

## CONCEPT PAPER

### **Building the World's Pre-Eminent Bioeconomy: A National Innovation and Competitiveness Leadership Agenda**

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## Key Question

The \$4 trillion global bioeconomy is projected to grow to \$30 trillion by 2050. What must the U.S. public and private sectors do today to capture the benefits of innovation, expanded industry, and job creation from this generational growth opportunity?

## Setting the Stage

The bioeconomy, currently valued at \$4 trillion annually and poised to revolutionize the global economy,<sup>1</sup> is a vital sector for the United States' economic competitiveness and national security. In the United States, the bioeconomy contributes \$210 billion to the U.S. GDP, supports 644,000 domestic jobs, and generates \$49 billion in wages.<sup>2</sup>

A significant convergence of technologies — from AI, to advanced materials, to gene editing, to bioprocessing, to digital integration, to bioprinting — is unlocking remarkable new opportunities for the United States across nearly every sector of the economy. A surge in productivity in the bioeconomy could position the sector for exceptional growth, with some projecting a global bioeconomy of \$30 trillion by 2050.<sup>3</sup> With such high stakes, global competitors are emerging to capture their share in this opportunity.

To maintain its status as a global leader, the United States must act decisively and quickly to optimize every facet of the bioeconomy — from research and development, to production and commercialization. This complex, integrated, globe-spanning bioeconomy — dependent on innovation-driven growth — must also creatively leverage partnerships and collaboration to tackle global grand challenges and to seize global opportunities.

The stakes are high for the world — and there are pressing U.S. competitiveness questions, which must be addressed:

1. How can the nation capture the innovation and value creation — with new industries, firms, and jobs — the future bioeconomy promises?
2. What are the best regulatory and standards frameworks to support smart, safe, and rapid growth?
3. What infrastructure (physical and policy) is needed to power growth in the bioeconomy?
4. How does the bioeconomy attract investment for projects that demand a different scale and timeframe of return compared to other highly innovative sectors?
5. Does the nation have the talent necessary to support the growth of the bioeconomy — if so, how do we strengthen; and if not, how do we develop?
6. And in a world of emerging and converging technology revolutions, how does the growing bioeconomy connect to and benefit from the explosion in transformative computing, advanced materials, etc.?

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<sup>1</sup> [\*A Status of the Global Bioeconomy\*](#). World Bioeconomy Forum, 2023.

<sup>2</sup> [\*The Economic Impact of the U.S. Industrial Bioeconomy\*](#). Teconomy Partners, LLC, June 2024.

<sup>3</sup> [\*The Global Bioeconomy\*](#). Nature Finance, April 2024

Answers to these strategic questions — and more — are needed to ensure the United States stakes and maintains a global leadership role in the bioeconomy, bolstering its competitive edge, and economic and national security.

## **The Bioeconomy: A Driver of U.S. Competitiveness**

In 2017, the Council on Competitiveness released [LAUNCH — Advancing U.S. Bioscience: Challenges and Opportunities in Sustainable Energy, Environmental Remediation, 21<sup>st</sup> Century Agriculture, Human Health & Biomanufacturing](#), providing a summary and analysis of the tremendous potential bioscience has to transform a broad swath of existing industries and to create new ones.

However, the study's finding was clear: To advance biomanufacturing and biotechnology to address grand scientific challenges for energy, the environment, human health, and agriculture requires a strategic, aggressive, focused, and coordinated effort to reduce silos among federal agencies, industry, academia, and the national laboratories.

In 2020, the Council's first report from its flagship National Commission on Innovation and Competitiveness Frontiers, [Competing in the Next Economy — The New Age of Innovation](#), painted a picture of America at a crossroads, in dire need of a tenfold (10X) increase in its innovation capacity and capabilities. The report called for a new strategy to re-invent America by amplifying our ability to *imagine*, gain *insight*, express *ingenuity*, create cutting-edge *inventions*, and develop and deploy *impact* at home and around the world.

