



BRIE Working Paper
2026-2

Growing the Circular Bioeconomy in a Rural Region:

Case Study of the North San Joaquin Valley

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Part of *The Emerging Bio-Economy: California Opportunities and Challenges in a Global Transformation?*

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Executive Summary

In response to the economic dislocation from COVID-19 and the subsequent federal investment in recovery, one California county – Stanislaus County – chose to make a major investment in growing the local bioeconomy as part of an economic mobility strategy. That seed investment resulted in the creation of a new bioeconomy sector intermediary and the expansion of the work to become a regionwide priority where the intermediary has been working with dozens of companies and researchers since 2023. That funding successfully leveraged four times additional public and private resources. Over several years, this sector intermediary tested new approaches and shifted strategies in response to changes in technology readiness and feedstock diversity. The findings from this experience shaped the strategy. And the lessons from this experience are broadly applicable to regions nationwide. This case study details the specific actions that took place in Stanislaus County and the broader North San Joaquin Valley region to grow a new bioeconomy cluster.

Section 1: Introduction

This chapter is a case study that examines how a rural agricultural region, the North San Joaquin Valley (NSJV), anchored by Stanislaus County, deliberately pursued growth of a circular bioeconomy sector as part of a broader strategy to improve economic mobility and to diversify its economy. This case is not a theoretical discussion of how to form clusters and develop priority sectors as part of a regional development strategy. It is a precise and specific account of what happened when a county government alongside key local, regional, and eventually state partners decided to invest real political capital and public dollars into building a new industrial sector.

This case demonstrates the power of having a targeted sector approach where there is local commitment. In 2023, Stanislaus County deployed a \$10 million seed investment to grow the region’s emerging bioeconomy sector through a public-private strategy called the BioEconomy, Agriculture, and Manufacturing (BEAM) Initiative. As of 2025, the BEAM Initiative had leveraged this initial local investment to secure close to \$40 million in public-private co-investment, a 4:1 return at minimum in the effort’s first two years, with full capital mobilization expected to be far larger over time as the region develops shared infrastructure projects.

Importantly, this strategy did not originate as a climate-first initiative. In 2021, local leaders were not primarily asking how to reduce greenhouse gas emissions. They were asking how to create higher-quality jobs in a region where economic insecurity remained widespread and many working families earned below a living wage. The

alignment between the circular bioeconomy and California’s climate objectives later proved instrumental in attracting sustainability-minded private partners and state support. However, economic mobility—not decarbonization—was the initial motivator for action. This sequencing shaped both coalition-building and public narrative, and it offers a lesson for other regions seeking durable political support for emerging climate-smart sectors.

This case is also reflective of how to navigate some of the key specific challenges facing manufacturing industry growth in California. There is a persistent pattern where innovation invented in California often scales (and creates middle class jobs) elsewhere. Startups headquartered in the Bay Area routinely build commercial facilities in Texas or the Midwest. The question for many of California’s historically disinvested rural regions has become: can California become the place that not only leads in bioeconomy innovation, but also captures the fuller value chain of bio-based manufacturing?

The framework that emerged from this experience can be understood as a regional bioeconomy “Readiness Triangle,” composed of three interdependent elements: (1) raw materials and feedstocks, (2) manufacturing capacity and infrastructure, and (3) technology readiness and innovation alignment. Opportunity becomes actionable only when these three elements reinforce one another. When one dimension is weak, strategic intervention must strengthen it. As this case demonstrates, diagnosing the conditions of each leg of the triangle is the central analytical task of regional bioeconomy strategy.

This case study includes the following subsections: Section 2 describes the circular bioeconomy opportunity of the North San Joaquin Valley. Section 3 describes the path to selecting the bioeconomy as a priority sector. Section 4 describes the creation of a sector intermediary to guide the work. Section 5 describes the specific strategies undertaken. Section 6 includes key findings about growing the sector. Section 7 includes lessons on bioeconomy strategy that can be applied by leaders in any region looking to grow the sector.

Section 2: Defining the Bioeconomy Opportunity in the North San Joaquin Valley

The North San Joaquin Valley (NSJV) is one of the most productive agricultural regions in the world. With a population of approximately 1.65 million residents and a geographic footprint comparable to the state of Connecticut, the NSJV encompasses San Joaquin, Stanislaus, and Merced Counties. The region produces almonds, walnuts, tomatoes, dairy products, grapes, and numerous specialty crops at extraordinary scale. Each of the three counties consistently ranks among the highest in the nation by agricultural production value.

