

REINVENTING THE TRIPLE HELIX

A National Tiered Network of Federated Translational Biotechnology Institutes

A Policy Framework for Federal Decision-Makers

Prepared by Mark Bathe (MIT), informed by the workshop held February 25, 2026, at the U.S. Senate Visitor Center in Washington, DC, and subsequent broader policy dialogue.

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Version 1.0.1 · Public Release · August 24, 2026

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Suggested citation: Bathe, M. (2026). *Reinventing the Triple Helix: A National Tiered Network of Federated Translational Biotechnology Institutes* (Version 1.0.1). Consortium for the Advancement of the Bioeconomy, Association.

<https://doi.org/10.5281/zenodo.22081717>

Preface

This report grew out of a workshop convened on February 25, 2026, at the United States Senate Visitor Center in Washington, DC, entitled “*Reinventing the Triple-Helix: A Workshop on Establishing a National Network of Regional Tripartite Translational Bioeconomy Institutes*.” It was organized by Mark Bathe and Robin Scheffler (MIT), Edward Wack and Christina Rudzinski (MIT Lincoln Laboratory), and Will Rasky (Mass Ave Strategies), and made possible by Senator Todd Young, Chair of the National Security Commission on Emerging Biotechnology (NSCEB), and the Commission’s staff, who respectively provided the meeting space and assisted with logistics. The February workshop participants who opted to be identified are listed in the Appendix; many others who contributed to the workshop, the workshop report draft, and its subsequent revisions are not named. Although this report is distributed under the Creative Commons Attribution 4.0 International License, it was developed from discussions conducted under the Chatham House Rule. This report intentionally synthesizes those discussions without attributing statements, opinions, or recommendations to individual participants, and nothing in this license should be interpreted as identifying or implying the views or endorsement of any participant or organization.

The February workshop built on an earlier convening: the MIT-Engine Bioeconomy Workshop (October 31, 2025, at The Engine in Cambridge, Massachusetts), co-organized by Mark Bathe, Robin Scheffler, and Will Rasky, in which an MIT faculty working group and roughly one hundred participants across the private sector, government, and academia worked together to diagnose issues with the current U.S. biotechnology innovation system. Its participants’ insights are gratefully acknowledged as background to this report, available as an accompanying report.

The premise for the February workshop was simple and urgent: the United States’ historic “triple helix” of government, industry, and academia must be reinvented if the nation is to translate its unmatched biological discovery into companies, manufacturing capacity, national-security capability, and broadly shared, nationwide economic growth. The day opened with remarks from the NSCEB followed by framing talks from federal science and technology leaders—the Department of Defense, the Department of Energy, the National Science Foundation’s Technology, Innovation and Partnerships directorate, and DARPA’s Biological Technologies Office—and regional models and translational case studies presented by participants from North Carolina State University and the North Carolina Biotechnology Center, Indiana University, the University of Notre Dame, the University of Nebraska-Lincoln, Penn State University, Lawrence Livermore National Laboratory, and BioMADE, followed by inspirational remarks by Senator Young. Approximately seventy-five participants across all three sectors of academia, government, and the private sector then worked through eight discussion tables of the proposed institutes, covering their governance, capital stack, TRL 3–6 translation engine, shared data and AI infrastructure, regulation, site selection, workforce, and federal authorization and appropriations—each table tested the model’s foundations and failure modes, and drafted concrete recommendations for its implementation.

The present report was then drafted based on these discussions and the reporting from participants at the February workshop, both listed at the end of this report and unlisted, and subsequently edited and refined through several rounds of detailed feedback from the participants. The report’s framework was additionally sharpened by two public congressional briefings, each entitled “*Empowering American Industrial Leadership in Biotechnology*” and moderated by Mark Bathe. The first, at the Rayburn House Office Building on May 27, 2026, hosted by Representative Chrissy Houlahan (PA), featured panelists Joseph Cotruvo, Jr. (Penn State University), Elizabeth Stockton (Overlap Holdings), Scott Robertson (Dauntless Ventures), Rohan Shirwaiker (NC State University), and Edward Wack (MIT Lincoln Laboratory); and the second, at the Cannon House Office Building on June 24, 2026, hosted by Representative Mike Flood (NE), featured panelists Jared Auclair (Northeastern University), Nicole Buan (University of Nebraska-Lincoln), and Elizabeth Stockton (Overlap Holdings).

The February workshop and the two briefings were sponsored by the Consortium for the Advancement of the Bioeconomy, Association, a nonprofit organized for the promotion of social welfare under Section 501(c)(4) of the Internal Revenue Code, whose sole purpose is to advance the bioeconomy by convening and hosting workshops and meetings that facilitate structured discussion, research synthesis, information exchange, and policy planning. This report is intentionally detailed because institutional design matters, but it does not seek to prescribe implementation decisions or legal mechanisms, which are reserved for legislative action. Additionally, this report is viewed as a living document that may evolve over time as additional stakeholder feedback is incorporated.

The workshop and briefing organizers and the Consortium for the Advancement of the Bioeconomy are extremely grateful to Senator Young and the NSCEB staff, to Representatives Houlahan and Flood and their staff, and to the many workshop and briefing participants across the triple-helix whose valuable insights made this report possible.

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1. Executive Summary

The United States generates more biological discoveries than any nation on earth but captures proportionately too little of the resulting economic value. The gap between invention and deployment—the well-known “valley of death”—spans every vertical of the bioeconomy from pharmaceuticals to materials, chemicals, critical minerals, fertilizers, food additives, and fuels. Its cost is measured in hundreds of billions of dollars of unrealized annual output, in manufacturing capacity ceded to foreign competitors, and in supply chains whose fragility became starkly visible during the COVID-19 pandemic. A root cause is fragmentation: academia, government, national laboratories, venture capital, and industry operate across disconnected timelines, incentives, and infrastructure, and no existing institution currently bridges the translational arc from laboratory discovery to commercial deployment. Incremental fixes have not closed the gap, and the stakes are no longer only economic: the National Security Commission on Emerging Biotechnology (NSCEB, 2025) concluded that without domestic infrastructure to translate discoveries into production, the United States risks ceding strategic ground in biotechnology to competitors moving deliberately to close the gap.

This report proposes a concrete solution: the National Biotechnology Incubator Network (NBIN)—a national network of regional translational bioeconomy incubators that empower academic and government-lab discoveries to reach the marketplace, leveraging the non-dilutive SBIR/STTR/ARPA programs in addition to regional capital. Unlike conventional university incubators that provide office space and mentorship, NBIN incubators are infrastructure-intensive translational facilities equipped with GMP-adjacent bioprocessing equipment, permanent technical staff, and integrated entrepreneurial and regulatory support—designed to advance biological discoveries through the technology readiness levels that neither university labs nor commercial manufacturers currently address. NBIN institutes operate upstream of, and in deliberate sequence with, Manufacturing USA institutes such as BioMADE, NIIMBL, and BioFabUSA: NBIN advances companies and technologies from discovery through TRL 3–6, so that they become candidates for the manufacturing-scale programs that Manufacturing USA institutes are designed to receive. Each incubator is anchored by a land-grant, sea-grant, sun-grant, or space-grant institution, a national laboratory, or another research institution—or a partnership among them, with governance, funding, and operational scope calibrated to regional context. NBIN is structured not as a federal program but as a non-profit strategic venture investment network with translational infrastructure, taking equity in the companies that flow through it in return for capital and facilities, recycling proceeds into the institutes to steadily reduce reliance on appropriations over time. It does not replace existing programs; it fills the structural void between early-stage academic discovery and federally-sponsored manufacturing-stage infrastructure, making every existing program more productive by providing the translational layer that they currently lack. NBIN is designed to serve as the bioeconomy pillar of the integrated national industrial strategy that national assessments have identified as essential to sustained U.S. manufacturing competitiveness (National Academies of Sciences, Engineering, and Medicine, 2026). Importantly, NBIN is not a replacement for, nor should it compete with resources for, the essential basic research funding and federal agencies that have empowered our innovation system and economy for decades. And it does not increase fragmentation, it reduces it by connecting our end-to-end innovation system more effectively to turn our biological inventions and discoveries into new companies, employment, and industries nationwide.

Investment & Funding Model

NBIN deploys federal, state, and private capital into the translational infrastructure that converts U.S. biological discoveries into commercial companies, jobs, domestic supply chain capabilities, and national security assets—generating compounding portfolio returns designed to steadily reduce federal dependence over two decades and to distribute bioeconomy wealth creation across all 50 states. The capital structure is tiered to fit each institute’s scale and regional context. Tier 1 institutes (e.g., \$5M–\$25M capex; \$2M–\$8M/year opex) could immediately be funded through existing USDA/NIFA formula streams—in principle requiring no new federal authorization. This entry point is designed to ensure that agricultural, rural, and economically developing states that have historically been underrepresented in federally concentrated research and commercialization investments have an immediately accessible pathway into the NBIN network. This also leverages regional strengths in specialty biofuels, microbially-engineered and waste-derived fertilizers, crop protection and animal health, and valorization of agricultural and industrial biomass and waste streams. Tier 2 regional hubs (e.g., \$50M–\$150M capex; \$15M–\$40M/year opex) and

Tier 3 flagship institutes (e.g., \$200M–\$500M capex; \$40M–\$75M/year opex) are competitively selected and follow mixed federal-state-private capital blends. These are per-institute ranges, with the framework designed to scale with appropriations and demonstrated performance rather than to presume a single national commitment. The suggested authorization pathway accommodates a network that, if fully built across all tiers and all 50 states over approximately fifteen years, would represent construction capital on the order of \$3B–\$8B—spread broadly rather than concentrated in a few regions. That full build-out is an outcome that authorization makes possible, not a spending package that Congress must commit to at the outset. Each institute is designed to cover a growing share of its operating costs in its second decade through licensing revenue, data access fees, and equity participation in resident companies as that portfolio matures. This model rests on portfolio breadth and recurring licensing and facility revenue across a diversified set of verticals, including higher-return clinical biologics alongside the broader base of small and medium-sized company formation, rather than on a small number of concentrated exits.

Private and state capital can participate in two complementary ways. Return-seeking investors can co-invest directly alongside NBIN in the individual portfolio companies flowing through an institute—following NBIN’s deal sourcing and due diligence with their own capital—while philanthropic, programmatic, or state supporters can help capitalize an institute itself. Consistent with mission-driven nonprofit investment organizations, the institute—not its contributors—holds equity in resident companies. Returns on the institute’s own equity stake are retained by the institute and recycled into its translation mission. Private co-investors receive returns only from the portfolio companies in which they directly invest, while institute-level supporters may participate in governance through board or advisory roles established under the institute’s governing documents.

Beyond appropriations, the model draws on two distinctive federal instruments: Department of Defense mission capital, which funds defined national-security capabilities without taking equity, and Office of Strategic Capital concessional financing, which supplies the patient, long-maturity capital that commercial markets will not provide. Federal agency participation is strictly voluntary and requires no changes to any agency’s core mission or appropriations. NSF, DOD, USDA, DOE, NIH, and peer agencies are the essential upstream producers of the discoveries NBIN translates, not functions it duplicates. Notably, NBIN’s authority to take equity in resident companies and to assemble a private and state capital stack is a function these agencies are not chartered to perform, so NBIN complements and collaborates with their grant-based missions rather than competing with it. NBIN is designed to operate across the full range of participation levels—from full federal partnership to entirely private and state-funded operation at the Tier 1 level. The goal of NBIN is not to detract funding or resources from the essential basic scientific enterprise of existing federal agencies: its goal is to make these investments productive for broad-based US industrial transformation in biotechnology by bridging the valley of death across all economic verticals; across the nation. Institutes are evaluated through milestone-based reviews emphasizing learning, accountability, and outcomes that are calibrated regionally.

The Economic Stakes

The global bioeconomy is valued at approximately \$4 trillion today and is projected to reach \$30 trillion or more by 2050 (BCG Henderson Institute, 2022). Across TRL 3 through 6—the gap between early-stage research (TRL 1–3) and commercial deployment (TRL 7–9)—U.S. attrition rates remain unacceptably high. The gap between the U.S. bioeconomy’s current contribution (approximately 5% of GDP, per the National Academies of Sciences, Engineering, and Medicine, 2020) and its estimated potential at full biobased displacement (7.4% of GDP, per the same analysis) represents more than \$600 billion in unrealized annual output at current GDP levels: NBIN is translational infrastructure designed to close this gap.

Why Now

Three converging forces make this the decisive moment for action. First, supply chain vulnerabilities in medicines, materials, chemicals, fertilizers, fuels, and critical minerals—starkly visible during COVID-19 and compounded by ongoing geopolitical instability and rapidly emerging biotechnological threats—have elevated bioeconomy translation from an economic priority to a national security imperative that crosses party lines. Second, as the 2025 NSCEB report established, China has deployed a coordinated national bioeconomy strategy integrating state financing, industrial policy, and institutional infrastructure at a scale that U.S. fragmentation cannot match. Third, the convergence of AI, laboratory automation, and gene-editing with biological sciences is opening a narrow window in which data moats and translational infrastructure can be established before competitive positions harden.

Together, these three factors make the moment for action now. Indeed, each year of delay allows China's institutional advantage to compound, AI training datasets to accumulate under foreign governance, and the legislative momentum generated by the 2025 NSCEB report to dissipate. If NBIN is authorized and operational by 2028, the first cohort of spinouts—including companies that reach market readiness before TRL 6 through licensing, strategic acquisition, or non-regulated product pathways—could reach the market as early as 2030. The broader cohort of TRL 6-ready companies follows, with a national biological data moat that is established before AI competitive positions harden and domestic biomanufacturing capacity is built to respond to the next supply chain crisis. Otherwise, these outcomes may be deferred, possibly permanently.

Importantly, the legislative path crosses party lines: domestic biotechnology industries, manufacturing capabilities, supply-chain sovereignty, rural job creation through bioindustrial development nationwide, and reduced dependence on adversarial supply chains are priorities shared across the political spectrum, with a coalition that spans agricultural states, coastal regions, manufacturing districts, defense-adjacent research institutions, and regions that have already invested in bioindustrial infrastructure.

Physical and Digital Sovereignty

At its core, the incubator network is a dual sovereignty initiative. Physically, it empowers domestic enterprises by derisking early-stage research to become commercially viable—leveraging existing federal programs in the process—thereby promoting regional economic development instead of exporting American inventions to foreign competitors. Digitally, it leverages autonomous labs and high-throughput robotic platforms to produce proprietary biological datasets, creating an irreplaceable national data moat in an era when artificial intelligence is rapidly eroding knowledge-based competitive advantages. No other existing program currently addresses both dimensions simultaneously. Thus, NBIN is a central mechanism by which the United States can assert sovereign capacity across the full translational arc: from bench discovery through pilot-scale demonstration, and from raw experimental data through AI-ready biological intelligence.

Key Recommendations

- Authorize NBIN: a tiered national network of biotechnology incubators anchored by land-grant, sea-grant, sun-grant, and space-grant institutions and other institutional partners, offered to all 50 states, and designed to scale incrementally or aggressively as appropriations and national priorities warrant, with each institute's location, scope, size, and capitalization determined by demonstrated regional translational demand and priorities rather than by a uniform national template. Incubators operate across three tiers—from targeted Tier 1 translational labs through full-capability Tier 3 flagships—and are co-located with regional academic, government, and industry partners within their defined TRL 3–6 mandate.
- Authorize a dedicated NBIN National Coordination Office with detailing to the White House—with statutory authority and appropriations. Preserve and channel non-dilutive capital (SBIR/STTR, ARPA awards, federal grants) to companies in NBIN pipelines; this capital flows to portfolio companies directly and is additive to NBIN's equity investment model. This recommendation aligns with and builds upon existing introduced legislation: the National Biotechnology Initiative Act (H.R. 2756/S. 1387) establishes authorization language for a White House bioeconomy coordination office, and the Cloud LAB Act (S. 2676) provides enabling authority for federally supported autonomous research infrastructure—both of which NBIN's authorization strategy should explicitly incorporate.
- Establish a standing International Regulatory Science Liaison within the NBIN National Coordination Office, with defined engagement responsibilities across ICH, the APEC Regulatory Harmonization Steering Committee, CODEX Alimentarius, and OECD biotechnology working groups—positioning the United States to shape emerging international standards while building multi-jurisdiction regulatory readiness for resident companies.
- Adopt blended capital structures composed of federal, state, and private for each institute, with capital expenditure treated distinctly from operating expenditure in appropriations.
- Implement multi-year funding commitments (minimum 10 years) with performance-based evaluation at years 3, 5, and 10—using milestone criteria that reinforce learning rather than trigger punitive cutoffs.

- Require each institute to establish pre-competitive data zones governed by federated, privacy-preserving frameworks, contributing to a national Web of Biological Data (H.R. 9307).
- Mandate federal agency-specific procurement specifications for bio-based products as a demand anchor, creating market certainty that attracts private investment.
- Integrate national laboratories into institute networks as infrastructure partners, SME sources, and secure project hosts, with streamlined engagement protocols.
- Embed workforce development funding in every institute's operating model, spanning entrepreneurship training, apprenticeship programs, technical retraining, and cross-sector talent mobility.

2. The Economic Cost of the Bioeconomy Translation Gap

2.1 Framing: A Value Capture Failure

The United States is not failing to invent. American universities and national laboratories produce scientific output at a scale and quality that is unmatched globally. However, this report does not argue that basic R&D investment is complete or sufficient—indeed, continued fundamental research remains essential, particularly in sectors such as biotechnology where cost-competitiveness requires further scientific breakthroughs. The failure addressed in this report is downstream: the conversion of proven discovery into products, companies, jobs, manufacturing capacity, and exportable economic value. This distinction matters because it identifies a separate and addressable problem. The challenge is not only one of R&D funding and output; it is equally one of institutional infrastructure—and it is the institutional infrastructure gap that this report seeks to close. This commonly called “valley of death” describes what happens when no institution exists to do the hard, expensive, operationally complex work of translation.

2.2 Order-of-Magnitude Estimate of Annual Loss

Economic Magnitude

Global bioeconomy: ~\$4 trillion today, projected \$30+ trillion by 2050.

U.S. unrealized potential: \$600B+/year—the gap between current bioeconomy output (~5% of GDP) and estimated full potential (~7.4% of GDP, NASEM 2020).

This gap is a present, ongoing economic loss—not merely a projection of future opportunity.

Primary mechanism: TRL 3–6 attrition, resulting in under-translation of discoveries into commercial successes, as well as offshoring of biomanufacturing and regional bioindustrial development.

This estimate is grounded in published independent national analysis. The National Academies of Sciences, Engineering, and Medicine (NASEM, 2020) calculated that the U.S. bioeconomy accounts for approximately 5.1% of GDP, and should currently available biobased processes fully displace traditional nonbiological processes, the bioeconomy could reach 7.4% of GDP. Applied to current U.S. GDP of approximately \$27 trillion, this 2.3 percentage point gap represents more than \$600 billion in unrealized annual output. This figure is necessarily approximate—the NASEM analysis frames 7.4% as a structural ceiling under full biobased displacement, not a near-term forecast—but it establishes the correct order of magnitude. Thus, the translation gap is a national-scale economic problem, not a sectoral niche, and the cumulative foregone output over a decade will substantially exceed the cost of the proposed NBIN incubator network.

2.3 Mechanisms of Loss

Translation failure manifests through several reinforcing mechanisms. TRL 3–6 attrition occurs when promising technologies stall at the pilot scale for lack of specialized infrastructure, process engineering expertise, and risk-tolerant, patient capital. Technologies do not necessarily fail scientifically; they fail institutionally due to lack of long-term support for their challenging developmental pathways. Under the two-way street model of science and technology described in Section 3.2, this translation is not the mere application of settled science but a required input to it: attempting to scale a technology is often what surfaces the cost-driving failure modes and the scientific questions whose resolution is the actual path to cost-competitiveness. Infrastructure with patient capital that enables these translation attempts therefore advances both science and essential translational know-how—even amidst individual product or commercialization set-backs or failures—while performance gates at years 3, 5, and 10 keep the commercialization portfolio disciplined rather than indefinitely subsidized.

