Council on Competitiveness Bioeconomy Initiative

Working Session 1 Prep Brief
Build Fast, Scale Big: Investment, Commercialization, and Biomanufacturing Leadership

Virtual Working Session | Thursday, September 17, 2026 | 2:00–3:00 p.m. ET

Project Background

The Council has been building a body of work around the U.S. bioeconomy and its implications for competitiveness, innovation, and national economic security. This effort builds on discussions at the 2025 National Competitiveness Forum, the leadership gathering hosted by Jim Stutelberg at Primient in Lafayette, the Council's April 2026 bioeconomy working session, and the Nebraska Competitiveness Conversation hosted by University of Nebraska System President Jeff Gold.

Building on these discussions and the growing national focus on biotechnology and biomanufacturing, the Council is convening six virtual working sessions starting on Thursday, September 17 and concluding on Thursday, October 22, each scheduled for one hour from 2-3 PM Eastern. The virtual working sessions will identify a focused set of high-impact, strategic recommendations to strengthen U.S. competitiveness and leadership in the global bioeconomy.

THE SIX-SESSION PROCESS

The six one-hour sessions will examine three complementary dimensions of the U.S. bioeconomy, with two sessions devoted to each:

1. **Build Fast, Scale Big.** *Investment, Commercialization, and Biomanufacturing Leadership*
2. **Win the Market.** *Demand and Global Competitive Advantage*
3. **Build National Capacity.** *Talent, Infrastructure, and Ecosystem Leadership*

The first session in each focus area will surface emerging trends, critical challenges and chokepoints, opportunities for U.S. leadership, and potential solutions. Following each session, the Council team will circulate a summary of the discussion, highlighting emerging recommendations and areas for further exploration, and invite participants to provide feedback. The second session will build on this input by challenging and refining the recommendations,

assessing feasibility and impact, identifying gaps and unintended consequences, and prioritizing the ideas with the potential for transformational impact.
Council staff will synthesize the work across all six sessions into a concise strategic recommendations report for release at the [2026 National Competitiveness Forum.] For additional background on the initiative, see the [Bioeconomy Initiative Project Plan].

SESSION 1 | BUILD FAST, SCALE BIG. INVESTMENT, COMMERCIALIZATION, AND BIOMANUFACTURING LEADERSHIP

The United States has extraordinary strengths in biological research, innovation, agriculture, capital, and entrepreneurship. Yet a critical gap remains between discovering new biological technologies and producing them competitively at commercial scale. This first working session will focus on understanding and proposing concepts for filling that gap: That is, *what would it take to make the journey from biological discovery to commercial production dramatically faster, cheaper, and more predictable in the United States?*

TOPIC AREAS

1. Accelerating the path from discovery to pilot, demonstration, and commercial scale by optimizing the bioeconomy ecosystem, including:
    - Closing financing gaps across the commercialization lifecycle
    - De-risking private investment
    - Optimizing agricultural production, strengthening domestic supply chains, and reducing strategic dependencies
    - Using AI, advanced computing, automation, and bio-digital technologies to increase productivity
    - Developing shared infrastructure and scale-up capabilities
    - Expanding U.S. biomanufacturing capacity
2. Making the economis work: Identify methods to capture the full value of biobased products and cover the cost gap during scale-up

THOUGHT STARTER QUESTIONS

1. Where are the key bottlenecks in the journey from discovery to commercial production, and what would it take to remove it?
    a. Where could targeted interventions have the greatest impact?

2. What creative mechanisms could be used to capture the full value of biobased production systems and products? How could the value be equitably distributed along the entire value chain?

3. What would a fundamentally better financing and commercialization system look like?

   a. How can the United States bridge the financing gaps across the commercialization life cycle, from R&D and pilot projects through demonstration and first commercial plants?
   b. What role should public-private partnerships play in reducing risk, attracting private capital, and enabling projects that otherwise struggle to reach scale?

4. How can we better connect U.S. agricultural production, energy, infrastructure, manufacturing, and end markets to build more resilient and globally competitive bio-based supply chains?
   a. Where can we reduce strategic supply chain dependencies on other countries or create new areas of U.S. leadership?