The *Competing in the Next Economy* report served as a clarion call for a renewed approach that enables the United States to set the global pace in the emerging technologies that will shape the future. These technologies have the potential to profoundly transform the U.S. industrial base, economy, security, global competitiveness, and society — like the suite of technologies supporting the country's bioeconomy.

The societal benefit of expanding the U.S. bioeconomy is profound. By harnessing the power of biology to replace traditional chemicals and chemical processes, the U.S. bioeconomy presents an unparalleled opportunity for sustainable economic growth, increased national security, revitalization and reshoring of U.S. manufacturing, building domestic supply chain resilience, and improved human health and longevity. Consider the following points:

- A March 2025 report by the Biotechnology Innovation Organization (BIO) and Kearney estimates the current (2025) value of the food, agriculture, and manufacturing biotech sector in the U.S. at \$237 billion, with potential to reach

more than \$400 billion by 2030 — nearly doubling its current direct economic impact.<sup>4</sup>

- The same report noted that with indirect benefits included, the total U.S. bioeconomy impact already exceeds \$830 billion.
- Studies also indicate that up to 60 percent of the physical inputs to the global economy could be produced biologically — one-third from biological materials and two-thirds through biological processes (e.g., bioplastics).<sup>5</sup>
- An estimated that 45 percent of the global disease burden can be addressed using technologies now achievable through advanced biotechnology.<sup>5</sup>

Expanding the U.S. bioeconomy would also transform and grow the labor market and strengthen communities across the country, particularly in the American Heartland and the Rust Belt. The widespread transition to the bioeconomy will revitalize a range of industries — growing, renewing, and re-shoring the U.S. production of biopharmaceuticals, fuels, chemicals and polymer monomers, materials, food and fiber, personal care, and the national security industrial base.

The potential benefits of bio-innovation to human health and longevity are extraordinary. Personalized medicine, driven by genomics and biotechnology, is already enabling tailored treatments and therapies that enhance efficacy and minimize side effects for patients. Regenerative medicine and tissue engineering can now facilitate the repair of damaged tissues. The development of biopharmaceuticals, including biologics and vaccines, enhances disease prevention and treatment. Exploration of nutraceuticals, microbiome research, and agricultural biotechnology is yielding promising innovations that will improve nutrition. Innovations in disease monitoring via biosensors and wearables enable real-time health management and improve access to care, while synthetic biology is paving the way for novel therapies and diagnostics.<sup>6</sup>

Policymakers are increasingly recognizing the potential impact of advancing the U.S. bioeconomy. Over the past two decades, leaders across the political spectrum have supported efforts to improve coordination and to strategically plan and invest in bioeconomy opportunities across federal agencies, industry, national laboratories, and academia. For example:

- [The 2012 National Bioeconomy Blueprint](#), which outlined a strategy to leverage biological research innovations to address national challenges in areas like health, food, energy, and the environment.
- [The 2013 Brain Research through Advancing Innovative Neurotechnologies \(BRAIN\) initiative](#), a partnership between Federal and non-Federal partners with

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<sup>4</sup> [Projected Impact and Growth of a Fully Unleashed Bioeconomy the Value of Food, Agriculture, and Manufacturing Biotechnology](#). Bio, Kearney, March 2025

<sup>5</sup> [The Bio Revolution: Innovations Transforming Economies, Societies, and Our Lives](#). McKinsey Global Institute, May 2020.

<sup>6</sup> [Structural Drivers of the Future. Technology Trends: The Future of Biotech](#). Office of the Director of National Intelligence, April 2021

a common goal of accelerating the development of innovative neurotechnologies in collaboration with HH, NSF, and DARPA.