Under-translation of discoveries to commercial successes is a compounding problem. When academic and government researchers cannot access translational infrastructure, technologies remain in journals rather than becoming companies. Consequently, the pipeline of startups that would anchor regional bioeconomy clusters never

materializes. Infrastructure duplication is a separate but related inefficiency: absent a coordinated nationwide network, academic institutions, national laboratories, and companies each build their own partial capabilities, producing redundant, competitive investments without coordinated national infrastructure that retains regional specialization. Finally, fragmentation yields time-to-market delays that impose market-share losses to faster-moving foreign competitors operating with coordinated nationwide industrial infrastructure, eroding first-mover advantages in biotechnologies whose value depends on early standard-setting based on early discoveries and demonstrations.

Importantly, translational incubators in dozens of private and university-affiliated bio-incubators across the nation provide real value in mentorship and bench space, but they are generally not designed to provide pilot-scale fermentation, GMP environments, high-throughput robotic platforms, or the process engineering expertise needed to cross the TRL 4–6 threshold. Moreover, their throughput is structurally insufficient: the volume of discoveries seeking to advance to TRL 4–5 far exceeds what incubator bench capacity can absorb. And finally, traditional venture funding acquired too early by start-ups exiting incubators is misaligned with biotech timelines—it introduces return-horizon pressure at exactly the moment patient, infrastructure-backed development is required, compressing economic returns for the innovators and downstream investors who need to complete the commercialization journey.

AI-Accelerated Competitive Erosion

An additional, increasingly urgent mechanism of loss has emerged from the rapid maturation of artificial intelligence: AI is systematically filling the competitive moats upon which U.S. biotechnology companies have historically relied. Published academic findings, patents, proprietary workflows, and even hard-won process knowledge are rapidly becoming training data—accessible to any well-resourced actor with sufficient compute. And AI does not respect borders: a foreign competitor with access to the global scientific literature and sufficient computational infrastructure can compress years of U.S. research advantage into months of model training. Knowledge-based moats, once the bedrock of biotech competitive strategy, are eroding faster than any previous technology transition has allowed.

The one category of competitive moat that AI cannot fill is proprietary experimental data that was never made public. These may include scale-up failure modes discovered at pilot scale; process parameter envelopes validated across biological feedstocks; strain performance data generated under real manufacturing conditions; regenerative medicines scale-up processes; and negative results that reveal the precise boundaries of what works and what does not. These data are tacit, infrastructure-dependent, expensive to generate, and impossible to reconstruct computationally from the literature alone. They can only be produced by institutions that operate the right physical infrastructure, with benefits that accrue only to those who generate them first. Without a national network of translational incubators equipped with autonomous labs, high-throughput robotic platforms, and integrated pilot-scale equipment, the United States will risk continuing to export its discoveries while foreign competitors, operating coordinated translational infrastructure, build the proprietary biological datasets that will define competitive positions in the global bioeconomy for the coming decades.

This requires a structural shift: open publication once accelerated U.S. advantage because U.S. institutions had superior capacity to exploit published knowledge, but AI eliminates that asymmetry—any actor can now extract and recombine open data at equal speed. NBIN's federated pre-competitive data zones preserve the collaborative acceleration benefits of open science within a controlled network while closing the exploitation pathway that publication now creates for adversarial actors.

2.4 Sector-Specific Impact

The translation gap manifests differently across sectors but is pervasive across all of them. In medicines and vaccines, the COVID-19 pandemic revealed the fragility of domestic manufacturing surge capacity. Domestic diagnostic capability was insufficient; production of critical countermeasures depended on foreign manufacturers whose priorities and production schedules were not aligned with U.S. national security needs. In agriculture and food, biological routes to crop improvement, nitrogen fixation, and sustainable inputs have demonstrated scientific viability but require scale-up infrastructure that does not currently exist at accessible, purpose-built facilities across the nation. In materials and chemicals, bio-based alternatives to petroleum-derived products face the same pilot-scale bottleneck; domestic fermentation and downstream processing capacity is limited and geographically concentrated. In biofuels and energy, advanced biofuel technologies have stalled at demonstration scale for more

than a decade—a challenge that reflects both continued cost-competitiveness gaps that require further R&D investment, as well as the absence of structured scale-up capital and infrastructure support. For technologies where the underlying science is mature, the translational infrastructure gap is a binding constraint; for others, translational investment and R&D must advance in parallel. Finally, in critical minerals, emerging biological extraction and separation technologies—including protein-based rare earth recovery systems—have demonstrated extraordinary scientific performance but face identical institutional gaps: no clear pathway from laboratory to commercial deployment.

A defining structural feature of the non-pharmaceutical bioeconomy verticals that NBIN targets in part—bio-based materials, agricultural biologicals, industrial chemicals, food additives and nutrition, and critical mineral and material extraction—is that they do not require the billion-dollar FDA approval pathways that govern drug development. Instead, these products are typically governed by other regulators—EPA under FIFRA and TSCA, USDA-APHIS, and the FDA’s food-ingredient pathways (GRAS and CFSAN)—on timelines and at costs far below those of clinical drug approval. NBIN does not exclude pharmaceutical or clinical-biologics translation—these remain fully in scope and feed downstream partners such as NIIMBL and BioFabUSA—but it is deliberately designed based on regional priorities to also serve the non-pharmaceutical verticals that many current models neglect. Unlike pharmaceutical markets, where winner-takes-all dynamics concentrate returns in a small number of fully FDA-approved products requiring decade-long development timelines and massive capital, these verticals permit small and medium-sized company formation with commercially viable products at significantly lower capital thresholds. Indeed, the U.S. bioeconomy already supports approximately 1.7 million jobs across these sectors, and the structural impediment to further diversified SMB formation is not market demand or scientific readiness alone but the absence of the translational infrastructure NBIN provides. This distinguishes NBIN’s expected portfolio composition from a pharmaceutical incubator: the network is explicitly designed to generate many small and mid-sized regional companies rather than a small number of high-risk pharmaceutical bets. Small businesses account for approximately 42% of all U.S. manufacturing employment (U.S. Small Business Administration, 2023), making NBIN’s SMB-oriented portfolio a direct lever for distributed job creation across every state in the network.

To make these sector-specific economic verticals concrete: an institute might advance a microbial fermentation platform for bio-based packaging polymers that displace petroleum-derived plastics; a nitrogen-fixing biological seed treatment that reduces synthetic fertilizer dependence for row-crop agriculture; a waste-stream nutrient recovery process that produces fertilizer from agricultural or municipal byproducts as a domestic alternative to petrochemical-derived ammonia; a specialty biofuel or bio-based platform chemical such as a fermentation-derived sustainable aviation fuel precursor or industrial solvent produced from surplus corn or crop residue feedstock (building on feedstock and process science already advanced by DOE’s Bioenergy Research Centers in Section 9); a precision-fermentation protein or functional ingredient for food and nutrition applications; or a protein-based bioleaching process for recovering rare earth elements from mining waste or end-of-life electronics.

Each sector-specific example above illustrates the same translational arc the NBIN network is designed to support: a laboratory-validated biological process that requires pilot-scale infrastructure, process characterization, and a resident-company structure to reach commercial readiness—not a research grant, and not yet a manufacturing-scale facility.

2.5 International Context

China’s bioeconomy strategy is not analogous to any single U.S. program. It is a coordinated national industrial policy that integrates state financing, institutional construction, regulatory facilitation, and demand creation through government procurement. The result is an accelerating pace of domestic bioindustrial deployment that is challenging for existing U.S. programs to match. Germany’s Fraunhofer Society provides a different and instructive model: 76 institutes, funded through a combination of federal and state government support and industry contracts, specifically designed to bridge fundamental research and industrial application. Brazil’s SENAI Innovation Institutes apply the same logic in an emerging economy: an industry-funded network of applied-research institutes, modeled in part on Fraunhofer, established nationwide under the National Confederation of Industry—several dedicated to biotechnology and biosynthetics—advancing Brazil’s bioeconomy alongside its broader industrial base. The Fraunhofer model has sustained German industrial competitiveness across advanced manufacturing sectors for decades. It is perhaps the closest existing precedent to what this report proposes with an important distinction: the proposed U.S. incubators are explicitly oriented toward serving early-stage startups whose innovations in

biotechnology tend to establish new industries and economies rather than serve pre-existing ones based on legacy technologies and feedstocks. Close partnerships with venture capitalists, private equity firms, banks, universities, and philanthropists committed to advancing their regional and our national bioeconomies are therefore essential, as are relationships with industrial partners willing to sponsor and co-invest in early-stage innovation—a posture that the pharmaceutical industry has successfully cultivated through its own network of industrial venture, incubator, and research & development groups.

NBIN's competitive framing extends beyond bilateral comparisons with China and Germany. If NBIN institutes generate the world's most comprehensive structured biological translational datasets—across multiple product classes, biological modalities, and production scales—those datasets position the United States to lead, not merely participate in, international regulatory harmonization conversations. Bodies including ICH, the APEC Regulatory Harmonisation Steering Committee, the CODEX Alimentarius Commission, and OECD biotechnology working groups make their most consequential decisions on the basis of the scientific evidence that stakeholders contribute. Countries and institutions that contribute high-quality, structured, reproducible translational data to these processes exert disproportionate influence over the resulting guidelines—which in turn shape the regulatory requirements that govern U.S. bioeconomy exports globally. A standing International Regulatory Science Liaison at the NBIN National Coordination Office, with defined engagement responsibilities across these bodies, is the mechanism that converts this potential into operational reality and simultaneously increases the commercial value of resident companies by building multi-jurisdiction regulatory readiness. This directly contributes to U.S. leadership in international biotechnology standards—a geopolitical consideration of growing importance (NASEM, 2026).

A further dimension of urgency extends beyond international economic competitiveness: biological threats to the United States—to human populations, livestock, and agriculture—are ever-present and intensifying. Crop pathogens, livestock disease, and the deliberate or accidental release of biological agents represent national security threats on domestic soil, not merely distant contingencies across international waters on foreign soil. Ensuring U.S. leadership in biological technology and its commercialization is therefore a prerequisite not only for economic advantage but for the capacity to define international norms, develop countermeasures at production scale, and sustain supply chain durability across sectors ranging from food and agriculture to pharmaceuticals and critical materials. NBIN's translational infrastructure therefore serves this security mission directly: the same platform that accelerates commercial bio-based product development is the platform that generates domestically produced diagnostic tools, agricultural bioprotectants, and biomanufacturing surge capacity that the United States cannot afford to source from adversarial supply chains.

2. Key Insights

The United States is not failing to invent—it is failing to convert discovery into products, companies, jobs, and manufacturing capacity nationwide. Technologies fail institutionally, not scientifically; what is missing is translational infrastructure.

The gap between current U.S. bioeconomy output (~5.1% of GDP) and its potential under full biobased displacement (~7.4%, NASEM 2020) exceeds \$600B in unrealized annual output, which is a present, ongoing loss.

AI is filling the knowledge-based moats U.S. biotechnology has relied on. The one moat it cannot fill is proprietary data generated at pilot scale, which physical translational infrastructure produces.

The non-pharmaceutical verticals—bio-based materials, agricultural biologicals, industrial chemicals, food ingredients, and critical minerals—can move to market at a fraction of clinical trial and translation costs, which can be addressed by small and medium-sized regional companies.

The cost of inaction—measured in foregone GDP, ceded bioindustrial capacity, lack of regional workforce and economic development, and eroded national security—exceeds the cost of NBIN by a significant margin.

3. The Translation Gap: From Diagnosis to Action

3.1 The Structural Problem

The persistent US translation gap across industries is well documented (Bonvillian, *Pioneering Progress* 2024). In biotechnology, this report argues the major reason it persists despite decades of awareness and numerous targeted interventions is structural: each existing type of institution across the triple helix of government, academia, and industry is optimized for a particular function—grant funding and regulatory approval, basic research, commercial scale production—and the spaces between those functions are not occupied by any institution with the mandate, infrastructure, investment capital, and incentive alignment to bridge them. Specifically, academic institutions produce discoveries but are generally not structured or incentivized to pursue the time-consuming, publication-averse work of process optimization, translation, scale-up, and regulatory preparation—even where tech-transfer offices and spinout programs exist, they lack the physical infrastructure, sustained staffing, and capital to advance most technologies through TRL 3–6. National laboratories have sophisticated infrastructure and deep technical expertise, but their core mission is not company formation, and their contractual frameworks and timelines are generally misaligned to startup and industry needs. And venture capital can de-risk and scale late-stage technologies, but it does not fund the infrastructure-intensive early and middle stages. Finally, government programs in the U.S. are often either too limited in scope or scale, or tied to milestones too aggressive for meaningful translational progress; and in some cases, they require specific technology applications and readiness levels that restrict funding to a narrow cross-section of inventions that could otherwise reach the market. Thus, the connective tissue between basic research and commercial demonstration—the TRL 3–6 translational pipeline—receives limited systematic institutional support, with existing programs each covering parts of the arc, but no institution structured to span it end-to-end.

3.2 The TRL 3–6 Bottleneck

TRL 3 through 6 span the distance from proof-of-concept validation to pilot-scale demonstration in a relevant operating environment—the zone where biological technologies are most operationally demanding and least served by existing institutions. For most regulated biological products this band is the structural bottleneck, whereas for non-regulated materials and chemicals the gap might begin at TRL 2–5, and for clinical biologics it might extend to TRL 6–7 or even higher. The underlying problem is the same across product classes: the absence of dedicated translational infrastructure. Crossing this arc requires pilot-scale bioprocessing equipment, GMP-compliant environments, process engineering expertise, regulatory science capabilities, and high-throughput robotic platforms for iterative screening and characterization—integrated with pilot-scale fermentation or bioproduction for continuous data generation. Capital from traditional federal and state grants is too limited in scale and ends too early, whereas venture capital engages either too late or on timelines that are too aggressive. Without the integrated automation-to-pilot infrastructure stack with associated expertise, scale-up remains a slow, expensive, and failure-prone process regardless of the quality of the underlying science. And because single institutions rarely provide translational capabilities in an integrated, accessible, and affordable package, biotechnologies tend to accumulate at TRL 3 and 4, consuming grant funding and researcher time without producing sufficient commercial outcomes for the nation. The problem is certainly not due to a lack of talented researchers, ambitious entrepreneurs, or promising discoveries. Instead, it is the absence of the institutional infrastructure that converts them into economic output.

Innovation scholar William Bonvillian, in his comprehensive treatment of American science and technology policy, frames this structural gap precisely: between the research/invention stage and commercialization lies what he describes as a “Darwinian Sea” of technical and entrepreneurial risk—a zone where neither federal civilian agencies (which fund basic research) nor venture capital (which funds product development and scaling) is structurally positioned to operate (Bonvillian, *Pioneering Progress* 2024, p. 84). “At this stage,” he notes, “VC and corporate support are largely unavailable”: venture capital seeks product and business development, not early-stage translational work, while corporate innovation support flows only to the firm’s core business areas. The federal government’s civilian role, while the most significant of any actor in this space, operates primarily through the SBIR Phase 2 program that offers limited financial capital without infrastructural support—“a major gap between the

two, with relatively few bridges.” NBIN is designed to be that bridge: the institutional form that fills the Darwinian Sea in biotechnology by offering both the requisite patient capital and the translational infrastructure.

This structural gap reflects a deeper limitation in how federal science policy has modeled the relationship between research and application. Vannevar Bush’s foundational framework in *Science, the Endless Frontier* (1945) treated that relationship as a one-way street: basic research flows downstream into applied research, development, and eventually commercialization, with the scientific questions already settled before translation begins. Donald Stokes’ *Pasteur’s Quadrant* (1997) revised this model, however, arguing that use-inspired research runs in both directions—that attempting to translate and scale a technology routinely surfaces scientific questions that bench-scale research alone never poses. NBIN operationalizes this correction: as technologies advance through TRL 3–6, scale-up failure modes—a fermentation process that behaves differently at pilot volume, a formulation that fails under GMP conditions, an assay that does not hold at throughput—generate new scientific questions that would not otherwise have been asked. The translational infrastructure NBIN provides is therefore not only a bridge across the Darwinian Sea; it is itself a source of scientific discovery that a one-way model predicts will not exist.

3.3 Why Incremental Fixes Are Insufficient

The policy response for biotechnology to date has consisted primarily of targeted programs—Manufacturing USA institutes, NSF Engines, NSF BioFoundries, SBIR/STTR, and ARPA programs—each addressing specific elements of the translation gap. NSF BioFoundries, in particular, operates upstream at TRL 1–4, building the automated discovery-scale infrastructure that feeds the translational arc NBIN occupies. These programs have tremendous value in their own rights, but together they do not add up to a nationwide solution for biotechnology. The fundamental limitation is that no existing program provides end-to-end continuity across the full TRL 3–6 arc, connects the three sectors of the triple helix through an integrated translational pathway, or operates at the scale and national scope required to shift systemic outcomes. Instead, individual programs fill individual gaps—BioMADE addresses non-medical biomanufacturing scale-up, NIIMBL addresses biologics manufacturing, BioFabUSA enables scalable, secure, and cost-effective manufacturing of cells, tissues, and organs—but none occupies the structural void between early lab discovery and manufacturing readiness that NBIN is designed to fill across products and economic verticals (NASEM, 2026; Bonvillian, 2024). NBIN provides this continuity by integrating and connecting existing capabilities where they exist and filling gaps where they do not, rather than rebuilding infrastructure already serving the pathway.

A revealing symptom of this void is that contract research organizations (CROs) and national laboratories often receive ARPA program funding in part because those organizations possess the productive brick-and-mortar facilities and trained personnel that many universities and small businesses lack: funding follows infrastructure. NBIN incubators are intended to provide this infrastructure, but with an explicit commercialization mandate, co-located entrepreneurial teams, and equity stakes that keep the value of translation in the proprietary domain. This co-located business development function addresses a gap that national assessments have identified as critical to bridging the valley of death in manufacturing-stage translation (NASEM, 2026).

A related design question is how to ensure long-term operational sustainability without perpetual dependence on annual appropriations as federal programs typically require. Manufacturing USA institutes have addressed this through member dues and cost-sharing arrangements; NBIN takes a different approach, detailed in Sections 5.3, 8.2, and 8.7: a self-sustaining equity portfolio, market-rate staff compensation, and independent, non-federal governance with performance-based evaluation at years 3, 5, and 10 that progressively reduce federal operating dependence while embedding accountability into governance.

New legislation could therefore accomplish a focused but consequential set of objectives: establishing NBIN’s legal identity, authorizing the NBIN National Coordination Office with a statutory mandate, and appropriating multi-year infrastructure capital—building on the National Biotechnology Initiative Act (H.R. 2756/S. 1387) and the House Biotech Caucus momentum already in motion. The stakes extend beyond efficiency. Bonvillian articulates an “innovate here/produce there” dynamic in which, as manufacturing migrates offshore, R&D and design follow—because production knowledge and innovation are inseparable in complex technology sectors. “You can’t understand a technology until you make it,” he writes, “because the production process teaches how a technology must be rethought, redesigned, and reformed to meet the demands of successful market entry” (Bonvillian 2024, p. 221). This principle applies with particular force in the bioeconomy, where biological manufacturing

knowledge—scale-up failure modes, process parameter envelopes, strain performance under real bioreactor conditions—is tacit, cumulative, and irreplaceable. When bioindustrial translation occurs in foreign facilities, or fails to occur at all, the United States does not merely lose jobs: it loses the embodied process knowledge that underpins the next generation of biological innovation. NBIN arrests this trajectory by making translational biological manufacturing a domestic capability, systematically building the proprietary process knowledge that constitutes the national data moat described in Section 5.5. NBIN aims to unify early discovery empowered by federal funding agencies with late scale-up capacity of the Manufacturing USA Institutes to ensure US biological inventions result in new domestic, not foreign, companies and industries.

3.4 University Incubators: A Valuable Foundation with Structural Limits

A clear demand signal for the infrastructure that NBIN would provide is the rapid proliferation of campus-based incubators. University, campus-based incubators have proliferated across U.S. research universities over the past two decades, serving a valuable function at the earliest stages of company formation: providing initial wet-lab and office space, mentorship, founder networks, IP and licensing support, and early customer discovery resources. Programs at the University of Wisconsin, the University of Nebraska, the University of Illinois, the University of Minnesota, the University of Pittsburgh, MIT, Stanford, the University of California system, Texas A&M, and dozens of similar programs at universities have launched a substantial portion of the current U.S. biotechnology startup pipeline. Their structural limits, however, reflect institutional design: typical university incubators operate at TRL 1–3 and lack the pilot-scale bioprocessing equipment, GMP space, autonomous data generation platforms, and multi-year regulatory science staffing that TRL 3–6 translation requires. Universities cannot make multi-million-dollar equipment commitments outside grant-funded programs, and university foundations are generally constrained from taking equity in tenant companies on terms compatible with capital-intensive translational operations and funding.

