

FON: EDA-TECHHUBSPHASE1-2023 | FY 2023 Regional Technology & Innovation Hub Program

Consortium name: Illinois Fermentation and Agriculture Biomanufacturing (iFAB)

Geography: Champaign-Urbana and Decatur MSAs (Champaign, Piatt, and Macon counties)

Core technology area (CTA): Precision fermentation and bioprocessing, the intersection of synthetic biology and advanced manufacturing (key technology focus areas #7 and #4)

Constraint met by consortium: "Significantly benefits small and rural community," given population of 223,000 and 101,000, respectively, in Champaign-Urbana and Decatur MSAs

FACTOR 1: TECHNOLOGY-BASED POTENTIAL OF THE REGION FOR GLOBAL COMPETITIVENESS

Nature and magnitude of CTA: As reflected in Executive Order 14081, an emerging industrial revolution is transforming agricultural commodities into biologically based products that reduce petroleum dependency and create sustainable chemicals.¹ At the forefront of this bio-revolution is precision fermentation, in which single-celled organisms acting as "micro factories" convert plant feedstocks (often corn sugar) into high-value ingredients, materials, fuels, and more.

Precision fermentation is critical for the sustainable production of the nutritional components that will feed a global population expected to grow by two billion people over the next 30 years.² Plant-based diets have a 75% lower greenhouse gas impact than do meat-based diets,³ but inferior taste and texture in these alternatives hinder adoption.⁴ By producing specific ingredients that improve the sensory characteristics of plant-based products,⁵ precision fermentation mitigates climate change while capitalizing on large market opportunities. Replacing a fraction of the multitrillion-dollar meat and dairy industries,⁶ **the precision fermentation-derived proteins market is growing by ~ 40% per year and will represent a \$30-35 billion industry by 2030.**^{7 8 9}

Opportunities are not limited to food. Using the same equipment, and resources, this CTA will enable the Biden Administration's 20-year goal to "produce at least 30% of [~\$500 billion¹⁰] US chemical demand via sustainable and cost-effective biomanufacturing pathways."¹¹

Central Illinois inventory of existing assets: Central Illinois is the ideal location for US-based biomanufacturing due to several key factors.

Feedstock: Precision fermentation relies on large quantities of corn sugar (dextrose) and soy products. Transporting this "feedstock" adds significantly to its cost, creating economic advantages for locating facilities near production. Illinois is the first and second largest producing state of soy and corn, respectively, with Piatt, Macon, and Champaign counties each representing top-five US producing counties in one or both of those crops.¹¹

Infrastructure: Decatur is one of the world's largest corn processing regions (850,000 bushels a day¹²), is home to two of the world's largest processors (ADM and Primient, both iFAB members), and has robust enabling infrastructure. This includes a multi-modal hub¹³ that provides domestic and international delivery flexibility through a transportation corridor (Illinois is the only state in which all seven Class I railroads operate¹⁴) and wastewater treatment facilities capable of handling commercial quantities of biological waste.¹⁵ Consortium members are investing in cutting edge production capabilities, which since 2021 has included construction of the world's largest insect protein facility with Innovafeed,¹⁶ two JVs with LG Chem to produce critical inputs for bioplastics,¹⁷ and a \$300M expansion of an alternative protein facility.¹⁸

Research leadership: With top programs in Agricultural (#4), Chemical (#5), and Bio (#17) Engineering, the University of Illinois at Urbana-Champaign (UIUC) drives the biomanufacturing industry through research expertise and educational programming. In 2018, the State of Illinois invested \$42 million to create UIUC Integrated Bioprocessing Research Lab (IBRL, lead consortium member) to accelerate technology transfer from research to commercial applications.

Path to global competitiveness: The industry faces a lab-to-market bottleneck constraining its capacity to test innovations in increasingly larger fermenters at the lab, pilot, demonstration, and commercialization stages. Currently, **demand far exceeds capacity for pilot- (~1,000L) and**

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demonstration-scale (~20,000-75,000L) fermenters, and a trained workforce is not available. Independent equipment ownership is cost prohibitive, leading European governments to invest in shared-use facilities. Lacking public investment, US startups must often seek testing capabilities abroad¹⁹ with Europe alone housing almost 50% of the global fermentation capacity compared with only 34% in the U.S.⁴

iFAB began to address this constraint using multi-use pilot scale fermentation equipment at IBRL (20-1,500L) and Primient (1,500 – 13,000L). EDA funding would enable more companies to execute development and manufacturing in one location, keeping innovation and jobs in Central Illinois, through the following initiatives:

- **Increased capacity:** Expanding IBRL will increase pilot scale project capacity from ~20 to ~60 clients annually. Primient will revitalize an idled demonstration facility with six fermenters (four 1,500L, two 13,000L) and make it available to external users. ADM will invest in demonstration scale (50,000L+) facilities, as well as co-location opportunities.
- **Workforce:** Richland Community College's (Decatur) and Parkland College's (Champaign) technical training and apprenticeship programs support diverse communities with upskilling and career placement. Both colleges will expand these programs for precision fermentation skillsets, leveraging existing relationships with industry partners. The Illinois Agri-Food Workforce Initiative, which includes ADM and UIUC, will provide K-12 curriculum to diverse students to expose them to career opportunities in the industry.
- **Entrepreneurship:** In addition to access to multi-use facilities, startups will benefit from comprehensive iFAB support through the University of Illinois Research Park (UIRP) and gener8tor's Illinois AgTech Accelerator. Serra Ventures agtech venture fund will provide local investment opportunities for commercialization.

Region's future share of the market: As it addresses the bottleneck described above, Central Illinois can reasonably capture a leading global market share (10-15%)²⁰ of its CTA in target end markets (implied \$3-5 billion in revenue by 2035 in protein alternatives):

- **Processed feedstock:** Maintaining corn processing levels, the volume of carbohydrates the region already produces conservatively represents \$15-20 billion in potential revenue if used for higher-value precision fermentation products (e.g., specialty proteins, enzymes)²¹. Recognizing this, ADM is already "redeploying" its legacy carbohydrates production capacity towards "fast-growing, higher-margin" segments in precision fermentation.¹⁷ This "BioSolutions" platform grew \$227 million last year alone (and is central to the company's sustainability commitments).²²
- **Enabling infrastructure:** Decatur's investment in logistics and utilities can support another 10-15 relocations of Innovafeed's magnitude. This represents \$700-800 million in revenue potential before requiring additional investment.²³ IBRL will also increase fermentation capacity clients served three-fold (20 to 60 clients annually).

Number and earning potential of related jobs: The region employs ~10,000 people in biomanufacturing roles from production through management. Top roles driving the industry pay a median wage of \$81,000, well above the \$44,000 median wage for the region. As the two MSAs have ~150,000 private employees in total, this CTA—with forecasted growth over 40%—will significantly expand the number of thriving wage jobs for small communities.²⁴

FACTOR 2: ROLE OF THE PRIVATE SECTOR

Founding iFAB members include startups (Boston Bioprocess), incumbent bioprocessing multinationals (ADM, Primient), and supply chain players (Clarkson Grain Company). This range of commitments reflects the consortium's understanding that growing the biomanufacturing industry requires involvement of varying size companies at all stages in the value chain.

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Startups: Emergent companies drive innovation and employment, and iFAB is committed to fostering, attracting, and retaining startups through its multi-use facilities, UIRP and Enterprise-Works Incubator, gener8tor’s AgTech accelerator, and capital from Serra Ventures. Over five years, IBRL has supported 90 companies, such as Geltor, Motif FoodWorks, EQUIL, Hyfé Foods, and Tandem Repeat, with transitioning to commercialization. As testament to the region’s startup support, Boston Bioprocess (BBP) established labs and offices in Champaign-Urbana to access iFAB’s capabilities. BBP now has six local FTEs (including its founders) and commits to continue hiring and bringing its client pipeline to the region.

Existing firms: Primient will redevelop an idled facility into a contract manufacturing facility—with plans to bring commercial-scale assets online—and commits to providing supply chain support to iFAB (e.g., access to utilities, lab assets, warehouse space, maintenance and safety talent). ADM, in addition to providing venture capital to fermentation-based startups²⁵ and strategic partnerships with alternative protein players,²⁶ is evaluating how it will expand and upgrade a facility to manufacture new fermentation-based products.

Suppliers: Clarkson Grain Company, a corn and soy supplier, is expanding its supply chain for precision fermentation in close collaboration with iFAB members, and will provide raw materials and feedstocks to emerging companies alongside Primient and ADM.

FACTOR 3: REGIONAL COORDINATION AND PARTNERSHIPS

iFAB’s 30 members holistically represent the region’s most relevant institutions across all required and optional entity types as outlined by Section 1.b.ii in the Tech Hub NOFO.