- [The 2015 Precision Medicine Initiative](#), which presented a new model of patient-powered research focused on accelerating biomedical discoveries.
- [The 2016 National Microbiome Initiative](#) focused on advancing the study of microbiomes across diverse ecosystems.
- [President Trump's 2019 Executive Order](#) to accelerate biotechnology research and development.
- [The 2021 National Security Commission on Emerging Biotechnology](#), which focused on the intersection of biotechnology and national security.
- [President Biden's 2022 Executive Order](#) that called for funding advanced biotechnology and biomanufacturing across several federal agencies (rescinded in March 2025).
- [In 2023, the U.S. Department of Defense increased the BioMADE \(Bioindustrial Manufacturing and Design Ecosystem\) budget by \\$450 million](#) to unite more than 175 organizations to rapidly develop and deploy biomanufacturing innovations at scale.
- [The 2024 formation of the National Bioeconomy Board](#), which works to align public-private interests to enhance societal and economic well-being via the bioeconomy.
- The April 2025 Final Report of the bipartisan National Security Commission on Emerging Biotechnology (NSCEB), "[Charting the Future of Biotechnology](#)," delivered to Congress 49 recommendations and proposed \$15 billion in federal investment to sustain biotechnology innovation and biomanufacturing growth, framing biotechnology as a decisive domain for U.S. economic and national security.
- [The December 2025 enactment of the BIOSECURE Act \(as part of the FY2026 National Defense Authorization Act\)](#) restricts U.S. federal agencies from procuring biotechnology equipment or services from companies owned or controlled by foreign adversary governments, directly addressing supply chain vulnerabilities and the U.S.-China biotechnology competition.
- [The Biobased Materials Investment and Production Act](#) — Introduced in March 2026 by Reps. Fischbach (R-MN) and Budzinski (D-IL) — would use CHIPS and IRA-like incentives to create new markets for U.S. farmers and revitalize U.S. manufacturing.

## **Structural Advantages of the United States in the Global Bioeconomy**

The United States holds a set of structural advantages that global competitors cannot easily replicate. These advantages span agricultural production, logistics infrastructure, capital markets, and research and talent systems. However, these strengths have not yet been fully translated into leadership in the emerging global bioeconomy.

The United States is the world's largest producer of corn, generating approximately 370–390 million metric tons annually, or roughly one-third of global output, depending

on seasonal variation and yield conditions.<sup>7</sup> China and Brazil follow as the next largest producers. In soybeans, a critical feedstock for bio-based products, the United States remains the world's second-largest producer after Brazil. U.S. farmers planted approximately 84 million acres in recent years, exporting more than half of total soybean production.<sup>8</sup>

The United States' integrated logistics system provides a critical advantage in moving biomass and agricultural inputs efficiently across long distances. Specifically, the U.S. freight rail system spans roughly 140,000 route miles, making it the largest freight rail network in the world. The rail system plays a central role in transporting agricultural commodities, including grain and related farm products, which account for millions of carloads annually.<sup>9</sup>

The United States also maintains the world's most liquid and extensive capital markets. U.S. equity markets represent approximately 40–45 percent of global market capitalization within a global total of roughly \$115 trillion.<sup>10</sup> In certain recent periods, U.S. equities have exceeded 50 percent of global market capitalization due to technology sector concentration and capital inflows. Within the life sciences sector, global biotechnology venture investment reached approximately \$60–70 billion in 2023, with the United States capturing a significant share of this activity.<sup>11</sup>

Research is another area of U.S. leadership. For example, the country operates 112 land-grant universities, including institutions in every state and territory. These institutions are mandated to conduct applied research and support technology transfer into agriculture, industry, and communities.<sup>12</sup> In 2023, U.S. universities awarded approximately 1,278 doctoral degrees in agricultural sciences and natural resources and approximately 9,724 in biological and biomedical sciences — together exceeding 11,000 PhDs annually in fields directly relevant to the bioeconomy.<sup>13</sup> (By contrast, China now produces the largest number of science and engineering doctorates globally, with estimates exceeding 50,000 STEM PhDs annually.<sup>14</sup>)

Despite clear advantages in agricultural production, logistics infrastructure, capital markets, and research capacity, the United States has not yet fully translated these strengths into leadership in the emerging bioeconomy. The gap is not one of available inputs, but of coordination, commercialization infrastructure, and national strategy.