NBIN is designed to complement university incubators rather than displace or duplicate them. For example, companies that successfully complete early-stage university incubation are natural candidates for NBIN admission—graduating into the deeper infrastructure stack, capital access, regulatory expertise, and operational scale required to advance through TRL 6 and into manufacturing handoff. The university incubator and NBIN form a continuous derisking pathway: discovery and earliest-stage company formation at the university, followed by infrastructure-intensive translation and scale-up, followed by manufacturing-stage handoff to BioMADE, NIIMBL, BioFabUSA, or commercial partners, which could include going directly to market, licensing, or outright acquisition of derisked technologies or start-up companies by major US industrial companies, all of which serve US economic growth and competitiveness.

3.5 Venture Capital Incubators: Isolated and Sector-specific Company Generation

Another clear demand signal for NBIN from the private sector comes from the numerous major biotech venture firms that have also built their own internal derisking platforms—Flagship Pioneering, Deerfield/Cure, Versant Ventures, and ARCH Venture Partners’ LabCentral relationships. Real estate developers like Alexandria Real Estate Equities have also built dedicated lab-incubator networks. Each of these typically serves a specific regional cluster, sector, stage, or fund thesis, and is focused on the largest venture groups that can actually afford such infrastructure. Collectively, however, their proliferation is evidence that the U.S. innovation community is asking for substantially more translational derisking infrastructure, which private capital and university-scale facilities alone are unable to supply at national scale.

A federated NBIN network would compound the value that these preceding campus and private incubators provide while alleviating their inherent limitations and conflicts: federated incubators cross-collaborate on shared pre-competitive data infrastructure, exchange resident companies and personnel across regional specializations, and—uniquely among current models—can collectively take on focused missions from the DOD, industry consortia, and venture co-investment groups, within single incubators or pairs or trios of incubators that coordinate to deliver against mission development objectives for companies and products.

3. Key Insights

The translation gap is structural, not incidental: each existing institution is optimized for a specific function, and no institution currently occupies the spaces between them.

TRL 3–6 is precisely where biological technologies are most operationally demanding and least served by existing institutions.

Incremental interventions have failed because they address individual symptoms without altering the underlying institutional architecture. NSF BioFoundries (TRL 1–4) and Manufacturing USA institutes (MRL 4–7) bookend the gap; NBIN fills it. Any NBIN authorization should demonstrate that NBIN is the structural prerequisite for those programs to function as their designers intended.

University incubators provide a valuable foundation—company formation, mentorship, IP support—but their TRL 1–3 scope and infrastructure plus funding constraints mean they cannot close the gap alone; NBIN is designed to extend, not duplicate, this foundation.

Venture-backed and developer-built incubators are proliferating for the same reason, and their spread is itself a demand signal—but each serves a particular regional cluster, sector, stage, or fund thesis, and none can take on coordinated multi-institute missions at national scale.

4. Concept: National Tiered Network of Biotechnology Incubators

4.1 The Tripartite Model

NBIN is a tripartite incubator model that aligns academia, government, and industry to advance research and development through a coordinated translational platform. The term “incubator” as used throughout this report denotes a purpose-built translational facility with trained professional staff, shared GMP-adjacent instrumentation, and equity-backed resident company programs—structurally, operationally, and financially distinct from the office-and-mentorship model common at universities and operating at a scale and capability level comparable to Fraunhofer institutes and some commercial biotech campuses, albeit at national-scale. In this model, “academia” provides scientific discoveries, associated patents, technical experts, and entrepreneurs that empower innovation. “Government” largely refers to federal agencies that act as mission-defined funders, and national laboratories that provide inventions, entrepreneurs, and backbone datasets and capabilities. For example, DOD and peer agencies can sponsor specific translational missions for the initial build and launch of the network to help “push” biotechnologies to the marketplace. In this framework, federal participation is mission-defined and capital-providing rather than governance-controlling, with co-location, shared facilities, and unified governance options the model supports where they fit regional capacity and partner appetite, not requirements imposed uniformly across the network. Finally, “industry” refers to industrial partners that act as mission-defined funders to help “pull” early-stage biotechnologies and companies to the marketplace by leveraging translational incubators, that offer market intelligence as well as mentorship, and that provide investment capital, including venture groups. The three-part structure is functional, not symbolic, because each sector contributes what the others lack: academia provides scientific depth and talent pipelines; government provides procurement demand signals, regulatory expertise, and access to national laboratory infrastructure and talent; and industry provides market knowledge, manufacturing expertise, and the capital and operational discipline required to reach commercialization.

Land-grant universities and their associated institutions are a natural institutional anchor for this tripartite model in many states because they were founded on exactly this three-part mission: scientific research, practical application, and direct engagement with the industries and communities of their regions. Their USDA relationships, extension service infrastructure, and agricultural and biological research bases make them the lowest-friction starting point for NBIN deployment across the full national geography. National laboratories or private institutions may also be natural anchors in some states. In either case, where regional partners can support it, physical co-location is a powerful accelerator for the model: translation failures are in significant part failures of tacit knowledge transfer that may include process scale-up know-how; regulatory navigation; and manufacturing troubleshooting that is transmitted through shared practice, not documentation or remote collaboration. Indeed, co-location often compresses the institutional friction created by different cultures, incentive structures, and timelines, with prominent examples including Research Triangle Park, SEMATECH, Kendall Square, the Bay Area, and the North Carolina Biotechnology Center that all demonstrate tripartite proximity accelerates translation in ways virtual collaboration cannot replicate.

Importantly, this co-location logic extends to downstream infrastructure: an NBIN institute sited adjacent to a BioMADE pilot plant, BioFabUSA GMP facility, NIIMBL-affiliated manufacturing platform, an EDA Tech Hub region, or national laboratory campus or industrial collaborator compresses the institutional distance between translational and manufacturing stages. Technologies advance without arm’s-length handoffs, re-explained to new teams or renegotiated across organizational boundaries. Co-location with downstream manufacturing partners can therefore be a positive site-selection factor, not necessarily a duplication risk. However, a nationally networked model of federated institutes also confers distinct and powerful advantages, as described next.

4.2 Network, Not Isolated Centers

Individual tripartite incubator institutes as outlined above would be valuable but insufficient to drive robust national bioeconomic development. Indeed, research on the success and failure of regional biotechnology clusters

consistently points to networked learning—the systematic accumulation and circulation of knowledge across firms, institutions, and disciplines within a connected ecosystem—as a primary differentiator between clusters that sustain innovation over decades and those that do not (Powell, Koput & Smith-Doerr, *Administrative Science Quarterly* 1996; Saxenian, *Harvard University Press* 1994). The proposed national network architecture is designed to operationalize this dynamic at national scale: the proposed model is a national network in which individual institutes specialize by regional bioeconomy sector and connect through shared data and knowledge infrastructure, cross-institute project mobility, standardized governance frameworks, and coordinated state and national grand challenges, empowered by the vast US federal and state funding and regulatory agencies. This networked model provides benefits no individual center can: technology-to-infrastructure matching, cumulative cross-site data, national-scale challenge capacity, and protection against political fragmentation by embedding each institute in a coordinated system.

The network's cross-institute collaboration capability is among NBIN's most distinctive advantages over isolated, competitive regional programs. For example, an expert computational protein designer in Washington State designs novel enzyme variants, and rather than attempting downstream validation in-house, they co-develop its application with a biofuels institute in Nebraska where the feedstock base, technical expertise, and pilot-scale infrastructure exist to test performance under real production conditions. Alternatively, a synthetic biology group in the Boston or Bay Areas designs production strains for high-value fermentation products, and it partners with an agricultural institute in Illinois or Iowa for feedstock validation and scale-up data. In both cases, IP remains with the originating institutes, scale-up data belong to the host institute, and portfolio companies access both under a pre-negotiated inter-institute IP framework. This cross-pollination compounds over time: a national network in which every institute can draw selectively on the discoveries, datasets, and specialized infrastructure of all others across state lines is structurally capable of generating substantially more company formation and entrepreneurial activity nationally than the same institutes operating in isolation would ever produce individually—this is a central economic and political case for federal investment in NBIN as a connected system rather than as a portfolio of unrelated state programs.

Further examples are systematically brokered by the NBIN National Coordination Office, which maintains a live capability map of every institute and actively identifies complementary pairings that accelerate translation faster than any single institute could achieve alone. The same cross-network architecture enables multi-institute missions from DOD, industry consortia, or federal agencies—tasks no individual translational incubator could absorb at scale. Section 6 goes into greater detail on the National Network Architecture and its unique benefits compared with isolated institutes.

4.3 Aligned Incentives Across the Triple Helix

Perhaps the most persistent challenge in tripartite collaboration is incentive misalignment. Academic researchers are typically evaluated on publications, and commercialization activities can generate IP concerns and publication delays. National laboratory staff often face mixed incentives between publication, transition to industry, and institutional mission. Industry partners might seek competitive advantage and are reluctant to share pre-commercial data. Finally, venture capital operates on 3–7-year return horizons misaligned to 10–15-year biological development timelines.

The NBIN model addresses these misalignments structurally rather than aspirationally: IP frameworks governing academic contributions are negotiated before work begins, not after, and publication pathways for non-proprietary findings are protected. Industry partners contribute to pre-competitive data zones in exchange for access to shared infrastructure and data. And national laboratory personnel are embedded in institute programs with roles that advance their institutional missions. The goal is not to make everyone's incentives identical because they may never fully align, but rather to design an institutional environment in which each actor's legitimate interests are served by collaboration, rather than undermined by it, to empower biotechnological innovation.

Venture capital's participation is addressed by redesigning the point of entry rather than asking VCs to change return expectations. For example, capital partners might gain agreed upon access to entrepreneurial teams and technologies at TRL 3–4—years before conventional channels surface them—building relationships and conviction across a longer observation window. In exchange, they can contribute to the institute's private capital stack and provide market intelligence. Base operations are funded through the federal and state capital stack, with VC participation accretive, not structural. And if a partner withdraws, the institute continues.

4.4 Federal University Partnership Network as NBIN Anchors

NBIN's national reach rests on the existing federal university partnership network. Land-grant universities (1862, 1890, and 1994 institutions, including HBCUs and Tribal Colleges) are the primary default anchor: 112 institutions across all 50 states with USDA/NIFA relationships and a statutory three-part mission of research, education, and extension. Sea-grant universities anchor marine economy translation in coastal states; sun-grant centers anchor bioenergy and bioindustrial materials in agricultural states; and space-grant consortia contribute precision agriculture, circular biomanufacturing, and aerospace-adjacent materials capabilities. Together, these designations provide an eligible anchor in every state and cover the full sectoral breadth of the bioeconomy. This geographic breadth is central to NBIN's economic logic, not incidental to it. As Gruber and Johnson argue in *Jump-Starting America* (2019), sustained public investment in science—deliberately distributed to seed new regional technology hubs rather than concentrated in a handful of coastal centers—is among the most powerful available levers for reviving broadly shared economic growth. A land-grant-anchored national network operationalizes precisely that strategy for the bioeconomy nationwide.

These federal university partnerships do not restrict who participates in NBIN—they identify the preferred institutional anchors for NBIN's network nodes. Private research universities, independent research institutes, government laboratories, and community colleges are all eligible to also participate as academic partners, as sources of resident companies and entrepreneurs, and as co-investors in specific programs. A Tier 1 institute does not need to be physically located on land-grant soil—it can be regionally co-located with a land-grant (or sea-grant, sun-grant, or space-grant) institution that serves as its primary academic anchor and federal funding relationship. This flexibility enables NBIN nodes to be sited in industrial parks, downtown innovation districts, or dedicated bioindustrial campuses while maintaining the institutional anchor relationships that provide scientific depth, talent pipelines, and federal partnership leverage, depending on regional preferences.

NBIN institutes are designed to help fulfill land-grant universities' own statutory mission—regional economic development, workforce development and technical training, and translation of research into applied use. Whether a Tier 1 institute is located on university soil and within existing campus facilities, or at an off-site regional location, is a determination left to the state and local actors proposing the institute based on their own cost, timeline, and site-availability considerations—not a requirement or default imposed by the network design. Indeed, either arrangement, or any mix across the network, is consistent with the NBIN model. Tier 2 and Tier 3 institutes are purpose-built or substantially renovated facilities, typically sited in industrial parks, innovation districts, or dedicated bioindustrial campuses regionally co-located with—but physically independent of—their academic anchor, albeit still with co-aligned mission of regional economic and workforce development.

4.5 NBIN as Strategic Venture Investor: Building on Proven Nonprofit Investment Models

NBIN does not require Congress to invent an entirely new kind of institution. Independent nonprofit and quasi-public venture organizations have deployed patient capital, supported technology commercialization, and recycled investment returns into regional innovation ecosystems for decades—at both the federal and state levels. In-Q-Tel (IQT), the nonprofit strategic investor established in 1999 for the Intelligence Community, is the most visible federal example: an independent board drawn from the private sector that takes equity on commercial terms and receives capital through investment agreements rather than grants or contracts subject to the Federal Acquisition Regulation, giving the government early access to capabilities it could not procure as quickly through conventional acquisition. But the model is far broader than one agency. Comparable nonprofit and quasi-public venture organizations already operate in states as different as Nebraska (Invest Nebraska), Tennessee (Launch Tennessee), Massachusetts (MassVentures), Connecticut (Connecticut Innovations), and North Carolina (NC IDEA)—with dozens of similar vehicles in states across the country—and they have shown that mission-driven organizations can coordinate public and private capital, support commercialization, recycle returns, and operate with an agility that traditional government programs cannot match. That such public-private investment models already operate and draw sustained support across state and federal levels is itself an argument for NBIN: Congress is not being asked to embrace an unfamiliar or untested institution, only to build nationally on a proven approach that state governments across the country have already chosen to fund at home. NBIN is the national, bioeconomy-specific extension of this proven family, not a departure from it—applying the same disciplined selection and patient-capital functions to the bioeconomy, with one important distinction: physical derisking, translational infrastructure.

IQT largely invested in software and hardware companies that can be developed in commercial labs and office space. In contrast, biotech companies cannot be built without pilot-scale fermenters or analogous process development equipment, GMP manufacturing suites, autonomous screening platforms, and regulatory science staff—infrastructure that no startup can afford to build alone and that no venture fund has historically been willing to capitalize outside the venture capital hubs of Boston, New York, and San Francisco, where deep biotech capital is concentrated. This is the structural reason the valley of death exists in biotechnology but is less acute in software: the capital requirements for the translational step are substantially higher. NBIN’s physical incubator network fills this gap, combining IQT’s governance model with the operational derisking infrastructure of Flagship Pioneering, Deerfield/Cure, and Versant Ventures: companies don’t just receive investment—they receive a lab, a team, regulatory expertise, and a pipeline of co-investors.

Importantly, the validation an NBIN institute confers by selecting a company operates independently of the capital itself. Much as IQT, state investment groups, venture groups, and incubators that provide seed capital such as Y Combinator, the successful Bay Area incubator, acceptance of companies into the NBIN network functions as a quality signal in the technology startup ecosystem—attracting follow-on venture capital disproportionate to the initial check sizes because selection processes have already done a first pass of technical and market diligence. Thus, an NBIN institute’s investment or resident-company designation is designed to function the same way for biotechnology: third-party validation that lowers the information-asymmetry burden for private co-investors evaluating an unfamiliar biological technology, accelerating the follow-on capital NBIN’s model is built to attract.

The non-federal governance structure is load-bearing: a non-profit board drawn from academia and industry—without federal employees as voting members—can close equity investments within weeks, attract investment professionals at market compensation, bring in private co-investors without triggering federal acquisition rules, and insulate operations from the annual appropriations cycle. Federal agencies participate through investment agreements with defined strategic return expectations, not through program offices that become budget targets.

The difference between NBIN and Manufacturing USA, SBIR, or ARPA programs is therefore structural, not merely programmatic. Manufacturing USA institutes are federal programs with federal governance, established under the Revitalize American Manufacturing and Innovation Act of 2014 (P.L. 113-235). SBIR and STTR are grant programs—they provide money but not infrastructure, equity stakes, or investment discipline. ARPA programs fund projects with defined deliverables but do not take equity, build infrastructure, or create self-sustaining investment vehicles. NBIN does all three and leverages all three: it builds the infrastructure, deploys capital with venture discipline, takes equity stakes, and is designed to generate compounding returns that, if successful, progressively reduce dependence on federal appropriations. It is designed to become progressively self-financing—and its governance structure is designed to survive changes in political administration, agency budget environments, and congressional priorities. As Bonvillian documents, DOD historically ran a connected innovation system—supporting development and demonstration alongside research—while civilian agencies “supported research only.” NBIN extends that connected model to the civilian bioeconomy (Bonvillian 2024).

4. Key Insights

Physical co-location is a mechanism by which tacit translational knowledge can transfer across institutional boundaries.

A tiered national network anchored across 50 states provides what individual centers cannot: technology matching, cumulative data, national-scale challenge capacity, geographic equity, distributed economic development, and political resilience—with a built-in coalition spanning every state.

Incentive misalignment is addressed structurally—through pre-negotiated IP frameworks, pre-competitive data zones, and redesigned VC entry points—not aspirationally.

NBIN is structured as a nonprofit strategic venture investor that offers translational infrastructure—taking equity in resident companies and recycling returns into its translation mission—building on proven public-private investment models such as In-Q-Tel and state venture nonprofits.

5. Institute Design Blueprint

5.1 Mission and TRL Focus

Each NBIN institute defines a sector-specific mission aligned to regional bioeconomy strengths—for example, agricultural biotechnology in the Midwest, marine bioproducts in coastal regions, critical materials in resource-producing states, biomedical and biopharmaceuticals in established life science clusters, etc. Each institute’s mission spans the translational arc from proof-of-concept through pilot-scale demonstration, which is typically TRL 3–6 for regulated biological products, TRL 2–5 for non-regulated materials and fuels, and possibly extending to TRL 7 or higher for clinical biologics in collaboration with BioFabUSA, NIIMBL, BARDA, and contract development and manufacturing organization (CDMO) partners. Precise TRL scope is set at enrollment based on regional product mix and demonstrated demand, not by a uniform network-wide mandate. Tier 1 institutes focus on the earliest translational stages; Tier 2 hubs cover the full arc with sector specialization; and Tier 3 flagships add national challenge capacity, autonomous data generation, and GMP manufacturing. Above each institute’s defined exit point, resident companies might graduate to Manufacturing USA institutes (BioMADE, NIIMBL, BioFabUSA), CDMOs, industry partners, or venture-funded standalone operation. Thus, structured handoffs above TRL 6 are designed relationships with specific downstream partners, codified at founding rather than improvised when a technology matures: BioMADE for non-medical biomanufacturing; NIIMBL for biopharmaceutical process development; BioFabUSA and associated CDMO networks for clinical and regulated product pathways. These codified relationships would help ensure the translational pipeline operates as a continuous arc rather than a series of disconnected hand-offs.

5.2 Physical Infrastructure

Physical infrastructure scales with tier designation and regional context. Tier 1 institutes (e.g., 5,000–25,000 sq ft) might leverage existing land-grant or partner institution laboratory space, adding targeted equipment for the most critical regional translational gap—a pilot-scale fermentation unit, a downstream processing skid, or an automated screening platform—without requiring new construction. Many Tier 1 institutes can be operational within existing buildings as soon as 18–24 months, with the automation-to-insight and pilot-scale equipment suites installed on a phased basis as procurement and validation complete. Tier 2 regional hubs (e.g., 50,000–150,000 sq ft) may require purpose-built or substantially renovated space with sector-specific equipment suites, GMP or near-GMP manufacturing areas, regulatory science staffing, and entrepreneurs-in-residence. Tier 3 flagship institutes (e.g., 150,000–300,000 sq ft) would house the full capability suite including autonomous lab platforms, multi-scale bioprocessing from 10L up to 10,000L, GMP manufacturing, national data infrastructure nodes, and the workforce development facilities to serve their broader regional network. The specific footprint within each tier is determined at enrollment based on demonstrated translational demand, available co-infrastructure, and state and industry co-investment commitments, which may incorporate venture capital, family office, private equity, and philanthropic investments. Core physical infrastructure at institutes might include: high-throughput automated biological and biomedical research platforms (robotic liquid handling, automated strain engineering, combinatorial screening); AI-ready data generation systems producing structured, FAIR-compliant (Findable, Accessible, Interoperable, and Reusable) biological datasets (Wilkinson et al., *Scientific Data*, 2016); pilot-scale fermentation and bioprocessing equipment; downstream processing and quantitative analytical infrastructure (centrifugation, filtration, chromatography, formulation, etc.); near-GMP manufacturing space for regulated product development; regulatory science and quality systems staff; and secure research environments capable of hosting government-sensitive projects with appropriate data separation.