5. How can AI, advanced computing, automation, digital twins, and other bio-digital technologies make biological production faster, more predictable, and more productive, from process development and engineering through commercial operations?
   a. What would it take to move these technologies from promising applications to widespread industrial adoption?

6. What infrastructure and capacity does the United States need to build, and what financing, ownership, and operating models would make that capacity broadly accessible and economically sustainable?
   a. What biomanufacturing infrastructure should the United States build collectively rather than company by company?
   b. Where are shared pilot, demonstration, testing, engineering, and manufacturing capabilities most needed to help companies cross the scale-up gap?

SESSION 1 AGENDA

- 5 minutes — Opening and framing. Purpose, context, and desired outcome.
- 10 minutes — Expert framing. Two or three kickoff discussants briefly identify the most important issues from their perspective.
- 40 minutes — Working discussion. Open discussion, debate, challenge, and recommendation development.
- 5 minutes — Synthesis and next steps. Identify areas of emerging consensus, unresolved questions, and issues for the second session.

COMMENT PERIOD

Following the session, the Council team will circulate a shared document summarizing the discussion and highlighting key recommendations and areas for further exploration. All project participants will be invited to provide feedback, which the Council team will consolidate and use to inform the ongoing work and recommendations.

BACKGROUND READING

Advances in precision fermentation, engineered organisms, bio-based chemicals and materials, fuels, foods, pharmaceuticals, and other applications are opening the possibility of producing an expanding range of products in fundamentally new ways. Artificial intelligence and advanced computing are accelerating this progress, making it faster and increasingly predictable to design biological systems and optimize the processes that produce them. For the United States, this presents an extraordinary opportunity, and also a new test of industrial competitiveness.

For decades, the United States has built an extraordinary ecosystem for biological discovery: world-class universities and national laboratories, entrepreneurial talent, deep capital markets, leading biotechnology companies, advanced computing, and the world's strongest research institutions. Now we as a nation must build on the that strength in discovery with competitive capacity to pilot, demonstrate, manufacture, and scale the technologies that emerge from it.

However, moving a biological process from the laboratory to commercial production is complex, requiring successive investments in engineering, pilot and demonstration infrastructure, specialized equipment, process development, talent, feedstocks, supply chains, regulatory approvals, customers, and capital. The timeline from a idea to product can be over 20 years, as there are technical, economic challenges, and regulatory challenges to overcome at every stage. A process that works in a laboratory must be redesigned for a fermenter. A process that works at pilot scale must prove itself economically at commercial scale. And a company with a viable technology and customers can still struggle to finance and build its first commercial facility.

The result is a critical gap between discovering a technology and industrializing it. Recent examples, including Geno, Anellotech, Liberation Bioindustries, Amyris, and Ginkgo Bioworks are examples of how difficult it remains to finance, demonstrate, manufacture, and scale new biological technologies in the United States.

The struggles these and many other companies face in scaling the bioeconomy are precisely why this project, and others like it, are so critical. The stakes for U.S. competitiveness are simply too high to leave the transition from biological innovation to commercial scale to chance without optimizing the ecosystem that will allow it to thrive. As biotechnology moves beyond the laboratory and into an increasingly broad range of industries (e.g., chemicals, materials, fuels, and food to energy, manufacturing, and defense), the ability to develop and produce these technologies domestically will increasingly shape the resilience of U.S. supply chains, the competitiveness of American companies, the strength of the manufacturing base, and the nation’s economic and national security.

The National Security Commission on Emerging Biotechnology reached a similar conclusion in its 2025 report, making the mobilization of private-sector investment to bring biotechnology products to scale one of its six central pillars and calling for a national network of manufacturing facilities to support precommercial bioindustrial scale-up.

Fortunately, the United States is well-positioned to take advantage of this opportunity and industrialize the bioeconomy. Across the country, we have world-class universities and national laboratories; globally competitive biotechnology and pharmaceutical companies; entrepreneurs and deep capital markets; advanced computing and AI; sophisticated engineering and manufacturing capabilities; abundant energy; a vast agricultural and forestry base; extensive transportation and logistics infrastructure; and the world's largest consumer markets.

