



Council of Graduate Schools

Office of Science and Technology Policy

Request for Information: Building a 21st Century Bioeconomy

December 2, 2011

The Council of Graduate Schools (CGS) is pleased to provide input to the Administration's National Bioeconomy Blueprint detailing steps to harness biological, research innovations to address challenges in health, food, energy and the environment. Among other things, this Blueprint will identify strategies to meet the grand challenges, focus research and development investments in areas that will provide the foundation for the bioeconomy and expand workforce training to prepare the next generation of scientists and engineers for the bioeconomy jobs of the future.

Our comments focus on the elements of the request related to workforce development and investments in education and training that are essential to creating a technically-skilled 21st century American bio economy workforce. We first provide information on recent reports concerning the role of graduate education in preparing a highly skilled workforce and the need to prepare more graduate students for careers beyond the academy. Specific comments and recommendations related to workforce issues in the RFI follow our general comments.

Background:

In 2010, CGS and Educational Testing Service (ETS) released a report titled *The Path Forward: The Future of Graduate Education in the United States*. That report provided a comprehensive overview of the trends, challenges, and vulnerabilities existing in the current U.S. system of graduate education and described the importance of producing an adequate number of graduate degree holders to meet 21st century needs. Pressing issues facing graduate education include:

- Demographic shifts that present educational challenges including lower levels of education particularly in math and reading skill levels.
- Disruptions in pathways to and through higher education complicated by drop-out rates at both the high school and undergraduate levels.
- Growth in international education and career opportunities for both international students and U.S. students.
- Failure to complete a graduate degree is one of the most vexing problems confronting U.S. graduate education, particularly at the doctoral level.
- Accumulated debt is consistently identified as one of the most important concerns of graduate deans and inadequate financial support is the most significant factor contributing to a student's ability to complete the doctoral degree.
- Career path transparency in terms of clear career pathways for graduate degree holders are often lacking, especially at the doctoral level. This lack of knowledge impacts students before they enter graduate school, during graduate school and upon degree completion.

Universities, businesses and government are responding to these challenges in a variety of ways. Through the Ph.D. Completion project, a number of universities have been working to improve completion rates at the doctoral level for a decade with some success. More information about the Ph.D. Completion project is available

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at <http://www.phdcompletion.org/>. Several recent federal policy initiatives, including the COMPETES Act, recognize the role of graduate education in preparing a highly skilled workforce and an educated citizenry and authorize financial and programmatic support accordingly. Many business leaders and corporations are actively engaged with universities and graduate schools to enhance communication concerning workforce needs, to provide internship and research opportunities, and in some cases financial support for graduate education and research.

Amongst the many issues, challenges and responsive activities addressed in the Path Forward report, one question emerged as critical to ensuring graduate schools are preparing precisely the talent that America needs. How effectively are America's graduate schools and America's employers working together to ensure the optimal pathway through graduate school and into careers? This issue has several dimensions. The critical dimension relates to student knowledge about career pathways and the programs that lead to careers in the 21st century global economy. Another aspect of the issue concerns the need to have a better understanding of the country's future workforce needs in critical areas including the next generation of scientists and engineers for the bioeconomy jobs of the future.

Commission on Pathways through Graduate School and Into Careers

Earlier this year, CGS and ETS launched a new *Commission on Pathways through Graduate School and into Careers* that will offer findings and policy recommendations in a new report to be released in April 2012. The Commission, composed of distinguished corporate and university leaders, is guiding a research effort addressing issues that include graduate student knowledge of career options, how students learn about occupational opportunities, the role of graduate programs and faculty in guiding students along the path to professional occupations, and career pathways that individuals with graduate degrees actually follow. We believe this new initiative and forthcoming report will be of interest to OSTP and other federal agencies when it is released. The press release announcing the Commission is available at the following link:

http://www.cgsnet.org/portals/0/pdf/N_PR_PathwaysCommission_Sept2011.pdf

The Pathways Commission has met twice to date to discuss the importance of developing a better understanding of how students make decisions about careers and the need for stronger and more deliberative linkages between graduate education and employers in industry, government and non-profit sectors. A clear theme emerging from the Commission's ongoing research effort is the need to prepare more graduate students for careers beyond the academy and specifically for careers in industry and government. Research conducted by some disciplinary societies has focused on the need to prepare more graduate students for careers outside of the academy.

For example, a recent study found that two-thirds of chemistry Ph.D.'s work outside of academe. Thus, calls for reorientation and revitalization of doctoral education in the field of chemistry have been made to include graduate preparation in teaching, teamwork, leadership, and management roles in and out of academe. Beneficial practices and strategies to support such preparation may include implementation of improvements to curriculum, advising, interdisciplinary training, internships, career preparation, outreach, and recruitment and retention of more diverse students. A key issue for further exploration is the development of holistic and scalable approaches to the training of graduate students in chemistry, as well as other fields to prepare independent, analytical thinkers with transferable skills. (Journal of Chemical Education 2011, 88.708-715. Reactions to Changing Times: Trends and Tensions in U.S. Chemistry Graduate Education.)