Collaboration model: IBRL will employ the Regional Innovation Officer (Dr. Beth Conerty) and serve as the lead consortium member. In addition to Dr. Conerty’s ties with the region’s stakeholders, IBRL will coordinate iFAB through established forums:

- *University-industry linkages:* UIUC has institutional relationships with all iFAB industry members, which serve on the advisory boards of IBRL, and/or have locations in the UIRP. Community college partners also have deep industry connections (e.g., Richland recently conducted 11 specialized training sessions for ADM and Primient).
- *Special economic zones:* Municipal, county, and state government members commit to support iFAB through financial incentives via enterprise zones in Macon and Champaign counties, which coordinate with Hub’s four labor and union partners. The city of Decatur creates customized redevelopment agreements to meet business needs as demonstrated with Innovafeed and Tillamook.

Past success: Recent instances of iFAB successes along the Champaign-Urbana and Decatur corridor (less than an hour drive) include the EDC of Decatur, City of Decatur, and ADM working together to attract joint venture opportunities such as LG Chem and Innovafeed, the Champaign County EDC’s role in ensuring that Clarkson Grain Company’s state-of-the-art facility landed in Champaign County, and Workforce Investment (WIOA) Solutions collaborating with ADM to hold an exclusive hiring event for 400 laid off employees following Akorn’s closing this year (see letters of commitment for additional details for each).

FACTOR 4: EQUITY & DIVERSITY

iFAB commits to addressing the region’s racial disparities (e.g., 25% and 29% of Black and Hispanic residents, have incomes below the poverty line, relative to 10% of white residents²⁷) and challenges with labor force participation (e.g., Decatur MSA qualifies for EDA’s Recompete Pilot Program with a prime age employment rate gap of 2.9%.²⁸) To do this, the Hub will expand the pipeline for STEM jobs, including those not requiring a four-year degree (e.g., technicians).

- *Richland Community College* has developed customized curricula for precision fermentation through industry partnerships (78% of program participants are Black.) One highlight is a four-

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week training program (paid, with benefits) with ADM that provides the skills to become process technicians, in which entry-level production specialists split their week between onsite training on Decatur’s campus and instruction at Richland.²⁹ Upskilling production roles is an important equity intervention given Black employees account for a disproportionate share of these roles (24% of region’s machine operators, compared to 13% of overall employment.)²⁴ Another initiatives is the paid ten-week EnRich Program, which provides technical and essential skills training to underserved populations and has supported over 800 individuals with multiple barriers to employment (90% of whom remained employed after participation).³⁰

- *Parkland Community College* commits to expanding opportunities for the 40% of its student body underrepresented in STEM.³¹ Program highlights include: National Science Foundation (NSF)-funded S-STEM to improve retention of underrepresented students; direct entry programs into UIUC; and the Support for Workforce Training program to support students (650 participants to date, more than 70% Black³²) in technical careers (including manufacturing), including stipends, childcare, and transportation reimbursement.
- *WIOA* organizations are partnering with iFAB to link job seekers and incumbent workers with occupational training programs and grants. Decatur’s WIOA has funded a \$27,000 leadership grant for Incumbent Workers at Stratas, quality control and machining Incumbent Worker Trainings at CAT, and On The Job Training for new employees and Incumbent Worker Training for Supervisors at Fuyao.

FACTOR 5: COMPOSITION AND CAPACITY OF THE REGIONAL WORKFORCE

Workforce description: Of the ~10,000 employees in the top 20 occupations within precision fermentation, ~80% are in roles that pay above the median regional wage (\$44,000). These include: 800+ in production roles (e.g., first-line supervisors and operators, ~\$52-62,000 median wage, typically requires a high school diploma), 200+ in innovation roles (e.g., chemists and technicians, ~\$46-76,000), 1,000+ in technical roles (e.g., engineers and computer scientists, ~\$88-95,000), and 5,000+ management roles (e.g., general and project managers, ~\$77-144,000).²⁴

The region has been more successful filling job postings in production and management roles (~5% of 2022 postings left unfilled) than in innovation and technical roles (75-85% of 2022 postings unfilled).²⁴ A regional EDC survey of nine Central Illinois bioprocessing employers in August 2023 confirmed the difficulty of filling engineering and scientific job openings, specifically the challenge of retaining the “new generation” of skilled workers in the region.