The country's biological resource base is itself extraordinary. DOE's 2023 Billion-Ton Report estimates that the United States could sustainably produce roughly 1.1 to 1.5 billion tons of biomass annually under mature-market scenarios while continuing to meet projected demands for food, feed, fiber, forest products, and exports — approximately three times current U.S. biomass production for bioenergy and coproducts. The resource base spans agricultural and forestry residues, wood and mill wastes, municipal and industrial wastes, wet wastes, dedicated energy crops, algae, and other emerging feedstocks.

But abundant feedstock does not create a competitive bioeconomy. A ton of biomass has economic value only when it can be collected, transported, processed, converted, separated, manufactured, and sold at a cost and performance that customers will accept. The competitiveness of a biological product depends on the entire system surrounding the biology: feedstock yields and consistency, energy costs, labor, logistics, process efficiency, capital intensity, downstream processing, infrastructure, regulatory pathways, market demand, and the ability to finance the next stage of scale.

The individual pieces of a competitive bioeconomy exist across different institutions, industries, regions, and capital markets, but they do not yet function as an integrated commercialization system capable of moving promising technologies from discovery to production quickly, repeatedly, and at competitive cost.

How can the United States optimize the system around the scale-up journey so that promising technologies face fewer predictable bottlenecks and so that private capital can assume risk with greater confidence?

More specifically, how can we make the journey from biological discovery to commercial production dramatically faster, cheaper, and more predictable by rethinking how the United States:

- connects feedstocks to manufacturers;
- expands access to pilot and demonstration infrastructure;

- finances first-of-a-kind facilities; and
- aligns public and private actors around shared infrastructure and risk?

The economics of biological innovation would dramatically improve if the United States could substantially reduce the time and capital required to move from discovery to pilot to demonstration to first commercial plant to scaled production. This acceleration and scaleup would also change the competitive position of the United States in the emerging global bioeconomy.

1. THE SCALE-UP GAP

The Council's 2025 bioeconomy meeting at Primient's facility in Lafayette, IN, characterized the value chain as a complex ecosystem rather than a linear pipeline, with different scientific, financial, engineering, and partnership requirements at each stage. Robust and different infrastructure is needed across the value chain: pilot plants, demonstration sites, modeling, and testing platforms are critical translational infrastructure for scaling promising technologies from discovery to commercialization. And fermentation yield is only one part of the economics; water, energy, contamination control, process stability, separation and purification, equipment, labor, waste streams, financing costs, etc. all determine whether a process works commercially.

Through the Council's work on advancing the bioeconomy, we have heard that the scale-up challenge is acute at the first commercial plant. A first-of-a-kind facility must simultaneously demonstrate that the technology works reliably at scale, the engineering is feasible, the economics are viable, and customers will buy the product. Four risks converge at this critical stage:

1. **Technology risk:** The process may not perform reliably or consistently at commercial scale.
2. **Engineering risk:** Translating a novel process into a functioning facility may prove more complex or costly than anticipated.
3. **Capital risk:** Hundreds of millions of dollars may be required before sufficient technical and commercial risk has been retired to attract private financing.
4. **Market risk:** Customers may be reluctant to commit meaningful volumes until commercial production has been demonstrated.

The Council heard a vivid example in April 2026: Mark Warner of Liberation Bioindustires reported approaching roughly 300 investor groups without finding appropriate capital, as their $115 million biomanufacturing project reached roughly 75 percent completion but then paused because the company could not complete its capital stack.

The opportunity to improve U.S. competitiveness is to reduce enough technical, engineering, financial, and market uncertainty simultaneously to make commercial facilities investable.

2. CAPITAL IS MISALIGNED WITH THE COMMERCIALIZATION LIFECYCLE

The bioeconomy suffers from a mismatch between the capital available and the risk profile of industrial commercialization.

Venture capital works well when relatively modest investments generate significant increases in enterprise value through scientific or intellectual-property milestones. Biomanufacturing is different. Commercialization can require years of process development, specialized equipment, physical infrastructure, working capital, and large upfront construction expenditures.

As participants in 2025 *Financing the Bioeconomy* session the Council held observed, venture and federal funding are insufficient for many capital-intensive biomanufacturing projects, while project finance becomes available only after technology and cash flows have been sufficiently demonstrated.

