



# U.S. Leadership in Biomanufacturing Is Asymmetric and Eroding: An Analysis

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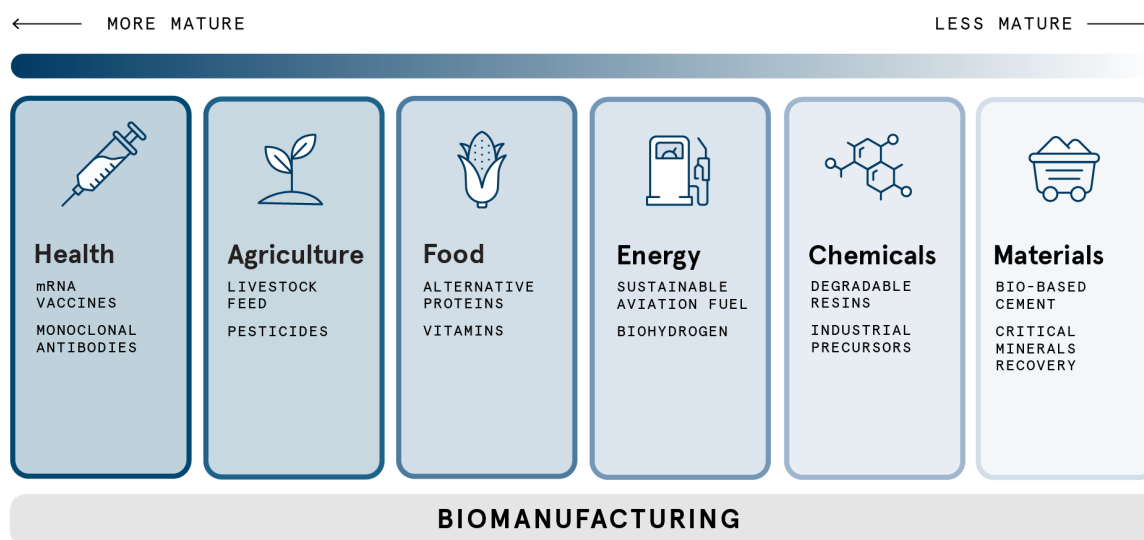
**Biomanufacturing—the use of a living system or its parts to produce goods—is an emerging priority for national security and economic leadership. The United States and its partners lead China across most biomanufacturing technologies, but this advantage is jagged and diminishing.**

Estimates suggest that production of 60 percent of the global economy’s physical inputs could be impacted by biomanufacturing, affecting trillions of dollars’ worth of economic activity. Though traditionally centered on pharmaceutical production, technological progress is rapidly expanding applications for biomanufacturing. It now supports a wide range of economically lucrative and strategically important products, such as fuels, fertilizers, and livestock feed (see figure 1).

The perception that nations can seize this important manufacturing frontier is driving a dramatic increase in policy focus both in the United States (including from the White House and Pentagon) and China. The countries that maintain a strong domestic biomanufacturing capacity will be the ones to capture these expanding economic benefits. However, because biomanufacturing is not limited to a single economic sector—it is not its own “vertical”—policies centered on specific products or sectors risk missing the wider picture.

Policy efforts to improve the U.S. standing must instead focus on the underlying processes and technologies that unify biomanufacturing applications. Yet, a detailed assessment of the current landscape of biomanufacturing technologies was lacking. By dividing a biomanufacturing process into three foundational phases (research and

**Figure 1. Biomanufacturing Underlies Many Applications**

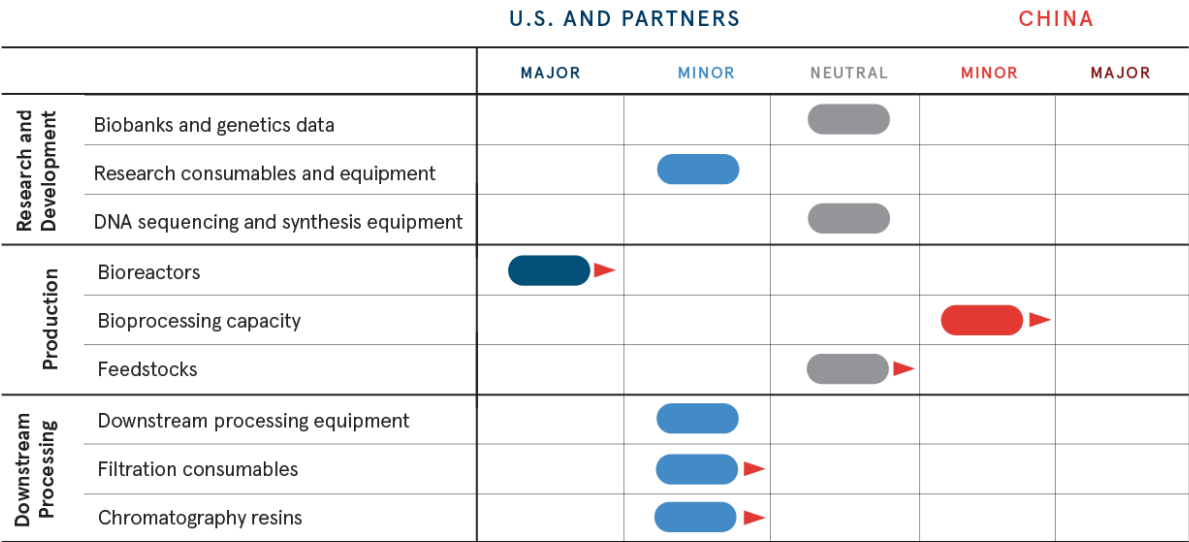


development, production, and downstream processing) and assessing the competitive landscape of underlying technologies, our research revealed an overall lead for the United States and its partners, albeit one that is asymmetric and eroding (see figure 2).

Overall, our research showed that:

- The United States and its partners lead across the biomanufacturing technology stack, but their relative edge over China is shrinking.** Western countries benefit from their legacy domination of the pharmaceutical industry and academic biotechnology research. However, China is expanding rapidly and deploying state support to eliminate domestic vulnerabilities, narrowing the gap throughout the stack.
- The United States and its partners dominate lucrative sectors while China specializes in industrial applications.** Western producers tend to deploy biomanufacturing for products with high profit margins. Chinese companies are more focused on strategic capacity, especially where supply chain resilience can be developed.
- China is better positioned to capture future applications of biomanufacturing.** As the bioeconomy develops, biomanufacturing will expand to primarily serve markets beyond lucrative healthcare products. Chinese firms hold a strategic advantage with sustained investment in industrial infrastructure, technology, and supply chains.
- The United States’ position depends on integration with partner nations.** Although the United States is a strong competitor, American firms rely on counterparts in partner nations—especially Germany, Japan, and South Korea—at every layer of the stack.
- Better commercial and supply chain data is necessary for informed policymaking.** This analysis and similar efforts largely rely on market data, an imperfect metric when Chinese firms often pursue production scale or supply chain control over profit. Information on nonpharmaceutical biomanufacturing is especially limited and fragmented.

Figure 2. Relative Competitiveness Across Biomanufacturing Technologies



▶ Lead Trending Toward China