This agricultural abundance generates significant biomass byproducts. Almond hulls and shells, orchard removals during replanting cycles, grape pomace, food processing residues, and dairy manure represent large and recurring waste streams. In addition, the nearby Sierra Nevada foothills produce woody biomass from wildfire mitigation and

forest management activities. These materials pose environmental management challenges, but they also constitute a substantial potential industrial input base.

Unlike many rural regions rich in biomass, the NSJV also possesses substantial embedded manufacturing capacity. The region is a global leader in large-scale food processing and distribution. It contains established logistics networks, cold chain infrastructure, rail connectivity, industrially zoned land, and a workforce experienced in industrial operations. This manufacturing legacy is strategically important. Bio-based production in the Valley can often leverage existing facilities and infrastructure rather than requiring entirely new greenfield construction—an important cost consideration in California’s high-cost regulatory and construction environment.

The NSJV is further distinguished by its proximity to the Bay Area and Sacramento-Davis innovation corridors. UC Berkeley, Stanford University, UC Davis, and national laboratories including Lawrence Berkeley and Lawrence Livermore National Laboratories are within commuting distance. This geographic proximity matters because the circular bioeconomy is a technology-dependent industry. Access to advanced research institutions, startup ecosystems, and specialized talent enhances the feasibility of commercialization. The NSJV is therefore uniquely positioned as a region that combines feedstock abundance, manufacturing infrastructure, and access to world-class innovation assets.

Section 3: Why Stanislaus County Invested in Growing the Regional Bioeconomy

The bioeconomy strategy emerged from the Stanislaus 2030 economic development initiative, launched during the COVID-19 pandemic. Federal American Rescue Plan Act (ARPA) funding created an opportunity for strategic investment. County leadership made a deliberate decision: rather than allocate all funds to short-term stabilization, a portion would be invested in long-term economic restructuring.

The origin of that decision is worth understanding precisely, because it shapes everything that followed. The County did not set out to grow the bioeconomy. It set out to address economic hardship. The Board of Supervisors, in partnership with the Stanislaus Community Foundation, backed a year-long data-driven planning process, the Stanislaus 2030 planning initiative, to examine the state of the regional economy and identify what could be done to increase economic mobility and inclusive prosperity. The process was grounded in community input and rigorous economic analysis, including a traded sector analysis conducted by Brookings Institution advisors.

What that analysis revealed was unexpected: job quantity was not the central challenge. Job quality was. Data showed that more than half of children in Stanislaus County were living in families classified as “struggling”, employed in jobs that did not pay enough to meet daily needs for a household.

That finding reoriented the strategy from job creation to job quality, and from general economic development to a targeted sector approach. The logic was: if you want

higher-quality jobs, you need to intentionally grow industries that concentrate higher-quality jobs and align with local assets. The bioeconomy emerged from a robust market analysis of regional opportunity sectors because it met multiple criteria simultaneously:

- It built directly on the region’s existing industry strengths in agriculture and food processing.
- It had demonstrated potential to generate higher-wage manufacturing and tech/innovation jobs accessible to workers at multiple skill levels.
- It aligned with state regulatory pressure, including California’s 2025 ban on agricultural open burning in the San Joaquin Valley, which created urgency around finding productive uses for agricultural residues.
- It intersected with emerging federal and state climate investment as well as federal interest in domestic supply chain resilience and nearshoring.

The Stanislaus 2030 Investment Blueprint ultimately recommended a portfolio totaling more than \$70 million across multiple strategic pillars, including an ambitious sector strategy focused on advancing the region’s bioeconomy.

This strategy was eventually named the “BioEconomy, Agriculture, and Manufacturing (BEAM) Initiative”, and a new organization, BEAM Circular, was formed to serve as the initiative’s backbone coordinating entity. In 2023, Stanislaus County allocated a total of \$10 million in ARPA funds to seed the BEAM Initiative— the County’s largest single investment of ARPA funds in an economic development strategy. This commitment functioned as catalytic capital. It signaled political seriousness and regional intent. External partners—including universities, national laboratories, philanthropic foundations, and federal agencies—require evidence of local investment before committing their own resources. The County’s allocation provided evidence and established credibility for subsequent coalition-building.

