

This information is provided in response to OSTP's Request for Information: Building a 21st Century Bioeconomy.

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Expanding the Bioeconomy Workforce for the 21st Century

In building a workforce for a 21st century bioeconomy in the United States, it will be essential to consider not only the science and engineering workforce but also what might be termed the "allied science and engineering professions". Just as the health care industry needs more than doctors to thrive, and hence recognizes the need to train people in allied health professions, so, too, the bioeconomy will require more than just biological scientists and bioengineers. A critical part of developing the 21st century bioeconomy workforce, therefore, will be identifying the additional required elements of this broader workforce and ensuring that the national's educational institutions are prepared to meet these demands. Below are some examples of important workforce demands that are likely to emerge:

- **Policy for the 21st century bioeconomy:** as identified in request for information, policy and regulation form a critical context for the new bioeconomy and will provide either support for or barriers to the development of bio-based industries. The 21st century bioeconomy will require policy professionals at local, state, and federal levels who are prepared with the knowledge and skills necessary to develop and adapt over time robust policies supporting the bioeconomy, ranging from policies to support investment and innovation to policies ensuring the safety and efficacy of new bio-products. Yet, strikingly, very few opportunities exist at universities in the United States for students to receive training even in the general field of science and technology policy let alone in the narrower field of policy for a bioeconomy.
- **Communication for the 21st century bioeconomy:** Every country with an emerging bioeconomy has already encountered widespread public controversy, and as the bioeconomy expands, accompanying public concerns are likely to continue to grow. In the United States, public controversies involving the bioeconomy have occurred from the 1980s onward and have included opposition to the release of genetically engineered organisms, human cloning, and stem cell research, as well as widespread public concerns about drug safety and food safety. The 21st century bioeconomy will require communications professionals who have the knowledge and skills not only to understand and effectively communicate the nuanced complexities of modern bioeconomies to skeptical publics but also to engage those publics in robust dialogues about public values and the bioeconomy and communicate the results effectively to science, engineering, business, and policy leaders. Again, opportunities for this kind of training in US universities are rare that include both preparation in the kinds of communication skills necessary as well as knowledge of the emerging bioeconomy for communication purposes.

- **Innovation for the 21st century bioeconomy:** Innovation and entrepreneurship are increasingly emphasized on university campuses, providing an important foundational element for the 21st century bioeconomy. But efforts will have to be made to ensure that these initiatives reach students in the biosciences, not just business and engineering. Students in business and management fields will need appropriate training for work in the bioeconomy. Students in public policy, law, and administration will also require skills in understanding and developing appropriate policies to support the necessary innovation systems and ecosystems necessary at federal, state, and local levels to ensure that the US bioeconomy remains competitive in global contexts. Finally, it is worth noting that, consistent with recent NIH and NSF initiatives in the responsible conduct of research, scientists and engineers trained for the bioeconomy will need appropriate training in what might be termed “responsible innovation” in an arena in which fundamental human values are at stake.

One vehicle for addressing the demand for professionals with the knowledge and skills necessary to support the US bioeconomy is via professional master’s degrees targeted at relevant fields. Professional science master’s (PSM) degrees have been touted as a solution to the problem of a shortfall of scientists and engineers with professional training, while also expanding exposure of scientists and engineers to business and policy topics. With some modification, PSM degrees can also provide training for future bioeconomy professionals in the fields described above as well as other relevant non-technical fields. Such programs would provide both an expanded understanding of the fundamentals of the bioeconomy, including its science and engineering foundations, while focusing principally on the professional skills and knowledge required to support the bioeconomy in specific fields. Examples of the latter kind of programs include the *Professional Science Master’s in Science & Technology Policy* at Arizona State University and, at Rice University, PSM degrees in *Environmental Analysis and Decision Making* and *Biosciences Research and Health Policy*. NSF, NIH, USDA, and other federal agencies should be encouraged to develop strategies for supporting and enhancing the ability of universities to prepare students for the full range of professions required to support a globally competitive bioeconomy in the US in the 21st century.