

*President's Council of Advisors on Science and Technology
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*Session 1: Advancing U.S. Biomanufacturing
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Biomanufacturing presents a unique opportunity for the U.S. to reinvigorate its domestic manufacturing in a way that is sustainable, flexible, and boosts American economic competitiveness.

While biomanufacturing has been widely utilized by the pharmaceutical industry, improved bioengineering tools - coupled with falling costs - are driving a massive expansion of commercialization of biologically derived products across all industries. Last year, McKinsey reported that an estimated 60% of the physical inputs to the global economy could be made using biological means. Investing in U.S. biomanufacturing to further support this trend offers significant advantages. For example, increased biomanufacturing stands to help mitigate climate change by offering lower-energy, cleaner alternatives to production via chemical synthesis, petroleum refining, or conventional farming. The same McKinsey analysis determined that using biology to make products stands to reduce annual, human-made, greenhouse gas emissions by 7-9% relative to 2018 levels by 2040 to 2050. Further, biomanufacturing can provide significant flexibility, since a single plant (if designed to be multi-purpose) can produce many classes of products and even shift among them if required, potentially easing supply chain tensions. Such multi-purpose facilities will become more valuable as the number of commercially relevant biological processes increases.

Infrastructural challenges remain with biomanufacturing, but U.S. government action can ensure that this industry reaches its full potential.

American biomanufacturing capabilities are not always employed by U.S. industry; for instance, of eight commercial products using Ginkgo organisms and/or processes, six are manufactured outside the U.S. This is in part due to limited domestic, flexible capacity for non-pharmaceutical applications of synthetic biology. There is also a lack of adequate downstream processing (DSP) equipment co-located at fermentation facilities. Each bio-manufactured product category requires different DSP equipment. At present, the U.S. has a significant lead in synthetic biology research and development, and a large number of new biological processes are being developed.. Additional support for downstream commercialization activities promises to increase U.S. economic competitiveness, including through reshoring of American manufacturing. Public-private partnerships to protect and grow capacity and equip more fermentation facilities with more DSP options such that the facilities are suitable for use as multi-organism and multi-product facilities would be immediately impactful.

Even though the coasts are presently benefiting from the bio-revolution, the Midwest and the South are well-positioned to host U.S. bio-manufacturing - and the jobs that come with it.

The most strategic location to build out bio-manufacturing in the U.S. is in the Midwest and the South. Specifically, synthetic biology products use corn and other crops as feedstocks, so co-locating fermentation and DSP facilities in America's strongest agricultural regions makes strong technical and logistical sense. Indeed, there is already substantial fermentation capacity in the Midwest in particular; however, these sites tend to be purpose built for a single very large volume commodity product (often corn-derived ethanol) and thus aren't designed to support production of multiple, smaller volume products at a single facility. Such single product facilities can be under-utilized if product demand plateaus or drops or the facility can no longer produce product at competitive prices. Strategic U.S. government engagement to retrofit and upgrade these sites (or invest in new ones) for multiple bio-manufactured products could improve utilization so they can remain open and competitive, while increasing domestic manufacturing capacity.

There are serious workforce shortages in biomanufacturing roles across the U.S., and this shortage is likely to get worse without U.S. government intervention.

The domestic bio-manufacturing workforce is far too small compared to the demand and projected growth of the industry, and many communities are not yet included in this workforce. For example, the trade association MassBio recently estimated that there will be 40,000 net new biomanufacturing jobs demanded in Massachusetts alone by 2024; Massachusetts is expected to have significant issues filling this gap, and we expect that similar gaps will occur at every emerging biotechnology hub across the country. Growing and diversifying the workforce needs to be prioritized. The days where you need a Ph.D. to be an effective worker in the bioeconomy are long gone. Many biomanufacturing roles can be filled by individuals with associates degrees or even certificates, which are far more accessible training requirements. Federal support for community college programs and high school curricula that provide training for laboratory and fermentation operations roles would go a long way, especially those targeted to regions and communities that are underrepresented in the growing bioeconomy.

Global competition to lead the bio-revolution is increasing

The synthetic biology industry began in the U.S., and American academic institutions continue to provide world-class biological training, feeding a strong synthetic biology startup environment. However, inadequate access to biomanufacturing capacity remains a barrier. Meanwhile, over the past decade, many of America's economic competitors including both China and the European Union have made massive investments in their synthetic biology and bio-manufacturing industries, and are pursuing strong national roadmaps to strengthen these areas. Without similar efforts, the U.S. risks losing its position as the global leader of the biological revolution.