce six-times the average number of patents as workers elsewhere in the country, the area ranked very low in terms of licensing technology and launching start-ups or spin-out companies. The authors attributed the low rate of entrepreneurship to the fact that the area had long relied on a few strong corporate entities, contributing to a risk-averse culture. In fact, between 1995 and 2003, the area attracted only 0.6 percent of the total venture capital market. The venture capital in the region tends to focus on the least risky opportunities. The report did note that the region is attempting to create coalitions around strengths like optics, and promote more collaboration between business and the universities[11].

Funding to bring new discoveries from the lab into commercialization is critical for innovation. Experts have noted the declining level of funding available for early stage commercialization—the money needed for proof of concept or prototype development. Angel investors, independent investors working with their own funds, have traditionally focused funding at this early stage, but their contributions have dropped dramatically, particularly with the recent economic downturn ($19 billion in 2008, down from a five-year high of $26 billion in 2007). At the same time, venture capital investment is increasingly trending toward later stage investment. The NSF *Science and Engineering Indicators* reported that venture capitalists have largely abandoned seed and start-up stage funding from a high of nine percent in 1996 through 1998, to a low of two percent from

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[9] *Innovation America: Investing in Innovation,* National Governors Association, The Pew Center on the States, 2007.
[10] *Clusters of Innovation Initiative: Atlanta-Columbus*, U.S. Council on Competitiveness
[11] *Fanning the Flames of Economic Progress: Igniting Greater Rochester's Entrepreneurial Economy*, U.S. Council on Competitiveness, September 2004.

2002 to 2004. Currently, such funding stands at five percent, but this lack of early stage funding contributes significantly to the “valley of death phenomena” which makes commercialization of new technology notoriously difficult[12].

Despite the increasingly competitive global environment, the U.S. is still a leader in knowledge and high-tech industries. According to the most recent National Science Foundation *Science and Engineering Indicators*, the U.S. provided 34 percent of knowledge intensive service industries (business, financial, and communications) in 2007 and 30 percent of the global value added for high technology manufacturing was accounted for by the U.S. However, the U.S. trade deficit in high-tech goods in 2008 was $80 billion[13].

4. Overarching Questions

- **What factors have enabled innovation in the past?**
- **What is the role of the Federal Government in spurring innovation?**
- **How can government best support entrepreneurs?**
- **What factors enable regional innovation-based economic growth? How can these be encouraged and sustained?**
- **How should efforts to create innovation be measured or assessed?**

[12] National Science Foundation *Science and Engineering Indicators*, 2010
[13] National Science Foundation *Science and Engineering Indicators*, 2010