The physical design integrates industry co-location space—wet laboratories, office space, and shared equipment access—for resident companies at various stages of development. Venture capital and corporate development partners can be embedded into the facility to provide capital access and market intelligence at the point of technological development. This physical integration would compress the distance between technology developers and capital providers that currently makes fundraising a multi-year distraction from both scientific discovery and translational progress.

Analytical characterization infrastructure is co-equal to bioprocessing equipment in institutes operating in regulated biological product verticals and should be treated as such in physical infrastructure plans. MAM, biophysical characterization platforms (microscale thermophoresis, analytical ultracentrifugation, native mass spectrometry), real-time process analytical technology (PAT), and higher-throughput, higher-sensitivity methods that directly measure cellular and product attributes, and associated data management infrastructure are some examples of the primary scientific tools by which process understanding is built, comparability is established, and product quality attributes are linked to process parameters at TRL 4–6. Without them, bioprocessing data cannot be translated into the structured, attribute-linked datasets that constitute credible regulatory evidence or meaningful process knowledge. These characterization datasets are as tacit, infrastructure-dependent, and strategically valuable as bioprocessing process knowledge, so the national data moat described in Section 5.5 would be incomplete without them. The specific characterization platform mix would be calibrated to each institute’s regional product focus, but the principle of co-equal investment applies across all regulated biological product verticals. Across the full capability stack—upstream strain construction and genetic engineering tooling, automation and high-throughput screening platforms, unit operations for bioprocessing, and analytical and characterization cascades—specific instrument selection, configuration, and workflow sequence is determined locally at enrollment by the regional product mix, feedstocks, and regulatory pathways each institute serves.

5.3 Governance Structure

Each regional NBIN institute is separately incorporated, which gives it operational autonomy while keeping it accountable to the network’s shared investment standards and data-sharing protocols. Each institute is intended to become a permanent regional institution whose capabilities, relationships, and investment returns compound over decades rather than resetting with each appropriation cycle. Participation is deliberately modular: private investors—family offices, regional venture funds, private equity groups, corporate strategics—can back a specific institute without assuming the governance or financial obligations of the broader network, and states can co-invest, pool support across shared regional institutes, or contribute in other forms, without requiring uniformity across 50 states. In every case, states participate as strategic partners and co-investors, not operators, and each institute remains independently governed.

NBIN comprises the NBIN National Coordination Office in Washington, DC and regional NBIN institutes across the country. The coordinating office is a non-federal entity that receives federal investment capital through investment agreements rather than procurement contracts, that is authorized to retain and reinvest the returns on that capital rather than remitting them, and that coordinates institute-level investment functions. The institute holds equity in resident companies, private co-investors participate at the company level on market terms, and institute-level supporters contribute without expectation of financial return. Any returns from the network’s investment function flow to operations and reinvestment, never to individuals. No institute earnings or appreciation in portfolio value may be distributed to institute directors, officers, or trustees, or contributors. The precise legal architecture—including entity form and the enabling federal authorities—is a determination for authorization and subsequent rulemaking, not for this report to prescribe, and is left open among the vehicle types surveyed in Section 8.3.

At the institute level, governance is led by a Board of Trustees modeled on proven nonprofit-investor governance. A representative board might typically include: the President/CEO (a private-sector appointment not subject to civil service rules); representatives of the anchor institution(s); up to three trustees drawn from private capital partners (regional venture funds, family offices, private equity groups, corporate strategics); one or two industry trustees from regionally relevant sectors; one or two philanthropic trustees; and one or two independent trustees with scientific or investment expertise. Where the state co-invests, a state economic development representative may be seated. Federal funders participate without holding voting control. No single funding source controls the board, private co-investors may hold governance participation proportional to their stake as the institute’s bylaws provide, and federal participation does not convert the institute into a de facto federal program.

The institute, never an individual, holds equity in resident companies during their residency, and any returns from the investment function accrue to NBIN’s operations and network reinvestment rather than to board members, officers, or staff. Importantly, conflicts of interest are managed structurally: trustees and investment-committee members are barred from personal positions in resident companies during their involvement, and disclosure, recusal, and independent review govern any adjacent financial interest. Investment decisions are made under written conflict-of-interest policies comparable to those used by established nonprofit venture organizations. A trustee’s

affiliated fund may still participate as a Layer 4 co-investor in resident companies under these disclosure-and-recusal rules (with the trustee recused from the institute's investment decision in that company and the affiliated fund investing on the same terms as other co-investors); what is barred is a trustee's personal financial position in a resident company. The detailed rules—cooling-off periods, any right to participate in a company's later financing rounds, and reporting mechanics—belong in the vehicle's governance documents and IRS filings, established at authorization.

The Investment Committee, operating under the Board of Trustees, governs equity investment decisions. Investment selection and portfolio management operate under authorities delegated by the Board that are distinct from program and operational governance, keeping investment decisions disciplined and insulated from day-to-day programmatic or political considerations. The Chief Investment Officer (hired at market compensation) chairs the Committee and is accountable to the Board on portfolio performance. Senior scientist positions with deep biological domain expertise—required to navigate scale-up changes in biological properties—are core staff at most institutes, as well as offered as core resident expertise in the national headquarters offered to all institutes.

An industry advisory committee that is separate from governance can provide market intelligence, technology roadmap guidance, and procurement linkages. The network may also convene an optional National Advisory Council of leaders from government, industry, academia, investment, philanthropy, and the national laboratories to provide strategic guidance, ecosystem coordination, and national champion-building, distinct from the fiduciary role of the Board. Technology intake into the institute pipeline may occur through multiple defined channels: faculty and researcher nominations through anchoring academic institutions; direct referrals from ARPA program managers; applications from SBIR/STTR awardees seeking infrastructure to advance beyond the project stage; and institute-initiated scouting by the scientific advisory board. Each intake pathway feeds into a common TRL assessment and project admission process, ensuring consistent standards regardless of how a technology enters the network.

5.4 Workforce Integration

The human capital challenge is among the most critical and underappreciated dimensions of the incubator model. Workshop participants identified a persistent gap in workforce development funding across major collaborative biotechnology initiatives: even well-funded ARPA-H programs have seen workforce training as the first budget line to be cut under resource pressure. This pattern must be reversed by design, not corrected after the fact.

Each institute embeds workforce development as a core operational function through entrepreneurship training, registered apprenticeships, cross-sector mobility rotations, and doctoral tracks designed to produce graduates fluent in both biological science and translational commercialization. Workforce development funding should be sustained through dedicated streams—NSF INTERN, DOL apprenticeship grants, NIFA workforce programs, and state economic development funds—not subsumed within R&D budgets where it will always be subordinated. Dual-degree programs (BS/BA, BS/MS, BS/MA, MS/MBA, PhD/MBA) are natural pipeline feeders; land-grant extension services provide a pre-existing outreach infrastructure for identifying rural entrepreneurs and channeling applied research demand into the institute pipeline.

Community college partnerships are a critical and underutilized access point for the technical workforce each institute requires. Two-year programs in bioprocess technology, laboratory automation, biomanufacturing operations, and fermentation science supply the skilled technician workforce that four-year degree programs do not produce at sufficient volume or with sufficient applied orientation. Each institute should formalize articulation agreements with regional community colleges, co-designing curriculum to match institute equipment, workflows, and staffing needs. Cooperative education placements, registered apprenticeships, and dual-enrollment pathways that allow community college students to train directly on institute infrastructure provide students with real translational experience while supplying institutes with a trained, locally rooted technical workforce. Land-grant and sea-grant institutions with existing community college partnership networks are natural conveners of these relationships, and NBIN's authorization should explicitly name community college partnerships as a required component of each institute's workforce development plan.

Residency structure is calibrated to the company's translational stage. Faculty investigators may enter residency through sabbatical or formal leave of absence, typically one to three years, maintaining their tenure-track position. National laboratory scientists enter through IPA assignments with protected re-entry pathways. Graduate students

and postdoctoral researchers reside for one to three years with academic credit and joint appointments negotiated with the anchor university. Each institute maintains standing residency agreements with anchor universities and partner laboratories that streamline appointments, IP arrangements, and re-entry pathways.

The cooperative education placements named above should be structured as paid, credit-bearing, semester-length rotations with defined curriculum integration, joint supervision, and re-hire pipelines—not standard internships, but multi-year commitments that create a self-reinforcing local talent pipeline. Alongside them, institutes should partner with regional community colleges and national bioscience credentialing bodies such as the Bioscience Core Skills Institute to co-develop stackable microcredential programs calibrated to the institute’s specific equipment, workflows, and safety protocols—not adopted from existing curriculum catalogs. In nascent-ecosystem regions where the existing workforce has agricultural and manufacturing backgrounds, these microcredentials are the primary near-term mechanism for transitioning incumbent workers into biomanufacturing roles. Regional work-based learning networks coordinated across multiple employers—for example, modeled on the emerging New England regional network linking the Roux Institute, the Rhode Island Life Science Hub, and the Massachusetts Life Sciences Center—can multiply the scale and career impact of individual institute programs and should ideally be documented and disseminated as a blueprint by the NBIN National Coordination Office.

Operational experience at existing university-based translational centers underscores that co-op and apprenticeship structures function as intended only when faculty champions actively advocate internally for credit recognition and when institute staff are explicitly budgeted to supervise and assess placed students—roles that do not emerge spontaneously from signed partnership agreements and must be protected as dedicated workforce line items.

5.5 AI, Robotics, and the National Data Moat Strategy

AI can now synthesize the published literature, mine patent databases, reconstruct experimental protocols, and accelerate hypothesis generation across any biological domain—rapidly filling the knowledge-based moats that have historically protected U.S. biotechnology leadership. A foreign competitor with sufficient compute can compress decades of published U.S. research advantage into a training run. This is a present competitive dynamic, and it is accelerating rapidly.

As noted earlier in the report, the moat AI cannot breach is the body of proprietary experimental data and process knowledge that was never published in archival journals or the patent literature in the first place. These include scale-up failure modes identified prior to or at pilot scale; process parameter envelopes validated across dozens of biological feedstocks; strain performance data generated under real bioreactor conditions across hundreds of iterative cycles; and negative results that map the precise boundaries of what works, what does not, and why—each of which is equally irreplaceable. These data are tacit, infrastructure-dependent, and impossible to reconstruct from any public source. They can only be produced by institutions operating the right physical infrastructure at meaningful scale—and they accrue exclusively to those who generate them first. In the AI era, proprietary biological data generated at translational scale are among the primary determinants of durable strategic national advantage in biotechnology.

Universities, despite their unmatched role in generating fundamental discoveries, generally cannot fill this proprietary, unpublished gap that is inaccessible to foreign competitors. Moreover, academic research environments are not structured, designed, or funded to run continuous, deliberate proprietary data generation campaigns at translational scale for commercialization purposes, and publication incentives favor novelty over systematic parameter mapping. Compounding these issues, institutional review processes are misaligned to the rapid iterative cycles of robotic high-throughput experimentation, and the capital required to acquire, operate, and maintain autonomous lab platforms—integrated with specialized pilot-scale equipment and downstream processing—far exceeds what all but a small handful of specialized academic core facilities can sustainably deploy. This is infrastructure where the ARM Institute’s expertise in industrial robotics integration and maintenance is a natural complement (Section 9). In parallel, the NSF BioFoundries program (\$75M across five awards, 2024) represents an important step toward democratizing automated biological research infrastructure at universities, and the five funded sites—integrating robotics, AI, and synthetic biology at the discovery scale—are natural feeders into NBIN’s translational arc and capabilities. But BioFoundries operate at TRL 1–4 and are structured for open-access academic research, not for the continuous proprietary data generation campaigns at pilot scale that constitute the national data moat.

The proprietary data moat is therefore not merely beyond what any single company can afford to generate alone; it is beyond what the university sector, even collectively, is structured to produce, even with substantial federal funding. Only purpose-built, professionally staffed translational institutes with a core mandate to generate these data—operating under governance frameworks that protect their strategic value—can fill this role at national scale. For example, each institute may run continuous, deliberate data generation campaigns as a core programmatic function if enabling for their regional bioeconomy—not as a byproduct of individual research projects. The resulting datasets—structured, FAIR-compliant, held within federated pre-competitive data zones—can be made available to resident startups as a foundational competitive resource that no individual firm could afford to generate alone.

The national data moat strategy intersects directly with an emerging strategic priority: sovereign AI. As nations and institutions recognize that AI capability depends fundamentally on control over the data used to train and fine-tune models, data sovereignty and AI sovereignty have become inseparable. Countries that control proprietary, high-quality biological datasets do not merely hold a competitive advantage in the bioeconomy—they hold the inputs to the next generation of biological AI. NBIN institutes, by generating structured, FAIR-compliant biological datasets under federated governance frameworks, are the institutional mechanism by which the United States asserts sovereign AI capacity in the bioindustrial domain: ensuring that the foundational training data for biological foundation models is generated domestically, held under U.S. governance, and made available to U.S. innovators on terms that foreign actors cannot replicate or intercept.

This framing elevates NBIN from a translational infrastructure investment to a data-and-AI sovereignty initiative—one whose strategic value compounds as biological AI models become central to drug discovery, agricultural optimization, materials design, and national security applications. The DOE Genesis Mission (formalized February 2026, \$293M RFA) provides the shared AI backbone NBIN institutes build on: foundational biological AI models, data infrastructure, exascale computing, and autonomous discovery infrastructure across all 17 DOE national laboratories. NBIN generates the proprietary translational-scale biological data layered on top—Genesis Mission provides the public computational and infrastructure foundation; NBIN generates the irreplaceable proprietary experimental process and data moat. Full integration details are provided in Section 9.

5.6 Intellectual Property and Data Framework

Each institute maintains template IP and licensing frameworks pre-negotiated with its anchor universities, removing one of the most common multi-year delays in technology translation. Resident companies may in-license intellectual property from their anchor universities under standard option-to-license terms—exercisable either while the company is in residence or after graduation from the institute—at pre-negotiated terms calibrated to translational-stage risk rather than ad hoc deal-by-deal negotiation.

New intellectual property generated within the institute is owned by the resident company, subject to Bayh-Dole principles and the institute's standard licensing back-rights for any federally-funded underlying research. Beyond patented intellectual property, resident companies build the proprietary process know-how, strain libraries, scale-up protocols, and structured experimental datasets that constitute the durable competitive moat described in Section 5.5. These trade-secret assets are not published, are owned by the company, and represent an increasing share of company valuation to investors as technologies mature.

Data sovereignty is a foundational design principle of NBIN. No company or entrepreneur operating at any Tier level institute is required to share proprietary data, unpublished results, or internal processes with any other company, institute, or network member. Participation in NBIN's federated Web of Biological Data is structured to allow companies to benefit from pre-competitive, aggregated benchmarks and public scientific resources—including open databases and models made available through DOE, NSF, and the published literature and patent record—without any obligation to contribute their own proprietary experimental data. The right to generate, hold, and exclusively exploit trade-secret data and processes is not conditioned on institute residency, network membership, or receipt of NBIN capital. This is not incidental: it is the entire point of the NBIN model. Companies participate in NBIN because the institute provides the infrastructure, capital, and expertise to generate valuable proprietary data—not because they are required to share it. The national data asset is assembled from the pre-competitive, aggregated, and anonymized process and failure-mode data that translation itself generates (Web of Biological Data, Tiers 1–2), not from companies' retained trade-secret data—so aggregate national advantage and individual data sovereignty are complementary rather than in tension.

The institute's role is to provide the legal infrastructure, template agreements, and embedded counsel that allow these IP arrangements to be executed on translational-stage timelines rather than academic-tech-transfer timelines. Importantly, however, extensive operational experience at university-based translational centers consistently reveals that IP friction points arise not from template terms but from the exceptions—the faculty investigator whose technology carries prior grant funding encumbrances, or the sponsored research agreement whose terms conflict with a proposed resident company license. Institutes that have built robust IP intake processes have done so by investing in dedicated IP counsel embedded at the center level, not in templates alone, which NBIN institutes should account for at inception.

5.7 Regulatory Science as a Core Translational Competency

The Institute Design Blueprint identifies regulatory science staffing as a physical infrastructure element alongside GMP space and downstream processing equipment. This framing understates the strategic role regulatory science plays in determining whether a technology successfully crosses the TRL 3–6 arc. At institutes focused on regulated biological products—biologics, biosimilars, cell and gene therapies, agricultural biologics—regulatory fluency is frequently the rate-limiting step that determines whether a company can attract follow-on capital, execute a credible handoff to a Manufacturing USA partner, or achieve the commercial milestone that justifies its residency. Regulatory science should therefore be embedded as a core strategic capability at every institute operating in regulated-product verticals, not merely as staffing capacity. This also distinguishes regulated biotechnology from hard-technology sectors: FDA phase progression provides a staged, externally validated milestone structure against which follow-on capital can be benchmarked—a validation scaffold most hard-tech ventures lack. But that scaffold engages only once a company can generate the characterization and process data a regulatory submission requires, which is precisely the capability the institute supplies.

Each NBIN institute should therefore maintain a dedicated regulatory science function with three operational responsibilities: pre-submission strategy (e.g., regulatory pathway assessment at intake, covering product classification, applicable guidance frameworks, and a translational roadmap sequencing scientific milestones against regulatory decision points from TRL 4 through handoff); CMC and process analytical support (e.g., coordinating access to the analytical chemistry and process analytical technology expertise required to generate characterization data packages that regulatory submissions require); and regulatory intelligence (e.g., a standing horizon-scanning function tracking emerging agency frameworks, draft guidances, and international harmonization developments, shared across the network through the NBIN National Coordination Office).

This is not a function that can easily be contracted out on an ad hoc basis: regulatory strategy at TRL 3–6 requires sustained, longitudinal engagement with a company's scientific program, and institutes that treat it as an occasional consulting resource will consistently produce companies with regulatory packages inadequate for NIIMBL, BioFabUSA, BioMADE, or CDMO intake. The structured, FAIR-compliant datasets generated by institute autonomous lab platforms are precisely the input material for AI-assisted CMC characterization and process validation—institutes that design data generation workflows to be regulatory-submission-compatible create a compounding advantage: the same data that constitutes the national data moat simultaneously accelerates and de-risks the regulatory pathway for resident companies.

Thus, the NBIN National Coordination Office should establish a Regulatory Science and AI Working Group with standing liaison relationships to FDA (CDER, CBER, CFSAN), USDA-APHIS, and the EPA. Because many bioeconomy verticals fall outside of FDA jurisdiction, this function needs to be fluent across the full range of applicable pathways—EPA review under FIFRA and TSCA for biopesticides and industrial chemicals, USDA-APHIS oversight for plant and animal biologics, and the GRAS and CFSAN pathways for food ingredients—so that agricultural, industrial, and food-sector companies receive regulatory strategy calibrated to the agencies that govern them at the federal and state levels. Because formal standards from bodies such as ISO, IEC, ASTM, and ASME increasingly underpin regulatory acceptance, each institute's regulatory science function should engage NIST—whose metrology, reference materials, and AI-ready data standards work directly supports these pathways—and these standards-development organizations early, advancing U.S. leadership in standards development, with its substantial economic implications, while ensuring standards accelerate rather than impede innovation.

5. Key Insights

Incubators must cover the TRL 3–6 arc with end-to-end infrastructure: pilot-scale equipment, GMP environments, regulatory science staff, and autonomous data generation platforms suitable to regional needs. Workforce development is a core function, not an amenity—and must be protected from budget subordination by design.