What was particularly unusual about the Stanislaus County investment in the BEAM Initiative was that the effort was designed from the start to be regional in scale and would explicitly engage and benefit communities beyond Stanislaus County borders. The bioeconomy strategy developed during the Stanislaus 2030 planning process was structured as a regional North San Joaquin Valley play, intended to catalyze investment and job creation across Stanislaus, San Joaquin, and Merced Counties – three counties with strong regional cohesion on paper, but limited political cohesion or collective identity in practice at the time.

Historically, city-to-city and county-to-county competition for economic investment is intense (a dynamic that persists today), and no significant tri-county initiative or organization had every been launched in the North San Joaquin Valley, Stanislaus County’s willingness to seed a strategy that would require cross-county collaboration and ultimately benefit its neighbors was politically significant. It required the Board of Supervisors to embrace a regional logic and identity that had not been the traditional posture. That decision proved important later both for building broad project coalitions

leveraging assets and institutions from across the broader region, and in attracting external capital, because state and federal funders consistently prioritize regional approaches over parochial ones.

Two important factors shaped the ambitious scale and regional focus of the Stanislaus 2030 planning process. First, nearby Fresno had launched the Fresno DRIVE economic development planning process in 2020, which received major state financial support. That process demonstrated that coordinated regional positioning could significantly attract philanthropic and public resources and served as a model for other regions throughout the state interested in inclusive economic growth. Second, the state of California was beginning to reward regional collaboration through initiatives that later resulted in the launch of the California Jobs First investment initiative. Stanislaus County recognized that to truly advance a robust sector strategy, and to compete for meaningful state and federal dollars, it needed to work at the regional level. As a region, the three counties of the North San Joaquin Valley had the collective population and assets – including universities, infrastructure, and major existing industry partners -- to become a global leader in the emerging bioeconomy sector.

The initial months after the County commitment in early 2023 were spent building what had not existed before: a functioning multi-county coalition, an institutional vehicle to hold and deploy the funds (BEAM Circular), and a concrete operational plan that could credibly claim to represent the tri-county North San Joaquin Valley rather than Stanislaus alone. That coalition-building work included formal partnership agreements with regional community colleges, securing UC Merced and Lawrence Berkeley National Laboratory as co-leads of the regional coalition, engagement with agricultural industry leaders committed to advancing the bioeconomy such as the Almond Board of CA, and outreach to economic development organizations and workforce boards in San Joaquin and Merced Counties. The goal was to position the bioeconomy strategy as a genuinely regional play before applying for more significant resources.

What changed when the County commitment was finalized was not just the availability of capital. It was the signal that commitment sent to potential partners. A \$10 million allocation from a county government, especially one structured explicitly as seed capital rather than the full budget, communicated seriousness. It made the bioeconomy strategy credible to external partners who might otherwise have viewed it as aspirational planning. UC Merced, Lawrence Berkeley National Laboratory, and later the National Science Foundation all required evidence that the region was genuinely committed before they would invest their own institutional resources. The County's ARPA commitment provided that evidence. The transition from plan to coalition to funded initiative happened over approximately 12 months, from early 2023 through early 2024, as BEAM Circular formed, the regional coalition formalized, and the first external grants were secured.

Section 4: Institutional Strategy and BEAM Formation

After the County committed \$10 million to advance the Stanislaus 2030 bioeconomy strategy in January 2023, the key question became: what was the local institutional capacity to carry out the work? The answer was: essentially none. No organization existed that could hold the strategy, coordinate the coalition, attract external capital, and deliver the range of programming needed to build an industry sector. This became the founding role for BEAM Circular.