There are also many examples of collaborations between industry and graduate schools to provide training and information to graduate students about careers in certain sectors or corporations.

For example, Microsoft operates the largest Ph.D. internship program in the information technology industry. Each year, nearly 1,000 top computer-science students have the opportunity to work at one of the Microsoft Research's locations around the world. (Ideas. Intellect. Innovation, Microsoft Research, 2010)

These examples, while not specific to biological research training, are relevant in terms of providing future researchers with the types of transferable skills needed to be successful in most professions in the future.

The RFI states – *the majority of doctorate recipients will accept jobs outside of academia. What modifications should be made to professional training programs to better prepare scientists and engineers for private-sector bio economy jobs?*

The biological research and development workforce of the future requires people with the knowledge, skills and flexibility to work at the interface of disciplines. In addition to intensive training in biological research, the professional training required for the future biological workforce will have much in common with the type of training needed for graduate students in a variety of other fields.

The Commission on Pathways through Graduate School and into Careers has identified some preliminary ideas and proposals to prepare graduate students for a variety of 21st century careers as follows.

Graduate Schools are at the forefront of providing graduate education and training in the biological research and development areas. Many universities are engaged in providing graduate students with opportunities to engage in research and internships in the corporate and government sectors but more institutions need to do this. Universities have a responsibility to graduate students to provide them with information about a variety of career pathways beyond those in academia and to note the opportunities for career fulfillment and success in these sectors. Many universities utilize graduate alumni from biological fields to showcase career pathways in different sectors for graduate students and this initiative needs to become a hallmark of graduate education in the biological research area as well as others.

Additionally, many Graduate Schools offer Preparing Future Professional (PFP) programs designed to allow students to explore opportunities in business, government and non-profit organizations and to enhance their preparation for those career options. Rooted initially in the Preparing Future Faculty program, the PFP programs address a range of transferable skills. Active programs can be found at Arizona State University, the University of Texas, Michigan State and Virginia Tech.

Increasingly, universities are creating advisory groups of employers to provide input and perspective on the types of training and skills needed for 21st century jobs in the bio economy. The creation of advisory groups is a cornerstone of Professional Science Master's (PSM) programs. The predominant field of study for existing PSM programs is biology/biotechnology reflecting its importance to the nation's future.

Employer advisory groups should be a hallmark of all graduate education programs in the biological areas, as well as others, at both the master's and the doctoral levels to help inform the curriculum and structure of graduate education and the production of future researchers and leaders prepared for jobs in the bioeconomy.

Faculty serve as mentors and advisors to graduate students, particularly at the doctoral level. Another effective strategy involves providing sabbaticals for faculty to conduct research or work in industry/government/non-profits to provide them with direct knowledge and experience of workforce needs and the types of knowledge, skills and training needed by future professionals. These types of sabbaticals should become more widespread and would be beneficial in the preparation of the future bioeconomy workforce.

What role should the private sector play in training future scientists and engineers for the bio economy?

Industry and non-profit organizations are in the position to signal the knowledge and skills necessary for success in non-academic sectors. Increasingly, employers across these sectors indicate a need for professionals who excel in teamwork, communications, problem identification and solutions and ability to have a broad view. Many professionals from these sectors serve as adjunct faculty for graduate students and this is a practice that could be expanded to enhance communication and collaboration between graduate school faculty and potential employers of people with graduate degrees in bio fields.

Industry in particular is in the position to fund biological basic research to provide a platform for advances and discoveries in health, food, energy and the environment. Federal agencies and biology oriented businesses could consider enhanced investments in university-based basic research that would support the training of graduate students. The IT industry provides an example with the commitment of Intel to invest \$100 million over five years in universities to fund about a half dozen campus centers that will focus on research in computing and communications.

What role might government, industry, and academia play in encouraging successful entrepreneurship by faculty, graduate students and postdocs?

Past discoveries and breakthroughs in the biological areas as well as others have been the result of entrepreneurship and risk-taking. The federal government is in a position to encourage entrepreneurship and risk-taking through support of new initiatives focused on addressing current national challenges in the bioeconomy. The federal government should give funding priority to proposals that fund collaborations between universities, businesses and government/non-profit organizations working on addressing national bioeconomy challenges.

The federal government should consider implementing a COMPETES doctoral traineeship program that would support doctoral education in areas of national need including biological research by providing direct student support through a stipend, tuition and fees, ancillary fringe costs, and other costs of education. Funds would be provided in response to proposals submitted by universities for graduate programs to support doctoral students in key areas. Those submitting proposals would be required to provide data, including enrollments, completion rates, and job placement information to the funding agency as part of the ongoing accountability associated with this funding. They would also demonstrate the institutional capacity to offer professional skill development of the kind offered to students in strong PFP programs. More information about the COMPETES Doctoral Traineeship program is available at http://www.fgereport.org/rsc/pdf/CFGE_report.pdf

Thank you for the opportunity to provide input to OSTP concerning the development of a National Bioeconomy blueprint including the development of the future workforce that would support biological research and innovations. Please contact Patricia McAllister at 202-223-3791 or at pmcallister@cgs.nche.edu for additional information.