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<sup>7</sup> [World agricultural production report](#). U.S. Department of Agriculture, Foreign Agricultural Service, October 2024

<sup>8</sup> *Soybeans and oil crops: Background and statistics*. U.S. Department of Agriculture, Economic Research Service, 2024

<sup>9</sup> *Railroads & states fact sheet*. Association of American Railroads. 2024

<sup>10</sup> [Capital markets fact book](#). Securities Industry and Financial Markets Association (SIFMA), 2024

<sup>11</sup> *Biotechnology venture capital report*. PitchBook, 2024

<sup>12</sup> *Land-grant university system overview*. U.S. Department of Agriculture, National Institute of Food and Agriculture, 2023

<sup>13</sup> *Survey of Earned Doctorates*. National Science Foundation, 2024

<sup>14</sup> *Science, technology and innovation outlook*. OECD, 2023

## Global Bioeconomy Competitors

The United States is not alone in recognizing the power and potential of optimizing its economy around a bio-driven future. In fact, more than 50 nations have put bioeconomy plans into action.<sup>15</sup>



Competing regions — particularly China — have adopted coordinated national strategies linking policy, industrial policy, and state-backed investment to accelerate bio-manufacturing and bio-agriculture.

**China.** China's 15th Five-Year Plan (2026–2030) elevates the bioeconomy as a core pillar of national industrial strategy, technological self-reliance, and long-term economic security. The plan reflects a shift from investment-led growth to innovation-driven “new quality productive forces,” positioning biotechnology alongside AI, advanced manufacturing, semiconductors, and quantum technologies as a frontier domain for strategic competition.<sup>16</sup>

Within this framework, the bioeconomy is treated as an integrated platform spanning health, agriculture, energy, and industrial systems. Policy priorities emphasize breakthroughs in synthetic biology, biomedicine, biomanufacturing, and industrial biotechnology, alongside scaled domestic capacity in biopharmaceuticals, bio-based materials, and bioenergy. These efforts are tightly linked to national goals for supply

<sup>15</sup> [Bioeconomy National Strategies in the G20 OECD Countries: Sharing Experience and Comparing Existing Policies](#). EFB Bioeconomy Journal, Volume 3, November 2023

<sup>16</sup> [China's 15th Five-Year Plan Recommendations – Key Takeaways for Foreign Businesses](#). China Briefing, October 2025

chain security, technological self-sufficiency, and reduced reliance on foreign inputs in critical life sciences and advanced manufacturing systems.

China's plan further reinforces biotechnology as a national security and economic resilience priority, supported by sustained R&D investment, coordinated public-private financing, and industrial clustering that integrates universities, state-owned enterprises, and leading private firms. An outward-facing dimension also emphasizes leadership in green technology and global industrial supply chains, particularly in bio-based materials and clean production systems.

China now accounts for an estimated ~30 percent of global gene sequencing capacity and has become the second-largest global market for biopharmaceutical clinical trials, reflecting its rapid expansion in life sciences innovation and scale-up capacity.<sup>17</sup> At the same time, a large share of global biopharmaceutical manufacturing inputs — estimated in some supply chains at 70–80 percent depending on category — are now linked to Chinese production networks.<sup>18</sup>

China's plan positions biotechnology not as a standalone sector, but as a foundational element of China's long-term development model, integrating industrial upgrading, energy transition, demographic adaptation, and geopolitical competition in frontier technologies.<sup>19</sup>