BEAM Circular formally launched in January 2023, supported by an initial County contract of \$650,000. But the organization did not incorporate as an independent 501(c)(3) for approximately 18 months after launch. BEAM Circular was initially incubated within Opportunity Stanislaus, a local economic development nonprofit. This was a deliberate choice. Rather than immediately creating a new nonprofit entity, with all the administrative overhead, governance setup, and fundraising requirements that entails, the emerging initiative was fiscally sponsored by an existing organization with a 30-year track record of community trust and federal grant eligibility. That arrangement proved strategically important. In the earliest months, before BEAM Circular even had a final name, the team partnered with UC Merced and Lawrence Berkeley National Laboratory to secure a \$1 million National Science Foundation Regional Innovation Engine Development Award, a competitive federal grant that required an established institutional applicant. The grant, which was awarded to UC Merced with LBNL and Opportunity Stanislaus (on behalf of BEAM Circular) as sub-recipients in early 2023, fueled broad coalition-building and early pilot activities that brought national visibility to the nascent BEAM Initiative. The ability to apply under the sponsoring organization's established entity was what made that possible.

The initial 18 months of operating BEAM Circular as a project within an existing organization served as proof-of-concept. By the time BEAM Circular incorporated as an independent nonprofit in mid-2024, the organization had already established significant momentum. This included demonstrating the local and regional need for a dedicated intermediary, securing multiple grants beyond the County's seed funding, and forming an initial staff team.

What made BEAM Circular distinctive from a standard economic development organization was its staffing design. For the first year, BEAM Circular was driven by a single full-time staff member, the Chief Executive Officer, supported by a small number of project-based contractors. As the work evolved from planning and coalition-building to program development and project execution, about a dozen staff were hired between 2024 and 2025. The "BEAM team" reflects the cross-disciplinary complexity of the target sector and the diversity of the initiative's home region. Staff roles encompass finance, community engagement, workforce development, innovation programs, communications, public policy, and economic development. The leadership team holds advanced degrees from Stanford, Harvard, MIT, and UC Berkeley, and includes professionals with backgrounds in chemical engineering, multinational finance, industrial biotechnology, politics, global health, environmental sustainability, corporate site selection, entrepreneurship, and California state government. Together, the team was

set up to hold the full scope of bioeconomy sector development work, a composition that no single existing organization in the San Joaquin Valley possesses.

Of note, one of the very first hires was a Director of Community Engagement, a decision that drew skepticism from some economic development professionals who saw community engagement as peripheral to the core mission of sector growth. That skepticism misunderstands the practical reality of project development in California: community trust is not a nice-to-have. It is a prerequisite. In California, where public opposition can halt permitting processes and defeat well-capitalized projects, building community support from the start, before projects are announced, is the practical strategy. For BEAM Circular, deep and authentic community partnership is core to the organization's mission and values. It is also a strategic imperative to maintain the broad coalition of support necessary for bioeconomy advancement.

The leveraged impact of the County's seed investment has been substantial. The initial \$650,000 contract unlocked the NSF Development Award and began the coalition-building that attracted state and private philanthropic capital. By August 2024, BEAM Circular had mobilized over \$15.7 million in public and private funds against the County's initial \$650,000 investment, a return of over 21 times their first contract. The specific external commitments mobilized through mid-2024 include: a \$3.6 million California Jobs First Economic Development Pilot Grant; a \$1 million NSF Regional Innovation Engine Development Award, co-led by BEAM Circular, UC Merced, and Lawrence Berkeley National Laboratory; and \$11.1 million in private philanthropic support from foundations including Schmidt Sciences, the Beard Land Improvement Company, Vanguard Charitable, San Joaquin Community Foundation, Silicon Valley Community Foundation, the Almond Board of California, and other sponsors.

In August of 2024, the County contracted with BEAM Circular to deploy the remainder of their \$10 million commitment to regional bioeconomy advancement. By the end of 2025, BEAM Circular had secured a CA Jobs First implementation award, a State Budget Allocation, and additional private philanthropy, bringing total funds mobilized by the initiative to over \$35 million on top of the County's commitment. This funding is currently being deployed as seed capital across a diverse portfolio of projects designed to attract and grow circular bioeconomy businesses.

Most importantly, by the end of 2025, BEAM Circular had engaged over 200 organizations in its partnership network, called CBIO Collaborative. In addition to a strong organizational board inclusive of local and nationally recognized leaders, BEAM Circular has nurtured a robust governance structure CBIO Collaborative, including a Leadership Council consisting of 25 executive leaders from key institutional partners, including university presidents and representatives from key industry organizations, labor partners, and community organizations. This multi-sector governance design has enabled the initiative to maintain deep local roots while securing global expertise and credibility, signaling seriousness to external funders and strategic partners.