Each institute is separately incorporated and independently governed beneath the NBIN National Coordination Office, so states, philanthropists, and private investors can back a single institute without assuming network-wide governance or financial obligations.

Proprietary biological data generated at translational scale is the one competitive moat AI cannot fill. The DOE Genesis Mission provides the shared AI and infrastructure backbone; NBIN generates the irreplaceable proprietary data layer on top. Together they constitute U.S. biological AI sovereignty.

Pre-negotiated IP frameworks and data sovereignty—resident companies own their proprietary data and are never required to share it—keep translational speed and commercial value aligned.

Regulatory science is a core, longitudinally embedded institute competency—spanning FDA and non-FDA pathways such as USDA-APHIS and EPA—not an outsourced consulting function.

6. National Network Architecture

6.1 Regional Specialization

The national network is defined by differentiated regional specialization, not replication of identical facilities across geographies. Candidate regions are identified by these distinct strengths and confirmed through the competitive, readiness-based enrollment process in Section 7, rather than preassigned. Each institute builds on what already exists: the microbioeconomy of its region—its feedstock availability, industry concentration, workforce characteristics, university strengths, and state economic priorities.

Every state's anchor institutions define natural starting specializations: Great Plains and Corn Belt states might anchor bioenergy, biofuels, agricultural biotechnology, and bio-based materials and industrial chemicals; coastal states might anchor marine bioproducts; Appalachian and Mountain states could anchor critical mineral bioextraction; Southern states a range of specializations depending on region; Mid-Atlantic and New England states might anchor biopharmaceuticals and cell and gene therapy; etc. These sector labels are illustrative starting points, not an eligibility filter; each institute serves the full breadth of its regional bioeconomy, including products that span or fall outside these categories. Tier 1 institutes in lower-density bioeconomy states focus on one or two peak sectors; Tier 2 and Tier 3 institutes in high-density regions cover multiple sectors.

A further axis of specialization is national-security-facing translation: institutes co-located with national laboratories or in defense-adjacent regions that anchor biodefense, biosecurity, and dual-use production capabilities—domestic diagnostics, medical countermeasures, crop and livestock protection, and biomanufacturing surge capacity—coordinated with the DOD mission portfolios described in Section 8.4 and the national-security rationale set out in Section 2.5. Tier 1 enrollment is available immediately to all 50 states, with the NBIN National Coordination Office providing technical assistance to any state that requests it. As one illustration of how Tier 2 and Tier 3 institutes might be selected on top of the Tier 1 institutes available to all 50 states, a candidate set of roughly ten regions, each aligned to a distinct strength, might include: the Corn Belt and Great Plains (agricultural biologicals, biomass and waste-stream valorization, and specialty biofuels); New England (advanced therapeutics and cell and gene therapy); the San Francisco Bay Area and Northern California (AI-driven biology and synthetic biology); the Research Triangle and broader Southeast (biologics and agricultural biomanufacturing scale-up); the Gulf Coast (industrial biotechnology and bio-based chemicals); the Pacific Northwest (computational protein design and sustainable materials); the Mountain West and Appalachia (critical-mineral bioextraction); the Upper Midwest and Great Lakes (bio-based polymers and manufacturing revitalization); the coastal Gulf, Atlantic, and Pacific regions (marine and blue bioeconomy); and the Northern Forest belt (forest bioeconomy and wood-derived biomaterials). This set is illustrative rather than prescriptive; actual regions, strengths, and tiers would follow from demonstrated readiness under the Section 7 enrollment process.

In many cases, cross-state collaboration can capture complementary value that no single state can generate alone. Additionally, local state boundaries can be flexible to serve regional demand from local entrepreneurial talent, institutions, industry, and economic goals. For example, Massachusetts and California's Bay Area anchor deep concentrations of synthetic biology, biopharmaceutical R&D, and AI-and-robotics-enabled automation platforms, whereas Nebraska, Iowa, and other Corn Belt and agricultural states anchor distinct comparative advantages in agricultural biologicals, biomass and agricultural waste-stream valorization, with land-grant-embedded field and farm research infrastructure that neither coastal hub possesses. Unlocking cross-state collaboration between synthetic biology and agriculture, or AI-based enzyme design and fermentation, can offer innovation pathways that neither region is likely to realize as efficiently on its own. For example, through its Competitiveness Conversations Across America initiative, the Council on Competitiveness has documented how Nebraska and the broader American Heartland already possess the agricultural output, feedstocks, research base, and tightly connected innovation ecosystems required to anchor next-generation bioeconomy leadership—assets that a distributed national network is designed to activate (Wince-Smith, 2026). In some cases, lower-density regions may also be served best initially by a single institute designed for a multi-state geography. The governing criterion is translational throughput and economic development—the volume of inventions and startups a region generates or could generate with appropriate infrastructure—not geographic containment.

6.2 Core vs. Distributed Capabilities

In the tiered model, the core/distributed distinction operates at two levels: within each institute (which capabilities are present at that tier) and across the network (which capabilities at higher-tier institutes are accessible to lower-tier nodes through formalized inter-institute collaboration agreements). Tier 1 institutes are not expected to house the full capability suite—they are expected to house the capabilities most critical to their regional translational gap with ability to access Tier 2 and Tier 3 capabilities through the network collaboration framework, or equivalent facilities at partner institutions that may be public or private. Certain capabilities should ideally exist at every institute to ensure baseline translational function, however, such as automated biological research platforms, pilot-scale bioprocessing, regulatory science guidance locally or through consultants, and data systems compliant with network-wide interoperability standards. Other capabilities would deliberately be distributed: GMP manufacturing of sufficient scale for commercial Phase I/II clinical supply may exist at one or two institutes in the network, accessible to all through established protocols. Critical mineral (e.g., rare earths) extraction infrastructure may be concentrated at two institutes with relevant regional feedstock access. National laboratory integration for classified or dual-use work may be formalized at a subset of sites with appropriate security infrastructure. Regional facilities available through partner institutions, DOE or other government labs, Manufacturing USA Institutes, and industrial partners such as CROs and CDMOs may further dictate the nature and extent of institute capabilities needed to promote effective translation. Regional institutes may be permitted to engage in collaborative, industry- or DOD-sponsored research using their core facilities and capabilities, either through start-ups operating in the incubator space or independently to promote local bioeconomic development.

The core/distributed distinction may be codified in the national network architecture—a formal document specifying which capabilities should exist at all sites, which are distributed, how distributed capabilities are accessed, and how costs are allocated, with state-to-state flexibility embedded to satisfy local demand and needs of entrepreneurs and institutions. The administrative resources required to staff and operate each institute and its facilities would vary by tier and regional context: a Tier 1 institute may operate with as few as 5–15 full-time staff; a Tier 2 hub with 20–60; a Tier 3 flagship with 100–200. The scope of resident entrepreneur services, the technology focus area mix, and local funding availability each shape these estimates. A national coordination overhead of approximately 3–5% of total network operating budget is estimated to support shared data systems, inter-institute capability scheduling, and network governance and guidance. Individual institute staffing plans would be developed at the time of site selection in consultation with regional anchor institutions and state partners. Importantly, this architecture should be dynamic, reviewed and updated as the network matures and as new technology and priority areas emerge for regional and national bioindustries and demand signals coordinated by the DC office.

6.3 Web of Biological Data

The national network's data architecture operates as a federated “Web of Biological Data.” The HSST Bill H.R. 9307 has been introduced to require the DOE to establish the Web of Biological Data. DOE has initiated this DOE-Biological and enviRonmental Infrastructure for Data manaGement and Exploration (DOE-BRIDGE, <https://sites.google.com/lbl.gov/berdatalakehouse/research-infrastructure/work-plan>), based on DOE's biological data systems and integrated with the Genesis Mission AI infrastructure. The Web of Biological Data should operate with three access tiers. Tier 1 (open): aggregated, anonymized process benchmarks and failure mode taxonomies accessible to any qualified researcher. Tier 2 (network): FAIR-compliant translational-scale datasets accessible to all NBIN members and vetted partners under standard data use agreements, with fees scaled to organization size so small companies face no prohibitive barrier. Tier 3 (restricted): biosecurity-sensitive or dual-use datasets accessible only under enhanced biosecurity advisory panel review, consistent with federal select agent and dual-use research of concern frameworks. Pre-competitive upstream characterization and process failure mode data are Tier 1 or Tier 2 by default; resident company competitive data remains proprietary but structured for future Tier 2 contribution, when agreed upon by the resident company.

Data infrastructure—federated storage, model training compute, cybersecurity, and audit systems—is budgeted at 8–15% of each institute's annual operating expenditure, explicitly appropriated and ring-fenced rather than absorbed from R&D allocations. Cost containment relies on federated (not centralized) storage, open-source foundation model tooling, tiered data retention with cold archiving for raw data, and a network-wide procurement consortium achieving volume pricing across all sites. The data architecture does not require universal standardization of data collection methods across all biological domains—a technically infeasible goal that would

consume far more resources than it produces. Instead, the network invests in AI-enabled data translation: systems that make heterogeneously collected data interoperable for specific analytical purposes without requiring retroactive reformatting. This approach, proposed by workshop participants with direct experience of failed standardization efforts, is more realistic, more flexible, and ultimately more powerful than rigid schema enforcement.

6.4 Network Coordination Mechanisms

Network cohesion requires institutional machinery. Cross-institute project mobility when suitable—formal protocols for transferring projects between institutes as they advance through the TRL scale—ensures that technologies reach the most appropriate infrastructure at each stage. Cross-regional sabbaticals for institute leadership embed mutual understanding of different regional capabilities and cultures, as well as promote regional and national collaboration. Network-wide data governance bodies set and enforce shared standards. The NBIN National Coordination Office (see Section 7) manages the network’s strategic agenda, mediates inter-institute conflicts, and maintains relationships with federal agency partners. Additional guidance on any requisite network coordination mechanisms would emerge during legislative drafting.

6.5 Expansion and Duplication Avoidance

A critical discipline in network design is avoiding redundant buildout. States that have already been engaged in bioindustrial infrastructure investment may experience understandable skepticism at another federal initiative. The network design process therefore begins with a comprehensive mapping of existing capabilities: Manufacturing USA institutes (BioMADE, BioFabUSA, REMADE, and their peers), NSF Engines, NSF X-Labs sites, EDA TechHubs, national laboratory infrastructure, DOE Bioenergy Research Centers, EMAPS materials-scale-up facilities, DOE biofoundries, NSF BioFoundries, USDA biomass processing centers, land-grant university research infrastructure, and academic core facilities. New institutes are sited in gaps in this map or complementarily co-located in regions that require integration of their end-to-end biotech innovation system incorporating translational infrastructure with a patient capital stack. Expansion triggers are codified: new institutes would be added or expanded when demonstrated demand—measured by entrepreneurial pipeline volume, private capital and industrial co-investment interest, and regional economic development opportunity—exceeded existing network capacity in specific capability areas.

Critically, NBIN institutes are not replacements for existing Manufacturing USA institutes—BioMADE, BioFabUSA, and their peers—nor for downstream service providers such as CROs and CDMOs. Both are downstream options for companies either during or once emerged from NBIN’s translational pipeline. The institute’s role is to advance technologies from discovery to the threshold of manufacturing readiness across application and product areas; Manufacturing USA partners and CRO/CDMO networks each provide distinct pathways to commercial scale from that threshold. This upstream-to-downstream pipeline relationship is one of NBIN’s most important structural contributions: NBIN institutes function as the national discovery-pull and translational derisking layer that identifies promising inventions from government laboratories and university research programs and systematically advances them through TRL 3–6—producing the TRL 4–7-ready companies and validated processes that Manufacturing USA institutes across medicines, chemicals, materials, therapies, bioenergy, and agricultural biotechnology are designed to receive.

Notably, there is no strict TRL level at which NBIN ends and Manufacturing USA hand-off begins, because these transitions depend on the product class (e.g., chemical or medicine), company type (e.g., B2B or B2C), etc. Additionally, NBIN strengthens Manufacturing USA institutes by supplying their scale-up pipelines with the qualified, de-risked technologies they are designed to receive—operating as the national discovery-pull feeder network that sources promising discoveries, particularly from small- and medium-sized businesses, and advances them toward Manufacturing USA partners. Thus, NBIN is designed to be the fabric that glues together otherwise fragmented institutions, structures, and initiatives. Integration with Manufacturing USA downstream partners is preferred for NBIN institutes, though certainly not required depending on regional bioeconomic goals and resources. In particular, where a BioMADE pilot plant, BioFabUSA manufacturing facilities, a CDMO campus, or a CRO cluster already exists in a region, an NBIN institute co-located nearby may create the shortest possible path from bench discovery to commercial manufacturing. The network design process maps these downstream assets as positive factors in site selection, not as indicators of saturation, and formalizes technology transfer protocols

between NBIN institutes and regional manufacturing partners from day one, whichever type they may be, federal or state, commercial or public, etc.

6. Key Insights

Regional specialization leverages existing comparative advantages.

The core/distributed capability model ensures baseline function at every site while concentrating rare, expensive capabilities where they are needed most.

The network's federated Web of Biological Data—three access tiers (open, network, restricted) under FAIR-compliant access terms and biosecurity review—turns distributed translational data into a national asset without forcing universal standardization.

Network cohesion is engineered rather than assumed: cross-institute project mobility, leadership sabbaticals, shared data governance bodies, and the NBIN National Coordination Office, which brokers pairings and mediates conflicts.

Avoiding redundant buildout requires mapping existing infrastructure first—NBIN fills gaps, it does not seek to duplicate what already exists.

7. Network Enrollment Framework

7.1 Enrollment Criteria

Site selection is the network's first major implementation decision and must be governed by transparent, merit-based criteria that withstand political scrutiny. The scoring rubric proposed by workshop participants integrates five primary dimensions.

Talent and Institutional Anchors

Each applicant should demonstrate the anchor institution relationship (land-grant, sea-grant, sun-grant, space-grant, or equivalent alternative) and its existing biological sciences research base relevant to the proposed focus area. National laboratory and private institution partners and regional workforce capacity are evaluated proportionally to the proposed tier: Tier 1 applications require demonstrated anchor capacity and basic technical workforce; Tier 3 applications require demonstrated multi-institutional partnership depth, national laboratory linkages, private capital sources, and ideally a defined industry co-investment pipeline. Proximity of existing bioeconomy-adjacent companies and resources strengthen the application at any tier.

Infrastructure Readiness

Physical infrastructure requirements—utilities, water, waste treatment, transportation access, and available land or existing facility stock—should be assessed before site selection. Existing relevant infrastructure (pilot plants, GMP facilities, research parks) accelerates deployment timelines and reduces capital expenditure. Sites with existing national laboratory presence that can provide infrastructure partnership receive additional consideration.

Industry Ecosystem and Feedstock Access

Regional comparative advantage in specific bioeconomy sectors—feedstock availability, established manufacturing partners, existing customer base, supply chain infrastructure—is weighted heavily. A site considered for agricultural biotechnology that lacks access to commodity feedstocks, waste streams, fermentation equipment fabricators, and agricultural research networks may not be capable of fulfilling its mission regardless of academic quality.

State and Local Commitment

State government commitment—which encompasses financial participation (matching funds, bond-backed capital investment), infrastructure provision (land, utilities, existing facility stock), workforce investment (retraining programs, community college and technical school partnerships), and regulatory support (facilitation, zoning accommodation, permitting streamlining)—is a prerequisite, not an afterthought. The form of state match is flexible by design; the requirement for meaningful, demonstrated commitment is not. States that have established dedicated matching fund mechanisms, as Massachusetts did for the first wave of Manufacturing Innovation Institutes, provide a model. Local government buy-in is equally critical: large infrastructure projects attract NIMBY (“not in my backyard”) opposition that can derail permitting and community relations. Sites with demonstrated local government engagement and community benefit frameworks are preferred. Collaboration rather than competition between neighboring, participating states is desirable to facilitate regional economic and workforce development across state lines.

Capital Access and Investment Readiness

The availability of venture capital, philanthropic capital, and corporate development interest in the region is assessed as a leading indicator of the site's ability to attract the private portion of the blended capital stack and to provide companies emerging from the institute with robust follow-on financing pathways.

7.2 Enrollment Process

Enrollment proceeds through the Translational Institute Network Application (TINA) submission and review process administered by the NBIN National Coordination Office. Any state may initiate a Tier 1 TINA through its

land-grant or designated anchor institution at any point; there is no competitive cohort or deadline. Tier 2 and Tier 3 enrollment requires a demonstrated track record—either from Tier 1 performance or from existing equivalent infrastructure—and is reviewed on a rolling basis by the NBIN National Coordination Office with input from USDA (for agriculturally-anchored institutes), DOD (for defense-mission institutes), DOE (for energy-related institutes), and other relevant federal agencies as technical advisors. Independent expert panels assess readiness against tier-specific criteria; selection authority rests with the NBIN National Coordination Office, not with political appropriators. States may submit joint TINAs where regional collaboration across state lines better serves translational demand than separate state-level institutes.

7.3 Tier Progression and Phasing

Tier 1 institutes can begin enrollment immediately upon authorization, with the first cohort of states submitting TINAs within the first 12 months. Because Tier 1 builds on existing land-grant infrastructure, operational launch timelines of 18–24 months are achievable without new construction. The first cohort of Tier 2 institutes—identified from states demonstrating strong Tier 1 performance or existing equivalent translational capacity—may be designated within 24–36 months, or sooner. Tier 3 flagship designation requires a competitive process among demonstrated high-demand regions. For regions without existing Tier 2-equivalent infrastructure, this process likely begins at year 5, with initial operational capacity targeted by years 6–8. Regions that already demonstrate the equivalent of Tier 2 capabilities—established research universities, biomanufacturing industry presence, national laboratory co-location, and high-density life sciences clusters—may initiate Tier 3 designation concurrently with or immediately following network authorization, subject to the same competitive review criteria. Such regions exist across the country, including in the South, Midwest, and Mountain West, as illustrated by established clusters such as the Research Triangle in North Carolina, the Texas Medical Center corridor, and the agricultural biotechnology infrastructure anchored by land-grant universities across the Great Plains. The first wave prioritizes readiness and demonstrated regional demand. First-wave institutes serve as proof-of-concept for the model, generating operational data that informs second-wave selection. The year-3 evaluation of first-wave institutes initiates second-wave selection, with second-wave expansion—at least three to five additional institutes—becoming operational in years 5–7, informed by network performance data and emerging technology priorities. Full network integration across all tiers is targeted by year 10, with a complete 50-state capital build-out realized over roughly fifteen years (Section 8.1), with expansion criteria based on demonstrated network capacity constraints and new mission requirements.

7. Key Insights

Site selection must be merit-based and technically administered to withstand political scrutiny and resist Congressional earmarking.

State commitment—financial, infrastructural, and regulatory—is a prerequisite, not an afterthought, and functions as a proxy for institutional durability.

Enrollment runs through TINA submission administered by the NBIN National Coordination Office: open to any state at any time for Tier 1, rolling review for Tiers 2 and 3, with selection authority resting with the office rather than with appropriators.

Phased buildout should balance speed with the learning that only operational experience can provide.

8. Funding Model

8.1 Capital and Operating Requirements

Funding Guidelines Per Institute

Capital expenditure (facility, core equipment): \$5M–\$25M per Tier 1 institute | \$50M–\$150M per Tier 2 hub | \$200M–\$500M per Tier 3 flagship.

Annual operating expenditure: \$2M–\$8M per Tier 1 institute | \$15M–\$40M per Tier 2 hub | \$40M–\$75M per Tier 3 flagship.

Blended capital structure: Tier 1 typically anchored by USDA/NIFA formula streams, state economic development funding, and modest industry contributions (no new federal authorization required); Tiers 2–3 follow an approximately ~40% federal | ~30% state/local | ~30% private blended model.

Minimum federal commitment horizon: 10 years with performance-based evaluation.

Capital expenditure treated distinctly from operating research funding in appropriations.