The capital stack evolves as the technology matures:

Stage	Primary need	Illustrative capital
Discovery	Science and IP	Federal R&D, university, corporate R&D
Prototype	Technology validation	Grants, seed, VC, strategic capital
Pilot	Process development	Cost-share, strategic capital, VC
Demonstration	Manufacturing validation	Public-private partnerships, project finance, strategic capital
First commercial plant	Production	Project finance, strategic investors, federal/state financing
Commercial expansion	Replication and growth	Corporate finance, private equity, debt
Shared infrastructure	Multi-user capacity	Public-private, regional/state, infrastructure finance

Public capital is most valuable when it removes risks that private capital is poorly positioned to bear, allowing private investment to enter earlier and at greater scale.

3. THE UNITED STATES LACKS SUFFICIENT SCALE-UP INFRASTRUCTURE

Startups and established companies can develop technologies domestically but often look overseas for fermentation, downstream processing, and other capabilities needed to generate the data required for commercial investment.

BioMADE's emerging Pilot Plant Network is an important response. Announced facilities in Minnesota, Iowa, and California are designed as shared infrastructure rather than single-company assets:

- **Minnesota:** a 122,000-square-foot demonstration-scale facility with two 25,000-liter industrial fermenters; approximately $132 million in investment.
- **Iowa:** a $40 million, 15,000-square-foot multi-user facility with fermentation capacity up to 10,000 liters, laboratories, and downstream processing.
- **California:** fermentation capacity up to 4,000 liters, with downstream-processing capabilities.

These facilities address the market failure that most emerging companies cannot justify building their own pilot infrastructure, yet without access to appropriate equipment they cannot generate the engineering and operating data required to finance commercial production.

The scale of the national challenge, however, remains much larger. The original ambition for the BioMADE network contemplated 12–15 facilities, while the United States continues to face a shortage of pilot- and demonstration-scale capacity. GAO reported in February 2026 that DOD had invested approximately $965.2 million since 2021 across three biomanufacturing initiatives, yet the United States still lacked sufficient infrastructure to advance promising biotechnology projects toward commercial production, particularly at the pilot scale.

An important competitiveness challenges is therefore to create an integrated national infrastructure ecosystem linking research, pilot production, demonstration, commercial manufacturing, and regional supply chains.

4. DOWNSTREAM PROCESSING CAN BECOME THE BOTTLENECK

Council participants noted in the Nebraska working session discussion that innovation has significantly improved fermentation yields, but some of those gains were being offset by the cost of downstream processing (DSP) (i.e., the recovery and purification of biosynthetic products from natural or fermentation sources to make them market-ready). One participant cited Ginkgo Bioworks data suggesting that the bottleneck had shifted from bioreactor performance to DSP capacity. The next generation of bioeconomy R&D therefore needs more integration of biology, chemical engineering, process engineering, and design-for-manufacturability.

5. AMERICA'S FEEDSTOCK ADVANTAGE MUST BECOME A MANUFACTURING ADVANTAGE

The United States possesses an extraordinary renewable-carbon resource base, but Council's April 2026 meeting identified a “matching problem”: available feedstocks must be matched with technologies and product markets in which the combined economics of energy, labor, capital, yield, transportation, and downstream processing work. Participants specifically cautioned against forcing biological technologies into bulk commodity markets where fossil-fuel economics remain extremely difficult to overcome.

Corteva's Todd Pester described one “model system” of a working bioeconomy in which seed production, research, farms, ethanol, livestock feed, and downstream markets reinforce one another. The opportunity is to extend this kind of integrated system beyond agriculture, connecting regional feedstocks with biological conversion, advanced manufacturing, energy, logistics, and end users.

6. AI AND ADVANCED COMPUTING COULD CHANGE THE ECONOMICS OF SCALE-UP

The U.S. Department of Energy’s 2026 Genesis Mission identifies “Scaling the Biotechnology Revolution” as a national challenge, combining AI with genomics, multi-omics, imaging, phenomics, laboratory automation, and digital twins. DOE specifically identifies digital twins as a way to de-risk process development, optimization, integration, and scale-up, potentially accelerating production of biofuels, biochemicals, and bioproducts by orders of magnitude.