**European Union.** While the EU's overall economic productivity has lagged the United States, the bioeconomy represents one of Europe's most consistent competitive strengths. In 2023, the EU's biomass-producing and converting sectors generated approximately \$935 billion in value added (about 5 percent of EU GDP) and employed 17.1 million people (around 7.9 percent of total EU employment). Bio-based pharmaceuticals accounted for roughly \$111 billion in value added, and total bioeconomy-relevant R&D expenditure — including scientific and knowledge-based activities — reached approximately \$25 billion, representing about 9 percent of total EU business R&D.<sup>20</sup> European pharmaceutical companies invested approximately \$50 billion in R&D in 2023, nearly double 2010 levels.<sup>21</sup> The EU also hosts world-class biotech clusters in Germany (approximately 20–25 percent of European biotech activity, depending on segment), Denmark, the Netherlands, and Belgium, anchored by leading research universities and supported by a \$2.2 billion EU public-private investment platform — the Circular Bio-based Europe Joint Undertaking — designed to scale innovation, commercialization, and industrial deployment across the bioeconomy.<sup>22</sup>

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<sup>17</sup> *The bio-revolution: Innovation in genomics and data-driven biology*. McKinsey Global Institute, 2023

<sup>18</sup> *Pharmaceutical supply chains and dependence on foreign manufacturing*. Congressional Research Service (CRS), 2023

<sup>19</sup> [\*How China's 15th Five-Year Plan Signals a New Phase of Strategic Adaptation\*](#). World Economic Forum, October 2025

<sup>20</sup> *Bioeconomy Monitoring System Report*. European Commission, Joint Research Centre (JRC). 2024

<sup>21</sup> *Health R&D Expenditure and Innovation Trends*. OECD, 2023

<sup>22</sup> *Circular Bio-based Europe Joint Undertaking (CBE JU) Factsheet*. European Commission, 2024

The EU is now working diligently to build on this foundation. The European Commission and European Investment Bank announced a joint initiative in December 2025 to mobilize \$10.8 billion in biotech and life sciences investment in 2026–2027, and the November 2025 Bioeconomy Strategy — the third since 2012 — sets the overarching policy framework. A second Biotech Act covering industrial biotechnologies and biomanufacturing is planned for 2026. These moves reflect a recognition within Brussels that despite Europe’s bioeconomy strengths, international competition — notably from the United States and China — risks diverting innovation and investment away from EU markets.<sup>23</sup>

**India.** India is a rapidly rising competitor in this space. In August 2024, India’s Union Cabinet approved the BioE3 Policy (Biotechnology for Economy, Environment and Employment) — the country’s first integrated national biotechnology policy — marking a shift toward a coordinated national strategy spanning biomanufacturing, precision biotherapeutics, climate-resilient agriculture, and bio-based chemicals.<sup>24</sup> India’s bioeconomy has grown from approximately \$10 billion in 2014 to \$165.7 billion in 2024, contributing about 4.25 percent of GDP at a compound annual growth rate of approximately 17.9 percent. Backed by a proposed \$12 billion Research, Development, and Innovation Fund, India is targeting \$300 billion in bioeconomy output by 2030, with its established strengths in generic pharmaceuticals and vaccine manufacturing providing a credible commercial foundation.<sup>25</sup>

**Brazil.** Brazil has built one of the world’s most operationally mature bioeconomies, rooted in five decades of consistent biofuel policy. Brazil is the second-largest ethanol producer globally, with the United States and Brazil together accounting for roughly 80 percent of global production.<sup>26</sup> In 2024, Brazil set a production record of approximately 36.83 billion liters of ethanol.<sup>27</sup> Biofuels supply approximately 25 percent of Brazil’s transportation fuel mix, a share that continues to expand under the 2024 Fuel of the Future Law.<sup>28</sup> Brazil’s deeper strategic asset is its biodiversity: the Amazon and Cerrado biomes provide feedstock and genetic resources at a scale unmatched globally. In April 2026, the government launched the National Bioeconomy Development Plan (PNDBio) — developed across 16 ministries with 185 defined actions — targeting approximately \$284 billion in additional GDP value and supported by an initial R\$1.6 billion commitment from the Brazilian Development Bank (BNDES).<sup>29</sup>