The figures in this section—capital and operating ranges, GDP-capture illustrations, company-formation and revenue projections, and self-sufficiency timing—are illustrative, order-of-magnitude planning estimates intended to inform authorization and appropriations design, not forecasts of outcomes or financial commitments. Most states can begin their NBIN journey without large capital commitments: Tier 1 infrastructure requires \$5M–\$25M in targeted equipment and staffing, built on existing land-grant anchored laboratory capacity. The path to full national coverage is deliberately graded. One of the most consequential components of that infrastructure is the integrated automation stack: high-throughput robotic platforms, autonomous lab systems, AI-ready data pipelines, analytical and biophysical characterization infrastructure, and biological modeling infrastructure. This automation-to-insight stack distinguishes an NBIN institute from a well-equipped academic core facility, is the primary engine of the national data moat strategy (Section 5.5), and should be treated as a first-priority capital expenditure—co-equal to fermentation, bioprocessing, and GMP facilities, not subordinate to them. Analytical and biophysical characterization infrastructure (Section 5.2) is also treated as a first-priority capital expenditure on the same footing.

Across the tiered network—Tier 1 institutes anchored by any land-grant institutions (\$5M–\$25M capex and \$2M–\$8M annual opex each), Tier 2 regional hubs (\$50M–\$150M capex and \$15M–\$40M opex), and Tier 3 flagship institutes (\$200M–\$500M capex and \$40M–\$75M opex)—the authorization accommodates a national network that, if fully built over roughly fifteen years, would represent, at its upper bound, construction investment on the order of \$3B–\$8B and steady-state annual operating costs on the order of \$500M–\$1B network-wide in its first decade, depending on network scope. This expenditure would decline toward a substantially reduced federal operating contribution during the second decade as institute equity portfolios mature and revenue from licensing, facility fees, and company exits covers institute-level opex; in the second decade, federal appropriations would shift largely to the NBIN National Coordination Office, shared data infrastructure, and new institute expansion.

Illustratively, and at representative per-institute costs, the authorization could support a variety of mature network configurations within the investment ranges described here—for example, a 50-state Tier 1 network paired with approximately 12 Tier 2 regional hubs and 5 Tier 3 flagships, or a leaner build of roughly 50 Tier 1 institutes with approximately 10 regional Tier 2 hubs and 4 national Tier 3 flagships. These examples are illustrative rather than prescriptive; the framework authorizes capacity and investment ranges, not a fixed number, distribution, or sequencing of institutes. The timeframes describe distinct milestones and should not be conflated: authorization and first-wave launch occur within two years, with the first spinouts reaching market or key commercial milestones by roughly 2030. The first federal commitment time horizon is ten years, whereas the complete 50-state capital build-out is realized over roughly fifteen years, with federal operating dependence declining through the second decade as portfolios mature. The framework does not require this full scale to begin: appropriations can start with a coordination office and a small first wave of competitively selected institutes and expand as demonstrated performance warrants. At full national scale, this upper bound is comparable to the annual budget of NSF or the

DOE Office of Science, with annual operating costs comparable to adding a new ARPA-E or ARPA-H—but the framework is designed to be entered incrementally and scaled as appropriations and demonstrated performance warrant, not funded as a single up-front commitment. These per-institute figures are stated directly rather than obscured in percentage allocations; what Congress authorizes is a durable framework, and what it appropriates can scale from a modest pilot to a full national network as national security and economic development priorities evolve. The federal share concentrates at the Tier 2 and Tier 3 levels, while Tier 1 institutes may be funded through existing USDA/NIFA formula streams rather than new federal authorization. Netted against those existing streams, direct new federal exposure is approximately \$1.2B–\$2.4B in construction capital (this figure excludes Tier 1 build-out to the extent it is covered by existing USDA/NIFA formula streams rather than new federal authorization) and \$200M–\$400M in annual operating contributions, concentrated in the first decade of that build-out. The case for this large investment rests on two foundations: the economic return and the additionality argument.

On economic return: the \$600B+ annual GDP gap (NASEM, 2020) means that even a 5% capture rate would, illustratively, correspond to on the order of \$30B in annual economic output nationwide—a potential return to the broader economy, realized gradually as institute portfolios mature, that could exceed the network’s total cost many times over. NBIN’s own operating self-sufficiency is a separate and slower matter—federal operating support is expected to decline progressively during the second decade as equity, licensing, and facility revenue mature. The distributed 50-state model addresses this gap more completely than a flagship approach alone: it reaches agricultural biotechnology, bioenergy, bioindustrial materials, and critical minerals recovery—sectors with hundreds of billions in GDP potential, major prospective impact on regional, rural workforce development, and limited existing translational infrastructure to promote local bioindustrial and economic development.

On additionality: NBIN requires new, dedicated appropriations, not cannibalization of Manufacturing USA, SBIR/STTR, ARPA, or other federal programs, as those programs occupy distinct, necessary positions that stripping them to fund NBIN would undermine. NBIN is the multiplier that makes every dollar invested in those programs more productive by providing the requisite translational infrastructure. Equally, NBIN’s productivity depends on continued robust basic science investment across NSF, DOE, NIH, and DOD: that foundational research is the seed corn from which NBIN translation grows, and any erosion of it weakens every downstream institute and regional economic development effort.

8.2 Investment Architecture: Four Capital Layers

NBIN’s investment architecture operates across four capital layers, each with distinct sources, instruments, return expectations, and governance rights. No single layer is required; the network functions across the full participation range from USDA/NIFA formula-funded Tier 1 institutes to fully blended Tier 3 flagships. Layer 1 (Federal Anchor Capital): federal agencies—USDA, NIH, NSF, DOE, and others—direct discretionary capital to specific institutes or technology missions through voluntary investment agreements that are not grants, not contracts, and not subject to the Federal Acquisition Regulation. Tier 1 institutes access this layer through existing USDA/NIFA formula streams (Hatch Act, Smith-Lever Act, McIntire-Stennis Act) without new authorization. Notably, no agency would be required to participate. Layer 2 (Mission Capital): DOD (including the Defense Innovation Unit, CDBP, AFWERX, SpaceWERX, NavalX, and Army Research Lab), IC agencies, BARDA, DHS, and other mission-driven entities direct project capital toward defined technology outcomes—a domestic rubber supply chain, a manufacturing surge capacity, a biosensor program—paying for delivered capability without holding equity or governance rights. Layer 3 (OSC Concessional Capital): the Office of Strategic Capital deploys below-market-rate, long-maturity concessional instruments at the network, regional, or institute level—precisely the patient capital infrastructure that commercial markets will not lead. Layer 4 (Private Co-Investment): family offices, regional venture funds, private equity groups, corporate strategics, and impact investors participate in two distinct ways that should not be conflated. As return-seeking investors, they can co-invest on market terms alongside NBIN in the resident companies, under the network’s conflict-of-interest rules. Separately, as philanthropic or programmatic supporters, they can make gifts or grants toward an institute’s mission and operations—capital that carries no expectation of financial return and confers no equity in the nonprofit. Governance roles for either group are not automatic; they arise only where an institute’s bylaws establish them. State capital functions as a regional commitment and accountability mechanism: a state that has helped fund an institute can be granted a durable governance interest in its long-term success under the institute’s governing documents—an arrangement more durable than politically imposed participation.

Importantly, resident companies remain fully eligible for non-dilutive SBIR/STTR awards and ARPA project funding throughout their translational development. NBIN's pilot-scale validation data and GMP-adjacent documentation are precisely the evidence SBIR Phase II and III review panels require—making institute residency a competitive advantage for these non-dilutive awards. This capital flows to portfolio companies without touching NBIN's equity stake; it is additive to, not a substitute for, the institute's investment.

Institute equity participation in resident companies is the self-reinforcing capital mechanism designed to move NBIN from a perpetual appropriations dependency toward an increasingly self-financing model over its second decade. Federal appropriations in the second decade shift to the coordination office, shared data infrastructure, and new institute expansion, as noted above. Institutes not reaching self-sufficiency by Year 10 are subject to capital structure review rather than automatic program termination—replacing the assumption of rapid self-sufficiency that national assessments have identified as a structural flaw in time-limited federal program models (NASEM, 2026). Where an institute cannot be restructured to viability, an orderly wind-down protocol transfers its facilities, equity portfolio, and data assets to other network institutes rather than stranding them.

As a point of reference for states evaluating their return on co-investment, Tier 1 institutes operating at steady-state are projected to generate one to three new resident companies or licensing transactions annually; Tier 2 regional hubs four to eight, generating an estimated \$15–\$30M in annual non-federal revenue by years 10–12 through equity stakes (averaging 2–5% per company) plus licensing and facility fees—sufficient to cover a substantial share of steady-state operating expenditure; and Tier 3 flagships eight to fifteen, with additional economic value accruing through workforce development, supplier ecosystem formation, and the tax base effects of retained bioindustrial employment. These projections are order-of-magnitude estimates based on comparable private incubator performance and are intended to inform state co-investment decisions, not to constitute financial commitments.

8.3 Non-Profit Vehicle Structure

Several proven vehicle types can carry NBIN's investment mission: the 501(c)(3) public charity used by In-Q-Tel; the 501(c)(6) business league used by several Manufacturing USA institutes; the quasi-public instrumentality that states such as Maryland (TEDCO), Connecticut (Connecticut Innovations), and Massachusetts (MassVentures) have relied on for decades; and the independent private nonprofit adopted by many of the other state venture organizations noted earlier. These are related precedents, not a single template: they differ in tax treatment, governance and membership rules, latitude for commercial investment, and independence, and the two-way capital mechanics described above would be adapted to whichever form is ultimately chosen. Because NBIN carries a federal investment relationship, a nonprofit or hybrid form is the most natural fit—but the precise structure is properly left to Congress and IRS guidance, which this policy recommendation framework does not prescribe. Whichever vehicle is selected, it should accommodate blended capital and non-federal governance, as described in Section 5.3. The detailed structuring—entity form, investment terms, and governance mechanics—belongs to authorization and organizational formation.

8.4 Mission Portfolio Structure

Federal agencies with specific bioindustrial capability needs—DOD, BARDA, DHS, and others—can access NBIN's infrastructure through mission investment agreements rather than through procurement contracts or grants. A mission is a defined technical outcome: a domestic supply chain capability, a manufacturing process, a material, or a biosensor system. The mission agreement specifies the outcome, the timeline, the capital contribution, and the IP access provisions. NBIN could deploy mission capital into one or more institutes with relevant infrastructure and sector expertise, identify or recruit portfolio companies to execute the technical program, and manage investments to meet defined milestones.

The guayule natural rubber mission illustrates the mechanics. The Defense Logistics Agency has a documented strategic interest in a domestic natural rubber supply that does not depend on Southeast Asian imports. Guayule (*Parthenium argentatum*), a shrub native to the Chihuahuan Desert of Arizona and Texas, produces latex chemically equivalent to Hevea rubber and has been demonstrated at laboratory scale. The translational barrier—pilot-scale extraction, latex processing, and compound formulation at commercially viable cost—is precisely the TRL 3–6 gap that NBIN addresses. A DOD mission agreement with NBIN might direct capital to the Arizona-Texas regional institute (e.g., anchored by the University of Arizona and Texas A&M, both land-grants with existing guayule and

semi-arid crops programs). The institute team could recruit or incubate two to four portfolio companies across the value chain: agronomy and cultivation, extraction and latex processing, and downstream compounding. NBIN would contribute capital and take concomitant equity in each, while the DOD would receive first-access licensing rights. Private co-investors—for example, Arizona agricultural family offices, specialty materials corporate strategics—would co-invest in the portfolio companies that emerged from NBIN once ready. OSC could additionally provide concessional capital for the pilot-scale extraction equipment. In this illustrative scenario, by roughly year 5 a commercially operational domestic natural rubber supply chain would exist, the DOD mission would be delivered, portfolio companies would be commercially investable, the regional bioeconomy would be further developed, and NBIN's equity would compound. Importantly, mission capital would not entitle the funder to governance. Technology developed with mission capital would be subject to first-access licensing for the funder, whereas all other commercial rights would flow to the portfolio company and, via equity, to NBIN and the co-investors. IP frameworks would be Bayh-Dole-consistent and established at mission agreement negotiation.

NBIN mission capital is not a substitute for, and does not compete with, federal investment in FFRDCs, UARCs, or national laboratories. FFRDCs, UARCs, and national laboratories operate under federal contracting and funding vehicles that typically preclude equity participation, resident-company hosting, and retention of investment returns, and are concentrated in a small number of states. Some, including ABPDU, already work with industry at pilot scale, so the distinction is less about technical capability or TRL levels but rather the NBIN capital and residency model. NBIN occupies the structural gap alongside and downstream of that work: advancing outputs from those institutions toward commercial readiness through a non-profit venture investment vehicle that federal contracting structures are not designed to replicate. Where regionally co-located, NBIN institutes would actively collaborate with FFRDCs and UARCs through the liaison and CRADA structures described in Section 9—and this collaboration is built in by design for DOD-facing missions with national-security dimensions, particularly at Tiers 2 and 3, where secure infrastructure and cleared personnel are required.

Missions could be directed to a single institute (a regional capability development mission), a subset of institutes (a national supply chain mission requiring multiple regional nodes), or the full network (a national preparedness capability that requires distributed surge manufacturing capacity across all tiers). Multi-institute missions would be coordinated by the NBIN National Coordination Office as a primary mechanism for the network's national challenge capacity—addressing problems that no single regional institute could address on its own.

8.5 Concessional and Patient Capital

As noted above, standard venture capital is poorly suited to early-stage bioindustrial translation—the patient, infrastructure-intensive work of advancing discoveries from the laboratory bench toward commercial readiness. VC fund structures—typically 10-year fund lives, within which individual investments target 3–7 year return windows, with return expectations calibrated to software or pharmaceutical royalties—are structurally misaligned to the development timelines that biological translation requires. Plants and mice take time to grow, and biological processes require iterative optimization across dozens of parameters before they can reliably be scaled. The distance from a promising bench discovery to a product that a CDMO or manufacturer can run reliably is measured not only in dollars but in years of systematic, infrastructure-backed work that early-stage VC cannot be expected to fund. Workshop participants identified a specific and actionable solution: the OSC within the DOD already has the statutory authority and financial engineering tools to provide concessional debt at the fund level, reducing the cost of capital for private investors and allowing longer investment time horizons. Expanding OSC's aperture to explicitly include bioindustrial infrastructure would allow it to catalyze private capital at scale without requiring additional authorization.

The BARDA Ventures model is also instructive here: government sets mission direction and fund parameters while a nonprofit manager makes the investment decisions, deploying taxpayer capital through an independent vehicle rather than a program office. Philanthropic capital—from mission-aligned foundations, university endowments, and family offices with patient capital mandates—could play a complementary stabilizing role across political cycles. State and philanthropic capital is more durable than federal appropriations through administration transitions; building it into the capital stack from the outset would reduce the network's vulnerability to funding disruptions.

8.6 Government as Funder, Enabler, and Buyer

The federal government plays three distinct and mutually reinforcing roles in the institute network. As a funder, it provides the capital anchor that makes private and state co-investment credible. As an enabler, it provides regulatory coordination, data access, national laboratory integration, and security clearances that private or state actors cannot replicate. As a buyer, it creates the demand-side market signal that de-risks private investment. Procurement specifications for bio-based products—clear technical and performance standards that government agencies commit to purchasing against—function as advance market commitments: they tell the private sector that a market exists, which justifies private investment in the supply chain infrastructure to serve it.

This buyer role is currently underdeveloped. Executive Order 14081 (“Advancing Biotechnology and Biomanufacturing Innovation,” September 2022)—the primary federal policy framework for the bioeconomy prior to its revocation by EO 14236 in March 2025—established the template for federal procurement coordination and agency alignment that NBIN’s network framework would formalize and make durable through statutory authorization rather than executive action. DOD specifications for bio-based products offer a starting point for the buyer role. The network framework formalizes and scales this function: each institute works with federal agency partners to develop procurement pathways for products in its regional technology focus area, creating a pipeline from institute-stage development to government market validation to commercial scale.

8.7 Evaluation and Milestone Structure

Performance-based evaluation protects public investment without undermining the sustained commitment that the model requires. Evaluation checkpoints at years 3, 5, and 10 assess: TRL advancement rates for projects in the institute pipeline; follow-on private investment attracted to institute-affiliated companies; capacity building metrics (trained workforce, new laboratory capacity, startup formation rates); and network contribution metrics (data generated, cross-institute collaborations, national laboratory integration). Critically, the evaluation framework is designed to surface learning—what is working, what needs adjustment—rather than to trigger binary sustain/terminate decisions based on short-term output metrics. The first wave of institutes should expect a three-to-five year ramp before full translational throughput is achieved.

Metric Category	Specific Indicators	Evaluated At
Technology Translation	TRL advancement rates; projects progressing TRL 3→6; time-to-TRL-6 vs. baseline	Years 3, 5, 10
Company & Commercialization Outcomes	New companies formed; licensing transactions; strategic acquisitions; revenue-generating products reaching market	Years 3, 5, 10
Private Investment Leverage	Follow-on private capital per federal dollar; industry co-investment; venture capital into institute-affiliated companies	Years 3, 5, 10
Workforce Development	Training program enrollment and completion; biomanufacturing jobs created; employer partnership agreements	Annual + Years 3, 5, 10
Supply Chain Resilience	Domestically produced critical bio-based inputs previously at single-source foreign risk; contributions to national surge manufacturing capacity	Years 5, 10
Regional Economic Multiplier	Estimated regional GDP contribution; supplier ecosystem formation; tax base effects attributable to institute activity	Years 5, 10
Network Integration	Cross-institute collaborations; data contributions to shared NBIN infrastructure; national laboratory integration events	Annual + Years 3, 5, 10

Performance benchmarks are calibrated to regional context, not imposed as uniform national standards: an institute in an emerging bioeconomy state with limited prior industry infrastructure would not be evaluated on the same commercialization velocity as a Tier 2 hub anchored in an established research cluster. Regional workforce development outcomes—including training program enrollment and completion, employer partnership formation, and documented job creation in biomanufacturing and related sectors—are explicitly recognized performance indicators alongside TRL advancement rates and spinout formation. Institutes serving rural or economically distressed regions may weight workforce and regional economic development metrics more heavily in their evaluation frameworks, consistent with their founding mission agreements.

The performance framework above requires a further structural distinction that is operationally fundamental to NBIN's design and political durability: the theory of change, success metrics, and implementation sequencing for NBIN institutes differ substantially depending on whether an institute is deployed into a nascent bioeconomy ecosystem or an established one. Applying uniform performance metrics across both contexts could systematically disadvantage nascent-ecosystem institutes and produce exactly the political outcomes the network is designed to avoid. Accordingly, in states and regions with limited existing bioeconomy infrastructure—for example the rural Midwest, Appalachia, the Mountain West, and lower-density agricultural states—NBIN's primary function may be ecosystem creation, versus ecosystem acceleration. The timeline from institute launch to meaningful translational throughput in these regions may therefore be longer—five to seven years, not three to five—and the early performance indicators that matter are leading indicators of ecosystem density: faculty engagement rates, student entrepreneurship pipeline, industry partnership formation, and workforce training enrollment, not solely TRL advancement rates for a pipeline the institute is simultaneously building. Applying a Year 3 metric of active TRL 3–6 project pipeline volume to a nascent-ecosystem Tier 1 institute could therefore produce a false negative assessment of an institute's function, thereby sending a signal to lower-density states that NBIN is not designed for them and undermine NBIN's function and political resilience. Accordingly, nascent-ecosystem Tier 1 institutes would be evaluated at Year 3 on ecosystem-building leading indicators, and TRL advancement rate would become a primary metric only at Year 5. Federal match requirements for these institutes would be structured to accommodate lower initial private co-investment, recognizing that the private capital density needed to meet a 30% private match requirement may not yet exist, and that the institute's first function is to create the conditions that will attract this capital.

In contrast, in some established bioeconomy clusters, NBIN's value proposition may be coordination and network integration, as opposed solely to infrastructure creation. Performance metrics in established-ecosystem institutes should therefore emphasize network integration outcomes—cross-institute project mobility rates to benefit regions of the US that are earlier in infrastructure and capital development journeys, pre-competitive data contribution volume, and national challenge mission participation—alongside TRL advancement rates. The NBIN National Coordination Office would maintain distinct performance frameworks for nascent-ecosystem and established-ecosystem institutes, with differentiated and tailored technical assistance packages.

8. Key Insights

Capital and operating expenditure require distinct treatment in appropriations.

The automation and data generation stack is a capital priority, not an amenity: it is an engine of the national data moat strategy.

Institute equity participation in resident companies transforms NBIN from a perpetual appropriations dependency into an increasingly self-financing innovation engine that reduces federal operating dependence over time.

