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

The Science of Science and Innovation Policy

Thursday, September 23, 2010
2:00 p.m. - 4:00 p.m.
2325 Rayburn House Office Building

1. Purpose

On Thursday, September 23, 2010, the Research and Science Education Subcommittee will hold a hearing to examine the current state of science and technology policy research, how this research informs policymaking, and the role of the federal government in fostering academic research and education in this emerging interdisciplinary field.

2. Witnesses

- **Dr. Julia Lane**, Program Director of the Science of Science and Innovation Policy program, National Science Foundation.

- **Dr. Daniel Sarewitz**, Co-Director of the Consortium for Science, Policy & Outcomes, Arizona State University.

- **Dr. Fiona Murray,** Associate Professor of Management in the Technological Innovation & Entrepreneurship Group, MIT Sloan School of Management.

- **Dr. Albert H. Teich**, Director of Science & Policy Programs, American Association for the Advancement of Science.

3. Overarching Questions

- What is the "science of science policy?" How can science and technology (S&T) policy research contribute to and inform evidence-based local and national policy decisions? To what extent are science and technology policies in the United States being shaped by what has been learned from S&T policy research?

- What new and continuing areas of research in this area could significantly improve our ability to design effective programs and better target federal research investments? What are the most promising research opportunities and what are the biggest research gaps? Is the Federal government, specifically the National Science Foundation, playing an effective role in developing the science of science policy?

- What is the state of education in science and technology policy at U.S. universities? What are the backgrounds of students pursuing graduate degrees in S&T policy? What career paths are sought by science and technology policy program graduates? What are the fundamental skills and content knowledge needed by science and technology policy practitioners? Is the National Science Foundation playing an effective role in fostering the development of science and technology policy programs at U.S. universities?

4. Background

During his keynote address in 2005 at the American Association for the Advancement of Science's Science and Technology Policy Forum, Dr. John Marburger, then science advisor to President Bush, called for the establishment of a "science of science policy." The "science of science policy" (SoSP) as described by Dr. Marburger and others includes the development of scientific theories, analytical tools, and rigorous datasets that will assist policymakers in science policy decisions. The SoSP is an interdisciplinary field that draws together researchers from economics, political science, and the social and behavioral sciences to improve our understanding of the science and engineering enterprise, including the process of innovation in an effort to establish a more quantitative approach to science and technology policy decisions.

While most believe that science, technology, and innovation are critical to the competitiveness and prosperity of the United States, we lack the rigorous tools to quantify that relationship. Therefore, it remains difficult to actually *measure* the economic impact, social benefits, and effectiveness of federal research and development (R&D) investments. In addition to improving our ability to target federal R&D investments, research in the area of SoSP holds the potential to provide insight into the effect of globalization on the U.S. science and engineering workforce, increase our understanding of technology development and diffusion, communicate the social and economic benefits of R&D spending to the general public, and shed light on the process of creativity and innovation.

In 2006, in response to Dr. Marburger's call to action, an interagency working group, co-chaired by the National Science Foundation (NSF) and the Department of Energy, was formed within the Subcommittee on Social, Behavioral, and Economic Sciences under the National Science and Technology Council. The interagency working group conducted an assessment of the state of SoSP research and surveyed the Federal agencies about the tools, methods, and data they were using to make investment decisions. This work resulted in the release of a Federal SoSP research roadmap[1] in 2008. The roadmap outlines three broad themes and poses 10 research questions to be addressed by federally-funded SoSP research.

<u>Theme 1: Understanding Science and Innovation</u>

Question 1: What are the behavioral foundations of innovation?

[1] *The Science of Science Policy: A Federal Research Roadmap*
http://www.whitehouse.gov/files/documents/ostp/NSTC%20Reports/39924_PDF%20Proof.pdf

Question 2: What explains technology development, adoption, and diffusion?

Question 3: How and why do communities of science and innovation form and evolve?

Theme 2: Investing in Science and Innovation

Question 4: What is the value of the Nation's public investment in science?

Question 5: Is it possible to "predict discovery"?

Question 6: Is it possible to describe the impact of discovery on innovation?

Question 7: What are the determinants of investment effectiveness?

Theme 3: Using the Science of Science Policy to Address National Priorities

Question 8: What impact does science have on innovation and competitiveness?

Question 9: How competitive is the U.S. scientific workforce?

Question 10: What is the relative importance of different policy instruments in science policy?