Interventions to grow STEM workforce: To address workforce gaps, iFAB will focus on retaining the pipeline of local STEM graduates—among the largest and most qualified in the country. UIUC enrolls 35,000 undergraduate and 20,500 graduate students, including 5,065 students in leading degree programs aligned with bioprocessing (see Factor 1). To keep students in Central Illinois, IBRL will expand its workforce development programs to increase training from 35 to 100 undergraduates per year and industry short course training from 80 to 180 participants annually. As addressed in Factor 4, the region’s community colleges will further expand the pipeline and increase equity. Parkland will also replicate the model of its NSF-funded Midwest Center for Precision Agriculture to offer training and industry apprenticeships in precision fermentation.

Labor organization engagement: iFAB has four labor unions and workforce organizations, which joined the consortium recognizing that growth in the precision fermentation industry increases demand for craft union jobs. These organizations will continue to work with the other iFAB members through special economic zones and existing partnerships, such as IBRL’s association with the Plumber & Pipefitters Union, as well as ADM and Primient’s relationship with the Decatur Building and Construction Trades Council ALF-CIO (see letter of commitment for more details).

FACTOR 6: INNOVATIVE “LAB TO MARKET” APPROACHES

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Programs and policies: As described in Factor 1, iFAB is addressing a critical lab-to-market bottleneck by increasing multi-use pilot and demonstration capacity. The demand IBRL is experiencing for its facilities is evidence of this need. Fermentation equipment is being booked by industry up to one calendar year in advance and IBRL increasingly has to deny new clients.

With EDA funding and member commitments, iFAB will recruit Series B and C startups bringing their first product to market. Many of IBRL's current clients start with Series A and raise Series B while working in the facility, but after "graduating" there is no capacity for them to conduct small-scale manufacturing and become revenue-generating. This leads companies to seek commercialization support primarily in Europe.¹⁹ iFAB will help solve that problem by expanding biomanufacturing capacity in Central Illinois.

Technology transfer: The State of Illinois invested \$42 million to create IBRL, with the objective of expanding and accelerating technology transfer from research to commercial application. By making multi-use equipment available to external users, technology is de-risked faster and cheaper. Expanding resource availability for pilot testing and scaling will expand technology transfer capabilities and will further the case for investing in and conducting at-scale manufacturing in the US, in proximity to pilot scale facilities.

FACTOR 7: IMPACT ON ECONOMIC AND NATIONAL SECURITY OF THE ENTIRE UNITED STATES

Positive regional impact: Historically, corn has been used to produce high fructose corn syrup and ethanol. However, both markets are declining as consumer preferences change (corn usage for high-fructose corn syrup peaked in 2005) and vehicles are electrified. UIUC found that projected ethanol usage would decrease prices up to 4% by 2050, in addition to production declines.³³ This will have profound implications for the ~100,000 Illinoisians whose jobs depend on corn.³⁴ Precision fermentation provides new customers for US corn production.

Alignment with national priorities: Simultaneously, new corn customers are creating new products to drive domestic, sustainable manufacturing in alignment with national priorities.

- *Supply chain resilience:* As noted in EO 14081 where "biotechnologies already exist to address high-risk bottlenecks [...] public-private partnerships must focus on de-risking technology deployment and expansion" (the focus of this proposal). By providing alternatives to products such as eggs—which saw large price increases due to bird flu in 2022—and chemicals—reliant on petroleum for production—precision fermentation addresses important supply chain vulnerabilities. On chemicals specifically, the EO notes that producing 30% of US chemical demand with biomass will specifically require improving "precision fermentation capabilities."¹
- *Decarbonizing end markets:* As noted in Factor 1, plant-based protein alternatives have massive decarbonization potential. Substituting 20% of meat consumption with fermentation-derived proteins could cut annual deforestation and associated CO₂ emissions in half.³⁵ Leveraging cutting-edge technologies, fermentation can go so far as to generate nutritious food and sustainable materials from atmospheric carbon dioxide and nitrogen.³⁶
- *Addressing production emissions:* iFAB is addressing carbon production from fermentation processes. A notable example includes the Illinois Basin - Decatur Project (IBDP), a commercial-scale carbon capture and storage (CCS) test adjacent to ADM's Decatur plant in partnership with UIUC and leading geologists.³⁷ iFAB will continue to explore opportunities for mitigating climate change and has a plan to account for current and future weather- and climate-related risks, as required by Section 1.B.vi in the Tech Hubs NOFO.
- *Pace of innovation:* Despite this CTA's importance, the US lags in its infrastructure (see Factor 1) and public funding. Europe directed \$155 million in public investment for precision fermentation in 2022, compared to \$5.5 million in the US.³⁸ Additional funding is needed for the US to ensure domestic ownership of intellectual property that is increasingly relevant for food security other critical supply chains.