NBIN draws on four distinct capital layers—federal anchor capital, DOD and agency mission capital, OSC concessional financing, and private co-investment—none of which is required for participation.

Mission investment agreements let DOD, BARDA, DHS, and peer agencies fund defined technical outcomes—the guayule domestic rubber supply chain is the worked example.

Government acts as funder, enabler, and buyer: federal procurement specifications for bio-based products function as advance market commitments that de-risk private investment.

Performance is evaluated at years 3, 5, and 10 against regionally calibrated criteria designed to surface learning rather than trigger punitive cutoffs.

9. Relationship to Existing Efforts

NBIN is designed to complement—not compete with or replace—existing federal, state, regional, and private-sector initiatives. Rather than creating new institutional silos, it strengthens the performance of the current innovation ecosystem by connecting, coordinating, and accelerating the translation of discoveries across existing programs and assets. In this way, NBIN builds on prior public and private investments, helping them operate more effectively at both the regional and national levels. Clarifying this complementary role is central to understanding NBIN’s purpose. Towards this goal, the mapping below illustrates how existing programs contribute distinct capabilities, identifies translational gaps, and highlights where NBIN provides value by integrating—not duplicating—existing infrastructure and resources. By serving as connective tissue across the U.S. biotechnology innovation ecosystem, NBIN is intended to amplify the impact of existing institutions and maximize the return on prior federal, state, and private investments.

USDA/NIFA and the Land-Grant, Sea-Grant, Sun-Grant, and Space-Grant Networks

NIFA administers the federal government’s primary partnership with land-grant universities through the Hatch Act (research), Smith-Lever Act (extension), and McIntire-Stennis Act (forestry) formula funding streams—providing over \$400M annually to land-grant institutions across all 50 states for applied agricultural and biological research and outreach. These existing funding relationships are the primary federal foundation for NBIN’s Tier 1 network: NIFA-funded research programs at land-grant universities already generate the biological discoveries that Tier 1 institutes are designed to advance toward commercial application. NBIN’s relationship with USDA/NIFA is therefore not a new federal partnership but an extension and formalization of one that already exists. Land-grant anchoring also provides something no urban research cluster can replicate: locally embedded agronomic, ecological, and biological contextual knowledge—across soil types, climate zones, livestock breeds, and cropping systems—required to validate agricultural biologicals and bio-based materials for regional adoption, the precise failure mode that has limited commercialization of promising technologies developed outside their target deployment context. NOAA’s Sea Grant program provides federal-university partnership infrastructure for marine bioeconomy translation; NASA’s Space Grant consortia for precision agriculture data systems; and the interagency Sun Grant initiative (USDA, DOE, and DOT) for bioenergy and biobased products translation. Together, these four federal university network programs—land-grant, sea-grant, sun-grant, and space-grant—provide NBIN with eligible anchor institutions in every state, covering the full sectoral breadth of the bioeconomy from agricultural biotech and bioenergy through marine bioproducts and aerospace materials and circular biomanufacturing capabilities for space missions.

BioMADE

BioMADE is a Manufacturing USA institute—specifically the sixteenth Manufacturing Innovation Institute—and focuses on non-medical biomanufacturing at manufacturing readiness levels (MRL) 4–7. It has supported over 100 projects valued at nearly \$230M and is building a regionally bespoke pilot-plant network in Minnesota, Iowa, California, and beyond. The institute network complements BioMADE by operating at earlier TRL stages, spanning medical and non-medical applications, and providing co-location, investment, and governance infrastructure that BioMADE’s distributed member model does not. The two programs could share physical infrastructure where co-location is feasible and coordinate on technology handoffs to empower early-stage innovation and commercialization to achieve market readiness.

BioFabUSA

BioFabUSA, a Manufacturing USA institute focused on cell-based manufacturing, addresses the production of living cellular products—including cell therapies, tissue-engineered products, and cell-based manufacturing systems—at manufacturing readiness levels (MRL) 4–7 to enable products to progress above TRL 5–6. BioFabUSA has attracted over \$3B in private investment to companies within the industry network. BioFabUSA, sponsored by

the DOD, is also co-located with the EDA-sponsored Regen Valley Tech Hub, both of which are managed by ARMI. The mandate of the Tech Hubs is to focus on the TRL 7–9 space. NBIN institutes in established life science and biopharmaceutical regions serve as natural upstream partners for BioFabUSA. NBIN provides the TRL 3–6 cell engineering, process development, and regulatory science groundwork that prepares products for BioFabUSA’s higher-MRL manufacturing programs. Cross-referral and co-development protocols between NBIN and BioFabUSA should be formalized, with shared infrastructure where geographic co-location is feasible.

NIIMBL

NIIMBL, another Manufacturing USA institute, focuses on accelerating biopharmaceutical manufacturing innovation—the process science, quality systems, and regulatory frameworks required to manufacture biological medicines reliably and at commercial scale. NBIN institutes in established biopharmaceutical clusters—the Northeast corridor, the San Francisco Bay Area, the Research Triangle—are positioned to be NIIMBL’s primary upstream feeders, advancing the biological product candidates and process platforms that NIIMBL’s manufacturing-stage infrastructure can then optimize. Structured handoff protocols, shared GMP infrastructure where feasible, and joint workforce development programs connecting NBIN’s early translational training with NIIMBL’s manufacturing-stage workforce needs represent high-value integration opportunities.

REMADE Institute

The REMADE Institute, a Manufacturing USA institute focused on sustainable manufacturing and industrial decarbonization, intersects with NBIN in the domain of bio-based materials and biological routes to circular manufacturing. Biological processes for upcycling, materials recovery, and renewable chemical production require the same TRL 3–6 translational infrastructure that NBIN provides, before they can be integrated into REMADE-relevant industrial processes. NBIN institutes in industrial biotechnology and sustainable materials regions should coordinate with REMADE on technology roadmapping and cross-referral to avoid duplicating process scale-up infrastructure.

ARM Institute

The ARM Institute, a Manufacturing USA institute focused on robotics and automation in manufacturing, is a natural infrastructure partner for NBIN’s robotic high-throughput platforms. ARM’s expertise in deploying, integrating, and maintaining advanced robotic systems in manufacturing environments directly applies to the autonomous lab and high-throughput screening infrastructure that defines NBIN’s data moat strategy. Collaboration on platform standards, robotic integration protocols, and shared workforce development for biological automation technicians will reduce the cost and complexity of deploying and maintaining NBIN’s automation stack across all network sites.

National Laboratories

DOE’s 17 national laboratories, the nation’s flagship Federally Funded Research and Development Centers (FFRDCs), and their equivalents across other agencies represent a national infrastructure asset that the institute network should integrate rather than duplicate. National laboratories bring world-class analytical capabilities, secure research environments, highly trained expert staff, and advanced computing resources that no institute could replicate. The integration challenge is access: laboratory engagement timelines, cost structures, and contractual frameworks have historically been misaligned to startup and industry needs. NBIN formalizes laboratory integration through dedicated liaison positions, streamlined CRADA and user agreement templates, testing portal infrastructure, and embedded laboratory staff within institute facilities.

Several laboratories already operate bioeconomy capabilities that NBIN institutes should partner with rather than rebuild. The Advanced Biofuels and Bioproducts Process Development Unit (ABPDU) at Lawrence Berkeley National Laboratory, established by DOE to scale early-stage biofuels, biomaterials, and biochemicals from bench toward commercial relevance, has partnered with dozens of companies on fermentation, separations, analytical characterization, and techno-economic analysis—demonstrating at a single site the pilot-scale translational model that NBIN distributes nationally. Ames National Laboratory, home of the Critical Materials Innovation Hub and co-located with Iowa State University, is the clearest existing example of the national laboratory–land-grant pairing

this report recommends, and a natural anchor for the critical materials vertical. Sandia National Laboratories contributes biomass conversion, high-throughput enzyme screening, and lifecycle and techno-economic modeling through its Joint BioEnergy Institute partnership, while Lawrence Livermore National Laboratory's Center for Predictive Bioresilience pairs biotechnology with high-performance computing and AI for biothreat response—capabilities most relevant to Tier 2 and Tier 3 institutes hosting DOD-facing missions.

This national infrastructure extends beyond DOE's laboratory system to University Affiliated Research Centers (UARCs)—DOD-designated, university-based research centers such as the National Strategic Research Institute (NSRI) at the University of Nebraska, one of only 15 UARCs nationally and the only one focused on biodefense against biological and chemical weapons of mass destruction. NSRI's 2024 partnership with MIT Lincoln Laboratory—a joint student research program pairing Lincoln Laboratory's Biological and Chemical Technologies Group with University of Nebraska researchers on biosynthetic screening and agricultural biosecurity—illustrates the kind of cross-institutional, cross-regional collaboration NBIN's network architecture is designed to formalize and scale: an FFRDC's technical depth paired with a land-grant UARC's agricultural and biosecurity expertise. NBIN institutes co-located with UARCs should establish the same liaison structures recommended for national laboratories.

DOE Bioenergy Research Centers

The U.S. Department of Energy's Bioenergy Research Centers (BRCs) drive major advancements in biotechnology underpinning the production of fuels and chemicals from dedicated biomass crops such as switchgrass, poplar, and energy sorghum. These Centers enhance energy security; create domestic supply chains for a range of fuels, chemicals, and materials; generate jobs in rural areas; and ensure U.S. leadership in a globally competitive bioeconomy. Each BRC is led by a DOE National Laboratory or a top university and consists of a multidisciplinary partnership involving experts from science and engineering, as well as from private companies and non-profit organizations. Working with collaborators across the nation, each BRC takes a unique approach to improving and scaling up the production of advanced fuels, chemicals, and materials, and each is focused on non-food energy crops with promise for its particular region. The Center for Bioenergy Innovation, led by Oak Ridge National Laboratory with 22 partner institutions, engineers both feedstock plants and conversion microbes, including for sustainable aviation fuels. NBIN institutes in bioenergy and sustainable chemistry regions should coordinate with BRC networks on technology roadmapping, shared feedstock access, and cross-referral of technologies approaching pilot-scale demonstration.

DOE Genesis Mission: Computational Backbone for NBIN's Data Moat Strategy

The DOE Genesis Mission—established by Executive Order in late 2025 and formalized through the Genesis Mission Consortium (February 2026)—unites all 17 DOE national laboratories with industry and academia to build a secure, integrated AI-for-science platform spanning supercomputing, autonomous discovery, and biological data infrastructure. Its \$293M FY26 RFA explicitly includes biotechnology as a priority focus area. The Genesis Mission, together with the DOE-BRIDGE data resource and NBIN are structurally complementary and non-duplicative: Genesis and connected biological data infrastructure provide the shared federal AI backbone, infrastructure and exascale computing infrastructure; NBIN generates the proprietary translational-scale biological data layer on top. This is a two-layer sovereign advantage—Genesis Mission as the publicly accessible federal foundation, NBIN's proprietary process datasets as the irreplaceable national competitive moat that foreign competitors cannot replicate.

Three integration mechanisms operationalize this synergy. First, NBIN institutes co-located with DOE national laboratories can formally affiliate their autonomous lab programs with the Genesis consortium, contributing pre-competitive biological datasets while retaining proprietary rights to company-specific process data. Second, portfolio companies in NBIN institutes are natural applicants for Genesis Phase I and II awards in biotechnology. Third, the NBIN coordination office should establish a standing liaison with the Genesis Consortium and the DOE BRIDGE biological data resource to ensure biological data standards are interoperable from day one, allowing cumulative datasets across 50 NBIN institutes to constitute the most comprehensive structured biological translational dataset in the world.

EMAPS

The EMAPS initiative targets the scale-up of advanced energy materials—including bio-based materials and biological processing routes—from laboratory demonstration to commercial-scale production. EMAPS and NBIN address adjacent problems in the same translational arc: EMAPS focuses on materials processing scale-up in energy applications, while NBIN addresses the earlier biological development stages. NBIN institutes operating in regions with EMAPS infrastructure—particularly in sustainable materials, biofuels, and critical mineral bioextraction—should establish formal technology transfer protocols with EMAPS facilities to ensure that bio-based materials technologies can move continuously from TRL 3–6 biological development through EMAPS-scale processing demonstration without institutional discontinuity.

NSF BioFoundries

In August 2024, NSF awarded \$75 million across five cooperative agreements to establish university-based BioFoundries that integrate robotics, AI-enabled automation, synthetic biology, and high-throughput measurement infrastructure into the design-build-test-learn pipeline for biological discovery. Individual awards range from \$15M to \$24M over six years. The five funded sites include the iBioFoundry at the University of Illinois Urbana-Champaign (opened January 2026), the ExFAB BioFoundry at UC Santa Barbara/UC Riverside/Cal Poly Pomona focused on extreme and exceptional microorganisms, and the Center for Robust Equitable BioFoundries at the University of Delaware focused on high-throughput automation tools. Each biofoundry is explicitly designed to provide broad open access to its research infrastructure and to advance standardization of instrumentation, data, and scientific practices to enable cross-site data integration.

NSF BioFoundries occupy TRL 1–4 and are structured for open-access academic research—they sit upstream of NBIN’s translational arc rather than alongside it. Their function is to generate validated biological designs, characterized genetic constructs, and initial proof-of-concept data using automated discovery tools; NBIN institutes then advance those designs through pilot-scale validation, process optimization, and GMP-adjacent development. Where a BioFoundry and an NBIN institute share a land-grant anchor institution—as with the iBioFoundry at UIUC—the two can operate as a seamless discovery-to-translation continuum: BioFoundry teams generating validated constructs at TRL 2–3 hand off to the NBIN institute for pilot-scale development at TRL 4–6, with shared data standards ensuring interoperability across the handoff. This co-location model is a positive indicator in NBIN site selection at land-grant institutions that host or are affiliated with NSF BioFoundry awards.

BioFoundry-generated open-access characterization data feeds into Tier 1 of NBIN’s federated Web of Biological Data; NBIN institutes generate the proprietary Tier 2 and Tier 3 translational layers on top. Data standards should be co-designed from launch, with the NBIN coordination office establishing a standing liaison with the NSF BioFoundries network—analogue to the recommended DOE Genesis Mission liaison.

NSF Regional Innovation Engines and X-Labs

NSF’s Technology, Innovation and Partnerships (TIP) directorate was established specifically to bridge the translation gap, and its programs—Regional Innovation Engines, X-Labs, Tech Accelerators, and Entrepreneurial Fellowships—are designed to address gaps in the translation space. NSF Engines support regional innovation ecosystems across all technology sectors, including some with bioeconomy relevance. They operate at a complementary layer: NBIN adds the sector-specific translational infrastructure, GMP capabilities, and tripartite co-location model that sit alongside the Engines’ ecosystem-building role. NBIN sites should be coordinated with NSF Engine regions to leverage existing regional relationships and avoid duplication, with the two programs serving distinct, complementary functions. NBIN further adds an equity-based investment vehicle and blended capital stack that NSF’s grant and cooperative-agreement authorities are not chartered to provide.

The NSF TIP X-Labs (formerly Tech Labs) Initiative—announced in December 2025 and distinct from both the Engines and the Convergence Accelerator programs—funds full-time, independently operating research teams outside traditional academic institutions, with milestone-based funding and the explicit mandate to transition technologies from early prototype to commercially viable platforms ready for private investment. A companion Tech Accelerators Initiative is forthcoming with a complementary focus on technology translation across national priority areas. Both programs operate at TRL stages immediately upstream of NBIN’s translational infrastructure

mandate. NBIN institutes should establish formal intake relationships with X-Labs and Tech Accelerator teams in relevant bioeconomy focus areas: teams reaching the end of a X-Labs award cycle with a validated prototype at TRL 3–5 are precisely the candidates for whom NBIN’s pilot-scale infrastructure, GMP environments, and sustained regulatory science staffing represent the logical and necessary next step.

Commerce/EDA Regional Technology and Innovation Hubs Program

The Regional Technology and Innovation Hubs Program, administered by EDA, supports geographically defined consortia to accelerate regional technology leadership in strategically important sectors. Tech Hubs provide large-scale, place-based economic development funding, including for infrastructure, workforce, and commercialization activities. NBIN complements Tech Hubs by providing dedicated, sector-specific translational infrastructure at TRL 3–6, with physical co-location and shared governance across academia, government, and industry—capabilities not consistently required or funded under Tech Hub awards. Institute sites should be deliberately co-located with or embedded within Tech Hub regions where possible, using Tech Hub funding to support surrounding ecosystem buildout (workforce, suppliers, site infrastructure) while the institutes provide the core translational engine. EDA’s broader portfolio—including Public Works and Build to Scale—supports regional infrastructure and entrepreneurship ecosystems but does not fund integrated, sector-specific translational facilities at the scale required for bioeconomy deployment.

SBIR and STTR

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs are the federal government’s primary mechanisms for funding early-stage, high-risk technology development through small businesses. Administered on a multi-agency basis, these programs require participating federal agencies—most notably DOD, NIH, DOE, NSF, and others—to allocate a fixed percentage of their extramural R&D budgets to small business-led innovation. SBIR and STTR play a critical role in seeding the early pipeline of bioeconomy startups, particularly at TRL 1–4. However, they are project-based and not designed to provide shared translational infrastructure or sustained scale-up support. NBIN complements SBIR and STTR by providing the costly and inaccessible physical infrastructure and professional staff that SBIR- and STTR-funded companies need to advance their discoveries beyond the project stage toward commercial readiness, which even well-funded commercial incubators may not offer.

ARPA Programs: DARPA, ARPA-H, and ARPA-E

The ARPA programs—DARPA in defense applications, ARPA-H in health, and ARPA-E in energy—represent the United States’ primary institutional mechanism for funding high-risk, high-reward biological and technological research at the frontier of scientific possibility. They are extraordinary generators of breakthrough discoveries. However, these programs are not, by design, translational infrastructure. ARPA programs fund the ideas; NBIN provides the brick-and-mortar facilities, trained multidisciplinary staff, robotic platforms, and pilot-scale bioprocessing infrastructure required to convert those ideas into commercially deployable products. This is not a gap in the ARPA model—it is a deliberate division of labor. ARPA programs should be formal upstream partners of NBIN institutes: academic and government lab researchers whose ARPA-funded discoveries reach TRL 3 should have a defined pathway into NBIN’s translational pipeline, supported by joint program agreements between the relevant ARPA and the cognizant NBIN institute. This integration transforms ARPA’s extraordinary invention output into a systematically captured national economic asset rather than a series of individually negotiated commercialization attempts.

Evolving Pentagon Innovation Offices (with Bioeconomy Relevance)

The DOD has established a distributed set of innovation offices designed to accelerate the identification, funding, and transition of emerging technologies into defense applications—operating both at the Office of the Secretary of War level and within individual service branches. Key entities include the Defense Innovation Unit, the CBDP, the Office of Strategic Capital, and branch entities such as Army Research Lab, AFWERX, SpaceWERX, and NavalX, alongside service labs and program offices. These organizations are increasingly engaging in biotechnology across biomanufacturing, biosurveillance, and health security. These offices are well positioned to source and fund early-

stage technologies; NBIN complements them by supplying the shared translational infrastructure at TRL 3–6 that these efforts can build on. It does so by providing a scalable testbed and validation environment for dual-use bioeconomy technologies, enabling more effective transition from early funding to operational deployment. Across these programs, a consistent pattern emerges: federal efforts either fund projects or support ecosystems, but do not establish persistent, co-located, cross-sector infrastructure spanning the full TRL 3–6 arc. NBIN is designed to fill that structural gap.