Role of the National Science Foundation

In 2006, NSF's Directorate for Social, Behavioral and Economic Sciences (SBE) held three workshops to ask for recommendations and guidance from the research community about the breadth of activities that should be supported under an NSF-funded SoSP program. In 2007, NSF allocated $6.8 million for a new Science of Science and Innovation Policy (SciSIP) program. SciSIP supports both single investigators and collaborations in two areas. First, the program supports research on data and the improvement of science metrics, including research to improve our ability to identify, characterize, and measure returns on federal R&D investments. Second, the program supports research directed toward the development of models and other statistical tools as well as qualitative studies that will improve our understanding of the process of innovation and science outcomes, both societal and economic. In addition to supporting research, the program supports workshops, conferences, and symposia to help foster a community of researchers in the SciSIP area.

NSF's SciSIP budget request for fiscal year 2011 was $14.25 million, of which $8.05 million will be devoted to SciSIP research and community building activities through SBE's Office of Multidisciplinary Activities and $6.2 million will be for the development of data survey tools through SBE's Division of Science Resource Statistics (SRS). The data compiled by SRS for the biennial Science and Engineering Indicators report serve a vital role in the SoSP as a long-term source of unbiased information about the science and engineering enterprise.

NSF's current efforts in SciSIP are not its first. From the 1970's through the early 1990's NSF had a modest-sized staff carrying out policy research and analysis. These analysts worked in the Office of Research and Development Assessment, later the Division of Policy Research and Analysis (PRA), on specific tasks requested by the Office of Management and Budget, the Office of Science and Technology Policy, the Congressional Office of Technology Assessment, and other federal agencies. Additionally, PRA had a small budget to support academic research in areas directly relevant to their policy analysis tasks. In 1992, PRA was involved in a scandal over the faulty assumptions used to predict a looming shortage in engineers. The scandal led to an investigation by the Committee on Science & Technology and the dismantling of PRA.

STAR METRICS

The National Science Foundation and the National Institutes of Health are currently collaborating on a project known as STAR METRICS (Science and Technology for America's Reinvestment: Measuring the Effect of Research on Innovation, Competitiveness and Science), which is the first federal-university partnership to develop a data infrastructure that documents the outcomes of science investments for the public. An initial pilot project was recently completed with a handful of regionally and otherwise diverse institutions of higher education through the National Academies' Federal Demonstration Partnership. The pilot project validated the initiative's concept and its ability to collect relevant data from existing university databases. The full-scale project will proceed in two phases: Phase I will develop uniform, auditable and standardized measures of job creation resulting from science spending included in the American Recovery and Reinvestment Act; Phase II will develop measures of the impact of federal R&D spending on economic growth, workforce development, scientific knowledge, and social outcomes.

International Efforts

The Organization for Economic Cooperation and Development (OECD) has been developing and collecting science and technology indicators from their member nations for nearly 50 years. In 2004, the Science & Technology Ministerial called for a "new generation of indicators which can measure innovative performance and other related output of a knowledge-based economy" emphasizing "the data required for the assessment, monitoring and policy making purposes."[2] Since that time the OECD has continued to refine its science and technology indicators, and improve the tools they use for analyzing the impact of science and technology. Earlier this year the OECD released a report entitled, "Measuring Innovation: A New Perspective."[3] The report identifies five areas for which international action is needed: the development of innovation metrics that can be linked to aggregate measures of economic performance; investment in a high-quality and comprehensive statistical infrastructure to analysis innovation at the firm-level; the promotion of innovation metrics in public sector and for public policy evaluation; the identification of new approaches to understand knowledge creation and flow; and the promotion of the measurement of innovation on social goals.

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[2] What Indicators for Science, Technology and Innovation Policies in the 21st Century? Blue Sky II Forum – Background http://www.oecd.org/dataoecd/9/48/37082579.pdf

[3] http://www.oecd.org/document/22/0,3343,en_41462537_41454856_44979734_1_1_1_1,00.html

On April 14, Dr. Julia Lane spoke to the European Parliament about the STAR METRICS effort, emphasizing the global nature of science and engineering and the common need for better tools to assess and predict the impact of science, technology, and innovation. During her speech, Dr. Lane indicated that creating a universal researcher identification system could be an important first step in a global effort to understand and measure the return on scientific investment. Niki Tzavela, a Greek Member of the European Parliament, who serves as Vice-Chair of the European Parliament Delegation to the United States, and sits on the Parliament's Industry, Research, and Energy Committee (ITRE), has been a leader on the issue of improved science metrics in the European Union. Having indicated that the EU 8th Framework Program represents an opportunity to evaluate and improve science policy, Mrs. Tzavela introduced an initiative to the ITRE Committee proposing that the EU collaborate on this topic with the United States. The EU is now considering initiatives that would complement the STAR metrics project, and the Scientific Technology Options Assessment Panel within the EU has been designated to provide an in-depth analysis on Science Metrics. [4]

Education in Science & Technology Public Policy

According to the AAAS Guide to Graduate Education in Science, Engineering and Public Policy[5] there are more than 25 U.S. universities that offer a graduate degree in the interdisciplinary field of science and technology public policy. These degree programs draw from a number of fields, including economics, sociology, political science, and engineering; however the coursework associated with each program varies and is dependent upon the academic department or school that houses the program.