The core lesson of the BEAM formation story is that catalytic local capital can unlock larger flows, but only if it is accompanied by dedicated coordination capacity and active strategic partnerships. Capital and coalitions follow capital and coalitions. The \$10 million from Stanislaus County was not simply a subsidy; it was a signal to state, federal, and private capital that a serious regional partnership had formed and was prepared to execute. Without that signal, the broader coalition could not have formed, and the external capital would not have followed.

Section 5: What Is the Specific Strategy to Grow the Circular Bioeconomy in the San Joaquin Valley?

The North San Joaquin Valley circular bioeconomy sector strategy is designed around the region's distinct assets and constraints. To achieve growth in high-quality jobs and investment in firms requires simultaneously nurturing innovation, translating that innovation into commercial production using local feedstocks, building a workforce that can access the jobs created, and establishing durable sector institutional capacity to coordinate across jurisdictions and sectors.

The following six core strategies define the NSJV approach.

Strategy 1. Build a Regional Innovation Engine Anchored in Local Feedstocks

The first strategy is to nurture innovation that is explicitly grounded in the Valley's agricultural and waste-stream realities. Through the partnership network CBIO Collaborative, regional partners have formalized a governance model that connects university researchers, national laboratory expertise, manufacturers, growers, workforce institutions, and community organizations into a coordinated innovation ecosystem.

This is not traditional academic research detached from place. The strategy prioritizes use-inspired R&D that advances technologies capable of processing the diverse, heterogeneous biomass residues common in the Valley, rather than relying on standardized sugar-based inputs typical of Midwestern bioindustrial production. Activities include development of platform technologies to enable use of regionally available waste streams, establishment of a feedstock data and resource hub, coordination of grower and community review panels, and seed grants to advance promising technologies to higher technology readiness levels.

The CBIO Collaborative is co-led by BEAM Circular, UC Merced, and Lawrence Berkeley National Laboratory's Advanced Biofuels and Bioproducts Process Development Unit (ABPDU), with Modesto Junior College and the Manufacturers Council of the Central Valley as core partners. Supported by the NSF Regional Innovation Engine Development Award secured in 2023, the Collaborative has grown to include over 200 collaborating institutions, including some of the world's largest biotechnology and biomanufacturing companies, such as Novonosis and DSM-Firmenich. This activated partnership ecosystem has already enabled the formation of multiple new partnerships and joint projects, including a 5-year project backed by

Schmidt Sciences and the Foundation for Food and Agriculture Research (FFAR) to develop a shared data portal that enables connections between the NSJV's diverse feedstocks and prospective biomass users.

Strategy 2. Translate Innovation into Industry Through the Circular Bioeconomy Innovation Campus

The second strategy responds to the commercialization gap that has long plagued California's bioeconomy. The region's most ambitious catalytic initiative is the establishment of the Circular Bioeconomy Innovation Campus, anchored by a shared pre-commercial testbed facility.

The core problem is well documented: there are very few U.S. facilities that allow companies to move from laboratory success to pilot and demonstration scale. Without this intermediate step, firms either stall or relocate to regions with more accessible pilot infrastructure. The Innovation Campus converts that market failure into a regional (and statewide) opportunity. The Campus is designed to provide demonstration-scale fermentation capacity, upstream and downstream processing equipment, analytical tools, and integrated technical assistance, along with laboratory space, education and training facilities, and a community-facing visitor center. The facility is explicitly intended to process diverse feedstocks reflective of California's unique biomass resources and wastestreams, not only commodity sugars. Co-location opportunities for pilot and commercial projects at and near the campus offer further benefits for companies looking to benefit from direct access to partners, shared utilities and infrastructure, feedstock supply, and on-site resources such as meeting space and technical consultants.

The scale of the project reflects the region's commitment to becoming a national hub for circular bioindustrial manufacturing.

Strategy 3. Build the Supply Chain: Feedstock Coordination and Site Readiness

A third strategy focuses on the physical and logistical foundations required to make bioindustrial manufacturing viable. Abundant feedstock alone is insufficient; supply chains must be coordinated, aggregated, characterized, and made reliably accessible.