Flagship Pioneering, Deerfield/Cure, and the Emerging Landscape of Bioeconomy Company-Creation

The proliferation of private and campus-based translational incubators over the past decade is one of the clearest demand signals for the infrastructure NBIN provides. Flagship Pioneering (Cambridge, MA) creates companies internally using shared lab infrastructure—Moderna, Indigo Agriculture, and Invaio Sciences are among its portfolio; Deerfield Management’s Cure campus pairs physical lab space with investment capital; and Versant Ventures co-locates talent, lab resources, and regulatory expertise alongside capital, a model that has produced dozens of successful biopharmaceutical companies. A growing landscape of other platforms—Alexandria LaunchLabs, LabCentral, Nucleate, IndieBio, and generalist accelerators like Y Combinator that have increasingly expanded into biotech-focused cohorts—confirms both the urgency of demand and the structural limits of private capital alone at national scale. Each is optimized for a specific niche; what remains unmet is full-stack infrastructure integrated across the TRL 3–6 arc—pilot-scale bioprocessing, GMP-compliant environments, process engineering expertise, regulatory science capabilities, and high-throughput analytical and robotic platforms—which NBIN is designed to provide as a complement to these proven private models at national scale. Moreover, what no individual venture-led or campus-led incubator can deliver is the federated network effect a national tiered system makes possible: institutes that cross-collaborate on shared pre-competitive data zones, exchange resident companies and personnel across sectoral specializations, and collectively take on focused mission portfolios from the DOD, federal mission agencies, industry consortia, and venture co-investment groups that no single private or campus incubator could absorb at scale. What these incubators do share, however, is the insight that capital alone does not cross the valley of death—operational infrastructure, scientific expertise, and regulatory knowledge must accompany it.

NBIN extends this model to all 50 states and every bioeconomy vertical, combining the nonprofit strategic-investor model—In-Q-Tel federally, and a generation of state venture organizations regionally—with Flagship/Deerfield/Versant-style physical derisking infrastructure—available to companies and entrepreneurs in Nebraska, Montana, Louisiana, and every other state in the Union.

10. Implementation Roadmap

Years 0–2: Foundation and Authorization

Critical path items in Years 0–2 include: statutory authorization of the NBIN non-profit vehicle with initial federal capitalization through, for example, a USDA/NIFA or National Defense Authorization Act (NDAA) investment agreement; recruitment and seating of the national Board of Trustees, drawn from academic, industry, and patient capital backgrounds with no federal employees as voting members; appointment of the national management team (President/CEO, Chief Investment Officer, Chief Science Officer, Chief Mission Officer); launch of the Tier 1 TINA enrollment process through land-grant and sea-grant anchor institution networks; engagement with state governments to develop co-investment commitments for first-cohort institutes; execution of first DOD mission investment agreement(s) for priority national security applications; and development of template governance documents for institute-level investment vehicles. Federal agency participation beyond the initial USDA/NIFA or DOD investment is entirely voluntary and is pursued through bilateral investment agreement negotiation—creating no dependency on any single agency’s appropriations and insulating basic science agencies from any obligation to redirect their core research budgets toward NBIN activities.

NBIN’s design should also draw on the U.S. university-based translational centers already operating at Tier 1–2 scale, whose hard-won experience with tripartite governance, IP-framework negotiation, industry-partnership formation, and workforce integration is directly transferable. In Years 0–2, the NBIN National Coordination Office should therefore establish a voluntary, non-exclusive Operational Learning Network comprising existing university-based centers willing to share governance documentation, IP-framework templates, industry-partnership models, and workforce-integration protocols—directly informing the template governance documents noted above. Participating centers contribute documented operational experience and receive in return early access to NBIN data infrastructure, coordination support, and potential designation as Tier 1 prototype sites. Parallel to, not a replacement for, the TINA enrollment process, this network accelerates NBIN’s institutional learning curve and demonstrates that the network deliberately builds on the existing U.S. translational-infrastructure landscape rather than designing in isolation from it.

Legislative Momentum and Authorization Pathway

NBIN authorization does not require building from a standing start. Several legislative and executive developments have created a foundation of political will and institutional precedent that a dedicated authorization bill can build upon. The National Biotechnology Initiative Act (H.R. 2756/S. 1387, 119th Congress)—the first legislation introduced pursuant to the NSCEB’s April 2025 recommendations—establishes authorization language for a White House bioeconomy coordination office, proposed as an NSF-detailed position modeled on the nanotechnology coordination office. The House Biotech Caucus provides a bipartisan legislative constituency for bioeconomy investment. These are positive and necessary signs of momentum—but they are not sufficient. Coordination without infrastructure leaves the translation gap intact. NBIN authorization should be framed explicitly as the implementation layer that gives existing coordination mandates a national network to coordinate. Nothing in the recommended authorization forecloses a larger commitment later: the same statutory framework can support a modest pilot, a regional demonstration, or a national initiative on the scale of Manufacturing USA or CHIPS—through future NDAA’s, supplemental appropriations, or dedicated bioeconomy legislation—without new legislative redesign.

The two legislative tracks—authorization (establishing NBIN’s statutory identity and governance framework) and appropriations (providing capital and operating funds for first-wave sites)—have distinct natural homes. Authorization—establishing NBIN’s statutory identity, the NBIN National Coordination Office, and the site selection framework—is most naturally pursued through the Senate Commerce Committee and House Science, Space, and Technology Committee, where bioeconomy and manufacturing innovation legislation has historically originated. Appropriations—providing the capital and operating funding—requires engagement with Commerce, Justice, Science subcommittees for the coordination office and potentially Energy and Water subcommittees for the capital expenditure tranche, consistent with the infrastructure precedent set by DOE programs. The DOD mission-capital component—including any initial capitalization through a National Defense Authorization Act

investment agreement—is most naturally advanced through the House and Senate Armed Services Committees and the Defense Appropriations subcommittees, consistent with the NDAA’s role as the recurring vehicle for defense-linked innovation authorities. Engagement with both authorizing and appropriations committee staff in parallel, from the earliest stages of legislative drafting, is suggested to avoid the authorization-without-funding trap that has delayed comparable programs. NBIN is designed to function as the bioeconomy pillar of the integrated national industrial strategy that the National Academies and others have identified as essential to sustained U.S. manufacturing competitiveness (NASEM, 2026).

NBIN requires a federal administrative capability able to coordinate across agencies, regions, and sectors while supporting partnerships among nonprofit organizations, universities, industry, philanthropy, and state governments. Whether Congress assigns program administration to the Department of Commerce or another federal entity, the essential requirement is an administrative home with sufficient cross-sector authority and flexibility to support a national biotechnology translation network while complementing—rather than duplicating—existing agency missions.

Regardless of where these responsibilities are assigned, three federal functions should remain distinct: (1) policy leadership and strategic direction; (2) program administration and stewardship of appropriated funds with accountability to Congress; and (3) interagency coordination to align complementary activities across agencies such as DOE, NIH, NSF, DOD, USDA, and EPA. These federal responsibilities are separate from the non-federal NBIN National Coordination Office described in Section 5.3, which is responsible for network operations, institute enrollment and site selection (Section 7.2), technical assistance, performance assessment, and management of NBIN’s nonprofit investment activities.

Years 0–2 Priority Actions

Introduce and pass authorizing legislation for the National Biotechnology Incubator Network.

Establish the NBIN National Coordination Office with statutory authority and appropriated budget.

Launch competitive site selection RFP for first-wave institutes.

Develop template IP, data governance, and partnership frameworks.

Initiate state co-investment negotiations with prospective host regions.

Map existing infrastructure to identify capability gaps and avoid duplication.

Initiate voluntary interagency coordination—drawing on DOE, NIH, NSF, USDA, DOD, and other agencies that choose to participate—procurement alignment, and financing tool deployment under existing authorities to support early-stage implementation.

Years 2–5: First-Wave Institutes Operational

First-wave institutes become operational during this period, with facility construction or renovation completing at latest by year 3 and full programmatic operations by year 4. Key milestones include: first cohorts of resident companies established in institute facilities; initial TRL 3–6 project pipelines active; national laboratory integration agreements executed; workforce development programs enrolling first cohorts; and network data infrastructure operational and receiving contributions from all first-wave sites. Year 3 evaluation provides the first systematic assessment of performance and informs adjustments to site selection criteria and governance frameworks for second-wave institutes. Milestone criteria assessed at Year 3 include: pipeline activity (minimum number of active TRL 3–6 projects and industry co-investment ratio); resident company formation rate; data contribution benchmarks (volume and quality of FAIR-compliant datasets contributed to the national network); and governance health indicators (governing council functionality, staffing completeness, industry advisory engagement). Consistent with Section 8.7, these thresholds are calibrated to regional context: nascent-ecosystem Tier 1 institutes are evaluated at Year 3 on ecosystem-building leading indicators, with TRL advancement rate becoming a primary metric only at Year 5. An institute failing to meet minimum thresholds at Year 3 enters a supervised improvement period with a defined 18-month corrective action plan co-developed with the NBIN National Coordination Office. Failure to recover by Year 5 triggers a structured wind-down and asset disposition process, with the Year 5 evaluation serving simultaneously as an improvement certification or a formal decommissioning authorization.

Years 2–5 Priority Actions

- Complete facility construction and equipment installation at first-wave sites.
- Establish resident company pipelines and TRL advancement programs.
- Execute national laboratory partnership agreements at each site.
- Activate network data infrastructure and pre-competitive data zones.
- Launch workforce development programs with dedicated funding streams.
- Conduct year-3 evaluation and initiate second-wave site selection process.

Years 5–10: Network Expansion and Full Integration

Tier 2 hub institutes and Tier 3 flagship institutes may be authorized and initiated in parallel with first-wave Tier 1 institutes where regional demand, existing infrastructure density, and capital readiness support accelerated deployment. Sequential Tier 1→Tier 2→Tier 3 progression is a supported pathway for emerging bioeconomy regions building translational capacity from the ground up, not a network-wide prerequisite: states and regions with demonstrated anchor infrastructure—established research universities, existing biomanufacturing industry, national laboratory co-location, or high-density life sciences clusters—may enter the network at Tier 2 or Tier 3 directly. Tier designation reflects regional capacity, not maturity of participation in the network. Tier 2 hubs not emerging from Tier 1 programs are designated through the same competitive review process, assessed against the same capacity and demand criteria, with state capital commitments and industry partnership depth as primary differentiators.

Full network integration—cross-tier project mobility, network-wide data sharing, technology progression pathways across tiers when pertinent, and coordinated national grand challenge programs—reaches operational maturity by years 7–10, with precise timing dependent on the pace of institute funding and deployment across all tiers. By year 10, the network should demonstrate measurable outcomes: a pipeline of institute-affiliated companies having raised follow-on capital; documented TRL advancement rates; workforce training throughput; and data assets accessible to the broader US bioeconomy. Year 10 evaluation determines expansion, consolidation, or sunset criteria for individual institutes based on demonstrated performance and evolving national priorities.

The network governance framework includes a formal decommissioning protocol established at institute founding—not negotiated at the point of failure. In the event of institute wind-down, physical infrastructure and equipment are first offered for transfer to the host state or regional anchor institutions at book value; if declined, assets are marketed to industry or private buyers through a structured sale process administered by the NBIN National Coordination Office. Federal capital recovery provisions are codified in founding agreements: any residual decommissioning liability is apportioned among federal, state, and institutional parties proportional to their original capital contributions. The asset disposition framework is designed to maximize reuse—a decommissioned NBIN facility retains substantial value as a biomanufacturing or research asset even if its institute mandate is wound down—and to ensure that no single party bears disproportionate stranded cost risk.

Years 5–10 Priority Actions

- Open second-wave institutes and integrate them into network infrastructure.
- Demonstrate cross-institute project mobility and technology transfer.
- Publish network-wide performance data as a public accountability mechanism.
- Conduct year-5 evaluation informing second-wave adjustments.
- Scale pre-competitive data zones into the national Web of Biological Data.
- Conduct year-10 network-wide evaluation: expand, consolidate, and sunset decisions.

11. Conclusion

The United States leads the world in biological discovery, yet too often fails to translate that leadership into domestic economic growth, industrial capacity, and strategic advantage. The unrealized potential is substantial: applying NASEM's estimates of the bioeconomy's current and potential shares of U.S. GDP suggests that more than \$600 billion in additional annual output could be at stake (NASEM, 2020). This is a present and compounding loss, measured in companies never formed, manufacturing capacity ceded abroad, and regional economies that never materialize. Every year that translational infrastructure remains inadequate is another year in which promising biotechnologies remain confined to journals, bioindustrial capacity migrates offshore, foreign competitors strengthen their market positions, and supply chains for medicines, materials, and critical inputs remain fragile.

NBIN is the bridge from biological discoveries to biological industries. Federal investment currently funds world-leading biological discoveries in university and national laboratories upstream, as well as scale-up capacity downstream in the Manufacturing USA institutes such as BioMADE, NIIMBL, and BioFabUSA. However, what is lacking is the translational layer between them, where biological technologies are most operationally demanding and least served by existing institutions. NBIN occupies this gap: it does not duplicate the discovery engine or the manufacturing institutes; it provides the missing connection with the translational infrastructure, expertise, and focused capital that enable both to deliver the economic returns intended by their design

The NBIN network converts this latent value into economic development nationwide. Anchored by the land-grant, sea-grant, sun-grant, and space-grant system, and partnered with national laboratories and research institutes, this tiered network implements translational infrastructure to reach all 50 states. Its portfolio logic is deliberately distributed to include pharmaceutical and non-pharmaceutical verticals that include bio-based materials, agricultural biologicals, industrial chemicals, food ingredients, and critical mineral recovery processes, empowering the formation of small and mid-sized regional companies nationwide. Because small businesses account for approximately 42% of U.S. manufacturing employment (U.S. Small Business Administration, 2023), and because workforce development is embedded in every institute's operating model, bioindustrialization pursued in this way becomes an instrument for broadly shared economic growth, and long-term, sustainable regional competitiveness.

And the same NBIN infrastructure empowers national security. Biological threats to humans, livestock, and crops are present and intensifying, and they are answered by translating biological counter-measures from laboratory discoveries to pilot and production scale, not by limiting them to the bench. NBIN's institutes are the translational layer that empowers the United States to lead in biosecurity, with mission investment agreements offering one of several capital mechanisms that enable national security requirements to be met by realizing a domestic supply chain, a biomanufacturing surge capability, or an agricultural bioprotectant, none of which can safely be sourced from adversaries.

Importantly, China's coordinated national bioeconomy strategy is a present competitive reality, not a projection (NSCEB, 2025), and Germany's Fraunhofer network has already demonstrated that sustainable, government-anchored infrastructure produces durable industrial advantage. NBIN draws on Germany's lesson while differing from it in a decisive respect: Germany's strength is applied engineering and process refinement, whereas the United States holds the world's deepest concentration of frontier biological research, entrepreneurial talent, and risk capital. NBIN is designed to harness these unique strengths to accelerate domestic bioindustrialization, strengthen national competitiveness, and deliver economic growth nationwide.

The urgency for NBIN compounds in this AI era as published findings, patents, and workflows are now training data available to any well-resourced actor, and one of the few durable moats remaining is proprietary experimental data and process workflows generated at translational scale. This moat accrues to whoever builds it first, within a window that is already closing. Indeed, the nation holding the most comprehensive translational datasets will also shape international standards that govern global market access.

The policy dialogue documented in this report reveals broad practitioner convergence across academia, national laboratories, industry, venture capital, and government on essential design elements for translational biotechnology infrastructure: blended capital, non-federal governance, tiered processing and analytical facilities, regulatory

expertise, and regionally-calibrated performance-based evaluation. The National Academies frame such a translational layer as an essential pillar of the integrated national industrial strategy the United States requires (NASEM, 2026). NBIN is additive by design—bridging and integrating existing federal and state assets rather than duplicating them—and its equity participation in resident companies is structured to reduce federal operating dependence over the network’s second decade as it becomes self-sustaining.

The framework presented here is implementation-ready: the institutional design is specific, the financing model is structured, the governance architecture is defined, and the relationship to existing programs is mapped. What remains is the choice between continued fragmentation and this coordinated national infrastructure that turns biological discoveries into economic development, industrial capacity, and security in every region of the country. Congress now has the opportunity to establish the infrastructure needed to convert America’s scientific leadership into enduring economic prosperity, industrial strength, and national security. This report is a call to action.

12. References

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13. Abbreviations and Acronyms

The following abbreviations and acronyms are used throughout this report.

AFWERX—Air Force Works accelerator for Air Force innovation

AI—Artificial Intelligence

ABPDU—Advanced Biofuels and Bioproducts Process Development Unit

APEC—Asia-Pacific Economic Cooperation

APHIS—Animal and Plant Health Inspection Service (USDA)

ARM—Advanced Robotics for Manufacturing (Manufacturing USA Institute)

ARMI—Advanced Regenerative Manufacturing Institute

ARPA—Advanced Research Projects Agency (generic designation)

ARPA-E—Advanced Research Projects Agency—Energy

ARPA-H—Advanced Research Projects Agency—Health

BARDA—Biomedical Advanced Research and Development Authority

BCG—Boston Consulting Group

BRC—Bioenergy Research Center (DOE)

CBDP—Chemical and Biological Defense Program (Department of Defense)

CBER—Center for Biologics Evaluation and Research (FDA)

CDER—Center for Drug Evaluation and Research (FDA)

CDMO—Contract Development and Manufacturing Organization

CEO—Chief Executive Officer

CFSAN—Center for Food Safety and Applied Nutrition (FDA)

CHIPS—Creating Helpful Incentives to Produce Semiconductors (CHIPS and Science Act)

CMC—Chemistry, Manufacturing, and Controls

CODEX—Codex Alimentarius Commission (joint FAO/WHO food standards body)

CRADA—Cooperative Research and Development Agreement

CRO—Contract Research Organization

DARPA—Defense Advanced Research Projects Agency

DHS—Department of Homeland Security

DOD—Department of Defense

DOE—Department of Energy

DOL—Department of Labor

DOT—Department of Transportation

EDA—Economic Development Administration (Department of Commerce)

EMAPS—Energy Materials and Processing at Scale (DOE initiative)

EPA—Environmental Protection Agency

FAIR—Findable, Accessible, Interoperable, and Reusable (data principles)

FDA—Food and Drug Administration

FFRDC—Federally Funded Research and Development Center

FIFRA—Federal Insecticide, Fungicide, and Rodenticide Act

FY—Fiscal Year

GDP—Gross Domestic Product

GMP—Good Manufacturing Practice

GRAS—Generally Recognized As Safe (FDA food-ingredient pathway)

HBCU—Historically Black College or University

HSST—House Committee on Science, Space, and Technology

IC—Intelligence Community

ICH—International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use

IP—Intellectual Property

IPA—Intergovernmental Personnel Act

IQT—In-Q-Tel (non-profit strategic investor for the U.S. Intelligence Community)

IRS—Internal Revenue Service

MAM—Multi-Attribute Method (mass spectrometry-based biological product characterization)

MRL—Manufacturing Readiness Level

NASA—National Aeronautics and Space Administration

NASEM—National Academies of Sciences, Engineering, and Medicine

NBIN—National Biotechnology Incubator Network

NDAA—National Defense Authorization Act

NIFA—National Institute of Food and Agriculture (USDA)

NIH—National Institutes of Health

NIIMBL—National Institute for Innovation in Manufacturing Biopharmaceuticals (Manufacturing USA Institute)

NIMBY—Not In My Backyard

NIST—National Institute of Standards and Technology

NOAA—National Oceanic and Atmospheric Administration

NSF—National Science Foundation

NSCEB—National Security Commission on Emerging Biotechnology

OECD—Organisation for Economic Co-operation and Development

OSC—Office of Strategic Capital (Department of Defense)

OSTP—Office of Science and Technology Policy

R&D—Research and Development

REMADE—Reducing Embodied-energy and Decreasing Emissions (Manufacturing USA Institute)

RFA—Request for Applications

RFP—Request for Proposals

SBIR—Small Business Innovation Research

SEMATECH—Semiconductor Manufacturing Technology (historical industry consortium)

SMB—Small and Medium-sized Business

SME—Subject Matter Expert

STTR—Small Business Technology Transfer

T-BRSC—Tri-Service Biotechnology for a Resilient Supply Chain (Department of Defense program)

TINA—Translational Institute Network Application (NBIN site selection process)

TIP—Technology, Innovation, and Partnerships (NSF directorate)

TRL—Technology Readiness Level

TSCA—Toxic Substances Control Act

UARC—University Affiliated Research Center

USDA—United States Department of Agriculture

VC—Venture Capital / Venture Capitalist

14. Appendix: Workshop Opt-In Participants

The following individuals opted in to having their names included in workshop-related reports and publications. Workshop discussions were conducted under the Chatham House Rule: no statements are attributed to individuals, listed alphabetically by last name. Additional acknowledgment is extended to Theresah N. Korbich Zu (Bio-Materials Synthesis and Assembly Branch; Biology, Materials, and Manufacturing Sciences Division; DEVCOM Army Research Laboratory) for providing valuable comments on the report.

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