5. Questions for Witnesses

Dr. Julia Lane

1. Please describe NSF's Science of Science Policy and Innovation program, including a description of the Foundation's overall vision and strategy for research and education in this area.

   Specifically,

   How is NSF fostering collaboration between social and behavioral scientists and researchers from other disciplines, including computer scientists, engineers, and physical scientists, in science and technology policy research?

   How is NSF fostering the development of science and technology policy degree programs and courses of study at colleges and universities? What is the current scope and level of support for such programs?

   How is NSF encouraging the development of a community of practice in science of science policy and the dissemination of research results to policy makers?

[4] http://www.euractiv.com/en/science/eu-looks-to-us-model-for-measuring-rd-impact-news-448950
[5] http://www.aaas.org/spp/sepp/

2. As a Co-Chair of the Science of Science Policy Interagency Group under the National Science and Technology Council, please briefly describe the work of that group and how the various federal science agencies are collaborating on the development and implementation of science of science policy tools to improve the management and effectiveness of their R&D portfolios and other science and technology-related programs.

3. Please provide a brief description and update on the status of the OSTP led project on science metrics, known as STAR Metrics, including a description of international engagement and interest in this effort.

Dr. Albert Teich

1. How can research on innovation and the scientific enterprise also known as the science of science and innovation policy (SciSIP) be used to inform the design of effective federal programs and the management of federal research investments? Do you believe the results of science and technology policy research are being effectively incorporated into national policy decisions?

2. What are the challenges to the incorporation of science and technology research in the decision making process? What is AAAS's role in mitigating those barriers? Specifically, how is AAAS helping to build a community of practice in the SciSIP? What recommendations, if any, do you have for the National Science Foundation's SciSIP program? Do you believe SciSIP research is being effectively coordinated across the federal agencies? If not, what if any recommendations do you have regarding interagency coordination?

3. As you know there are more than 25 U.S. universities that offer graduate degrees in science, engineering and public policy. In your opinion, are these programs having the intended effect of producing graduates with the skills necessary to shape science and technology policies? What type of education and training should science and technology policy practitioners receive? Is the National Science Foundation playing an effective role in fostering the development of science and technology policy programs at U.S. universities? If not, what recommendations, if any, do you have for NSF and/or the universities with such programs?

Dr. Daniel Sarewitz

1. Please provide an overview of the research activities of the Consortium for Science, Policy, and Outcomes. How are you facilitating interdisciplinary collaborations within the Consortium? What new and continuing areas of research in the science of science and innovation policy (SciSIP) could significantly improve our ability to design effective programs and better target federal research investments? What are the most promising research opportunities and what are the biggest research gaps?

2. Is the Federal government, specifically the National Science Foundation, playing an effective role in fostering SciSIP research and the development of a community of practice in SciSIP? What recommendations, if any, do you have for the National Science Foundation's SciSIP program?

3. Please describe the education and outreach activities of the Consortium for Science, Policy, and Outcomes.

4. How can the dissemination of SciSIP research findings be improved so that policymakers are better informed of the current state of research? Are there best practices that can be implemented by the Federal government and/or the research community to improve the incorporation of science and technology policy research into the decision making process?

5. What are the fundamental skills and content knowledge needed by SciSIP researchers and practitioners? What are the backgrounds of students pursuing graduate degrees in science and technology policy and what careers paths are sought by these graduates? Is the National Science Foundation playing an effective role in fostering the development of science and technology policy degree programs at U.S. universities? If not, what recommendations, if any, do you have for NSF and/or the universities with such programs?

Dr. Fiona Murray

1. Please provide an overview of your research. What new and continuing areas of research in the science of science and innovation policy (SciSIP) could significantly improve our ability to design effective programs and better target federal research investments? What are the most promising research opportunities and what are the biggest research gaps?

2. Is the Federal government, specifically the National Science Foundation, playing an effective role in fostering SciSIP research and the development of a community of practice in SciSIP? What recommendations, if any, do you have for the National Science Foundation's SciSIP program?

3. What are the fundamental skills and content knowledge needed by SciSIP researchers and practitioners? What are the backgrounds of students pursuing graduate degrees in science and technology policy and what careers paths are sought by these graduates? Is the National Science Foundation playing an effective role in fostering the development of science and technology policy degree programs at U.S. universities? If not, what recommendations, if any, do you have for NSF and/or the universities with such programs?