Through collaboration with Lawrence Berkeley National Laboratory and University of California partners, BEAM Circular is developing a regional inventory of sustainable waste-stream-based feedstocks and a digital portal to facilitate matchmaking between suppliers and manufacturers. This digital infrastructure is an approximately \$10 million, five-year project that addresses a persistent information gap: feedstock is often available but not easily discoverable or transacted by potential buyers. The region has also completed a Bioeconomy Development Opportunity Zone (BDO Zone) study, becoming California's first certified BDO Zone earning a rare "AA" rating that validates reliable supply of feedstocks and positions the NSJV as a designated location for bio-based investment.

Complementing feedstock coordination is a strategy around industrial site readiness: supply-and-demand analysis of industrial land, identification of priority sites, and infrastructure investments to support bioindustrial manufacturing projects. These activities reduce friction in project siting and signal to external firms that the region is prepared for manufacturing-scale operations.

Strategy 4. Develop Commercialization and Capital Pathways

A fourth strategy focuses on strengthening commercialization and capital access. BEAM Circular launched a circular bioeconomy startup accelerator program, operated in partnership with the global accelerator and venture capital firm gener8tor, to attract and support startups seeking to scale operations in the NSJV. The inaugural cohort demonstrated strong demand, with 90 applicants. Just one year later, the second cohort attracted 200 applications for just five slots, reflecting tremendous growth in demand and a growing global reputation for the highly competitive program.

In parallel, BEAM Circular has launched a variety of services and funding programs for companies, including innovation vouchers, technical assistance programs for value-chain firms, and matching grants to help local companies access federal commercialization funds such as SBIR/STTR. These programs address capital gaps and reduce barriers for small and mid-sized firms seeking to adopt or supply bio-based technologies. The region is also cultivating investor networks to connect regional firms with specialized bioeconomy and climate-tech investors, particularly in Northern California. This layered approach reflects an understanding that commercialization requires more than a single intervention, it requires coordinated navigation of public grants, private capital, and technical advisory support.

Strategy 5: Activate Workforce System Alignment

Regional collaborators including community colleges, universities, county workforce boards and offices of education, training providers, and industry representatives have formed a Workforce Steering Committee through CBIO Collaborative to coordinate regional education and training strategies to ensure that the region has a prepared talent pipeline that will help attract and grow the bioeconomy – while ensuring that good jobs created in the growing sector are accessible to local residents. BEAM Circular has invested in comprehensive landscape analyses to assess industry needs and map the diverse career pathways present across the bioeconomy, at multiple skill levels and fields spanning the building trades, science, engineering, manufacturing operations, and business. Targeted grants have supported specific asset maps at the institutional level, and supported development of roadmaps to expand the region’s availability of industry-aligned training pathways.

The regional strategy emphasizes stackable credentials, industry-recognized certifications, paid internships and apprenticeships, and hands-on learning experiences connected to emerging pilot and commercial-scale facilities — including the California Bioeconomy Innovation Campus. To activate implementation, BEAM Circular has deployed pilot grants to support 23 education and workforce projects across the region

to date, including new curriculum development, educator professional development, equipment purchases, and training facility upgrades.

Central to the strategy is economic mobility and regional equity. BEAM prioritizes access for historically underserved populations, rural communities, and workers transitioning from vulnerable sectors, creating on-ramps into high-growth, climate-aligned industries. Through youth engagement, career awareness programs, and partnerships with K–12 schools, community colleges, and universities, BEAM and its partners work to inspire the next generation of scientists, technicians, operators, and entrepreneurs. By connecting climate innovation with tangible local job creation, BEAM’s workforce strategy strengthens both the regional economy and California’s leadership in sustainable biomanufacturing.

Strategy 6. Establish and Sustain a Sector Intermediary with Community-Centered Governance

Underlying all these strategies is a foundational element: sustained intermediary capacity. BEAM Circular serves as the sector backbone organization, coordinating program delivery, managing cross-sector partnerships, conducting continuous community engagement activities, and aligning local activities with state and federal opportunities. BEAM engages a Community Steering Committee made up of 17 local residents to guide and inform its efforts, and has launched both a Youth Ambassador Program and Community Ambassador Program to develop local leadership capacity in a “train-the-trainer” model that empowers local students and community members to share circular bioeconomy information and become champions for the region’s sector development efforts. The organization serves as a convenor of C BIO Collaborative, building and maintaining multi-sector partnerships, and acts as an ambassador for the region and for the circular bioeconomy sector.