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<sup>23</sup> *Proposal for “European Biotech Act”*. European Commission, 2025

<sup>24</sup> *Cabinet Approves BioE3 Policy for Biotechnology-led Economic Transformation*. Government of India, Cabinet Secretariat, 2024

<sup>25</sup> *National biotechnology development strategy and investment roadmap*. Government of India, Department of Biotechnology, 2024

<sup>26</sup> *International Biofuels Annual Report*. U.S. Energy Information Administration (EIA), 2024

<sup>27</sup> *Ethanol Production and Export Statistics*. UNICA (Brazilian Sugarcane Industry Association), 2024

<sup>28</sup> *Brazil Energy Policy Review*. International Energy Agency (IEA), 2024

<sup>29</sup> *Bioeconomy Policy Frameworks in Latin America*. OECD, 2024

## Writing the Next Chapter of the U.S. Bioeconomy

The bioeconomy is poised to enter a new era characterized by rapid expansion and economic and manufacturing transformation. Today, the convergence of affordable gene sequencing with advanced computing, automation, and artificial intelligence has fueled innovations in synthetic biology, genomics, and biomanufacturing. Due to this convergence of technologies, for the first time, the United States can rely on secure, domestically produced bio-based production methods that use feedstocks such as corn, sugar, and soybeans to replace traditional industries and manufacturing processes. This transition will drive significant economic growth, foster the creation of new businesses, and enhance security and prosperity for all Americans.

Achieving this vision requires deliberate strategy, serious investment, and aligned public-private action. This project will look at what policy, regulatory, talent, technology, capital, and infrastructure barriers must be removed now to secure enduring U.S. leadership in manufacturing, health, energy, food security, and national security.

## Council on Competitiveness Bioeconomy Initiative Project Structure

The Council on Competitiveness — a non-partisan, non-profit CEO-level leadership organization dedicated to strengthening U.S. competitiveness and innovation — recognizes the transformative potential of the bioeconomy to drive sustainable economic growth, reinvigorate domestic manufacturing, add resilience to supply chains, improve sustainability, and enhance public health. The Council's membership comprises key leaders from industry, academia, and labor; and the Council benefits from the support of many of the U.S. Department of Energy National Laboratories. This diverse representation of national leaders allows the Council to mobilize the expertise effectively to identify challenges and opportunities for expanding and strengthening the U.S. bioeconomy.

This proposal outlines an initiative led by the Council on Competitiveness to shape the future of the U.S. bioeconomy and establish the United States as a global pacesetter in next-generation materials, fuels, and manufacturing. Achieving this vision necessitates a comprehensive national strategy that leverages the country's strengths in agriculture, transportation, talent, investment, and innovation to rapidly accelerate the bioeconomy's growth.

## Initiative Objectives

1. **Cross-sectoral Leadership Formation.** Secure industry, university, U.S. Department of Energy national laboratory, and labor leaders to guide the project and develop a unified vision for the U.S. bioeconomy.
2. **Strategic and Actionable Recommendations.** Develop actionable recommendations through focused virtual working sessions that identify critical

challenges and design solutions to strengthen U.S. competitiveness across the bioeconomy value chain — ultimately informing a strategic national roadmap.

3. **Leadership Education and Communication.** Elevate the recommendations to policymakers, industry leaders, and influencers to educate them on core opportunities, as well as inspire public policy that accelerates U.S. competitiveness in the sector.

## **Conclusion**

Expanding the U.S. bioeconomy is a decisive opportunity to strengthen and control critical supply chains, revitalize domestic manufacturing, grow new industries, and expand access to high-value jobs. The Council on Competitiveness' initiative to advance the U.S. bioeconomy will align stakeholders across sectors to coordinate strategy, investment, policy, and action, strengthening U.S. leadership in the global bioeconomy and translating that leadership into broad-based productivity gains and long-term prosperity for Americans.