The potential is already visible in agriculture. Corteva now uses more than 20 petabytes of field-trial data from more than one million trials, applying AI to identify the highest-performing genetic crosses and compress breeding cycles.

The analogous industrial opportunity is to make scale-up progressively more digital, predictive, and automated, reducing the number of physical experiments required, identifying process problems before construction, improving reproducibility, and generating better data for engineers and investors.

SELECT BACKGROUND SOURCES

Council on Competitiveness Bioeconomy
The Council's recent bioeconomy work provides the foundation for this discussion, including its analysis of the bioeconomy value chain, commercialization pathways, translational infrastructure, financing, and cross-sector collaboration.

NSCEB — Charting the Future of Biotechnology: An Action Plan for American Security and Prosperity
The National Security Commission on Emerging Biotechnology (NSCEB) is a bipartisan, congressionally mandated commission that brought together leaders from government, industry, academia, and national security to assess how emerging biotechnology will affect U.S. security and prosperity. This NSCEB 2025 report offers 49 recommendations across six priorities, including mobilizing private-sector investment, strengthening domestic biomanufacturing, developing the biotechnology workforce, and maintaining U.S. leadership in the face of strategic competition.

NSCEB — The Future of Biotechnology Regulation
The Commission's 2026 regulatory work is useful context for the discussion of regulatory friction and the need for clearer, risk-proportionate pathways for novel biotechnology products. This aligns with the Council's work in developing smart standards and regulations.

National Academies of Sciences, Engineering, and Medicine, *Safeguarding the Bioeconomy* (2020)
This National Academies consensus study provides a comprehensive assessment of the emerging U.S. bioeconomy, including its economic significance, drivers of growth, ecosystem, and associated economic and national security risks. Importantly, the report frames the bioeconomy not as a single industry, but as a cross-cutting economic system driven by advances in life sciences and biotechnology and enabled by engineering, computing, and information sciences. It also examines the conditions needed to sustain U.S. leadership while managing emerging vulnerabilities.

Government Accountability Office — Defense Industrial Base: DOD Efforts to Develop Domestic Biomanufacturing
A useful recent assessment of the U.S. scale-up challenge. GAO identifies insufficient domestic infrastructure, particularly pilot-scale facilities, as a significant barrier to moving biotechnology from laboratory development toward commercial production.

U.S. Department of Energy — 2023 Billion-Ton Report
DOE's assessment of U.S. renewable carbon resources provides an important foundation for understanding America's potential feedstock advantage. The report estimates that the United

States could sustainably produce approximately 1.1–1.5 billion tons of biomass annually while maintaining food, feed, fiber, forest-product, and export requirements.

U.S. Department of Energy — Genesis Mission: Scaling the Biotechnology Revolution
This report provides current examples of how AI, autonomous experimentation, digital twins, and national laboratory capabilities could accelerate biotechnology commercialization and scale-up.

BioMADE — Pilot Plant Network
A practical example of a new U.S. approach to closing the pilot- and demonstration-scale infrastructure gap through a national network of shared facilities.

Reinventing the Triple Helix: A National Tiered Network of Federated Translational Biotechnology Institutes
This report proposes a National Biotechnology Incubator Network (NBIN) to address a critical gap in the U.S. bioeconomy: translating biological discoveries into companies, products, manufacturing capacity, and economic value. It focuses particularly on TRL 3–6, proposing a network of regional, tripartite institutes that bring together academia, government, and industry with shared infrastructure, patient capital, regulatory expertise, AI and robotics, and workforce development. The report also explores how a coordinated national network could strengthen regional bioeconomies, domestic biomanufacturing, and U.S. competitiveness.

Defining the Major Issues That Constrain the Accelerated Development of a Robust Bioeconomy
This paper examines the structural barriers preventing the United States from translating its biotechnology strengths into a globally competitive bioeconomy. Developed by a group of industry and policy leaders following the Nebraska edition of the Competitiveness Conversations Across America series, the paper identifies four gating barriers (i.e., market access, economics and value capture, infrastructure, and policy and regulation) alongside the foundational importance of agricultural viability. The paper also highlights two cross-cutting imperatives: reducing risk across the value chain and dramatically shortening the time from innovation to commercial scale.