Growing a circular bioeconomy requires an intermediary to ensure continuity, accountability, and strategic coherence. It is not possible to simply distribute grants to a coalition of organizations and expect a coordinated sector development effort to emerge. BEAM Circular is a dedicated institution charged with advancing inclusive and environmentally responsible sector growth.

Taken together, these six strategies reflect a comprehensive model for sector development in an emerging industry. Innovation is nurtured but tied to local feedstocks. Commercialization infrastructure is pursued at scale to support firm growth. Supply chains are mapped and strengthened. Capital and entrepreneurship ecosystems are cultivated. An industry-centered and inclusive workforce system is enabled. And institutional backbone capacity is built to coordinate across the region and align with state and federal policy frameworks.

Section 6: What Are the Key Findings About the Practical Barriers of Growing This Sector in California?

Over a span of its initial three years. BEAM Circular and its partners experimented as they sought to build an emerging sector. This experience working with community business, and public sector leaders led to the five key findings based on the specific experience in the North San Joaquin Valley. These five findings are unique to the BEAM experience but may have relevance for other regions. The findings cover the following topics: community support, technology readiness, marketing the California manufacturing opportunity, reusing existing assets due to high capital costs, and demand pull given the market maturity. After exploring each of these findings in detail the final section of this chapter explores a series of lessons that are written to apply in other regions.

Finding 1: You Need On-the-Ground Community Engagement If You Want Community Support to Stay Intact

There is significant misunderstanding of new sectors, especially the bioeconomy. If you do not invest in deep and meaningful community engagement early, it can kill sector growth before it gets going. Community engagement is not peripheral. It is foundational. Why? Because there are real fears in communities about bio-based industries, particularly around the word “biomass.” Engaging and centering local communities in sector development can help ensure projects are supported, and even more importantly, that project outcomes reflect what communities really want and need.

BEAM has experienced two distinct categories of concern. The first fear is about assumptions around what biomass means. The second fear is a more generalized concern coming from the uncertainties of an emerging industry.

Fear 1: Assumptions About Biomass

There is a widespread assumption that any activity involving biomass means burning or incineration, with particular concern attached to the potential burning of trash. This is not irrational. Waste incineration has caused real and documented harm to air quality in many San Joaquin Valley communities, with disproportionate harm falling on low-income neighborhoods and communities of color. There is also fear tied to agricultural burning, which has historically contributed to the Valley’s severe air quality challenges. Many residents have lived with the health consequences of the region’s poor air quality, which has led to some of the highest rates of asthma in the country, and some community members associate any new industrial activity – especially any activity related to the processing of waste or biomass – as potential continuation of past harms. Advanced biomanufacturing often offers direct alternatives to burning biomass and waste, and new technologies create pathways for biomass utilization that even help prevent the wildfires that contribute to air quality concerns for many Californian communities. However, fears that biomass activities involve harmful burning practices persist.

In addition, first-generation biofuels, especially corn-based ethanol, left a mixed legacy. These projects raised concerns about growing food for fuel, questionable lifecycle emissions, and limited community benefit. That history colors perceptions of newer bio-

based industries, even though low-emission biotechnologies and the circular bioeconomy as a general framework represent a fundamentally different approach – including an emphasis on sustainably sourced feedstocks, such as agricultural residues, that do not create competitive uses for food. The sector requires clear explanation of what it is, and what it is not.

Fear 2: Uncertainty Around an Emerging Industry

The bioeconomy is genuinely new and not widely understood. Unlike solar, which people can see on rooftops, most residents have never heard the word “bioeconomy” and cannot point to a local example of what it looks like. That uncertainty creates fear. There is also a perception that this is a highly technical, PhD-driven industry that will not create jobs for local residents, and that benefits will flow to people imported from outside the region.

Compounding the confusion is the lack of definitional clarity at the state and federal level. BEAM has had to be on the front edge of educating communities about a sector that is itself still organizing its own language nationally and globally. If community support is not secured early, projects will struggle. In California, where public opposition can create significant delays in permitting and entitlement, community buy-in is not optional. Companies have told BEAM directly: an unfriendly community environment in California is a significant factor in their siting decisions. BEAM’s response has been to build a broad coalition, emphasize the circularity and waste-reduction aspects of the sector, and focus its community narrative on jobs, health, and local economic benefits in addition to climate and environmental benefits.

Finding 2: Technologies Must be Advanced to Unlock California’s Feedstocks

A major finding was that technology maturity is uneven across the diverse bioeconomy sector, but generally less commercially mature for the kinds of feedstocks abundant in California. This finding fundamentally reshaped BEAM’s strategy.

When BEAM launched in 2023, the operating assumption was that the technologies were “out there” and commercially viable, and that the work was to market California’s assets to companies that would come and use them. Experience showed otherwise. Very few commercial manufacturing facilities in the world use diverse, heterogeneous feedstocks like those found in the North San Joaquin Valley.

Biomanufacturing technology is relatively mature for conventional feedstocks: corn, soy, sugarcane, and sugar beets. These are the dominant inputs for most commercial bio-based companies. California is not a significant producer of any of these commodities relative to the Midwest or Brazil; it is a net importer of corn due to its large livestock industry. California has extraordinarily abundant biomass— but not the biomass that most commercial technologies are currently optimized to process.

This creates a specific strategic challenge: bio-based manufacturing companies tend to locate near feedstock or in very low-cost regions. California is not a low-cost region. The primary reason to locate a commercial-scale bio-based manufacturing facility in

California is if the company can use California feedstocks. Making California's diverse biomass resources broadly usable as feedstocks for bio-based requires advancing technology readiness levels for processes that can handle diverse, seasonal, heterogeneous agricultural residues at commercial scale. That is a longer path to large-scale job creation than BEAM initially anticipated and has led to more narrow targeting of commercial manufacturing operations and a greater emphasis on innovation investments and engagement of earlier stage companies.

California is a hotspot for the invention of bio-based technologies; it has abundant startups, leading academics, and national labs doing breakthrough work. However, most of those innovations, when they reach commercialization, do not scale in California. They scale elsewhere, wherever feedstocks are cheaper and permits are faster. Exceptions exist: California has been a national leader in dairy digesters and anaerobic digestion of food waste. Divert, a Turlock-based food waste digester company producing power with offtake to PG&E, is one example. But these are narrow segments and limited in job-creation potential. If California wants to capture a broader segment of advanced manufacturing, it must intentionally work on what it will take for companies to use California feedstocks -- including seriously addressing both technology readiness and economic readiness. This is why BEAM Circular's Innovation Campus is a critical strategy not only for attracting companies to the NSJV, but also for advancing the key technologies that will unlock California's diverse feedstocks and, as a result, bioeconomy opportunities across the state.

Finding 3: California's Manufacturing Challenges Require Constant Storytelling and Certainty on Timing

Manufacturing in California presents specific barriers that compound the technology readiness challenge. These include the difficulty of securing local and regional entitlements and permits, the complexity of ensuring adequate water and power infrastructure for industrial facilities, the potential for litigation or political pushback, and resulting timeline uncertainty.

Permitting of new manufacturing facilities in California can take two years or more. But many companies need to be operational within one year to stay competitive in the market. These firms often use the projected timeline to operations as a deciding factor in their site search. The gap between California's regulatory timeline and corporate decision timelines has cost the NSJV real projects. Timeline length and uncertainty, not the lack of incentives, has been the main barrier.

The most pointed example BEAM has encountered involves a climate-focused company making a bio-based alternative to a harmful chemical used in many household products, backed by a major climate fund. The company was founded in California, with the founder from the Bay Area, and they were genuinely interested in locating operations in the state. After a two-year permitting struggle in California, they moved to Texas, where approvals came quickly. BEAM considered including the company in its accelerator cohort but concluded that the path back to California was too uncertain at this stage.

This is not an isolated case: BEAM can identify at least three similar situations where permitting timeline was the deciding factor.

California's permitting challenge is further complicated for the bioeconomy by conflicting statutory frameworks around biomass and biomanufacturing. Different agencies operate under different and sometimes contradictory definitions of what constitutes permitted biomass activity. CalRecycle, whose funding flows through statutory requirements designed for waste management, operates under definitions that can exclude fermentation-based bioprocessing because its statute treats certain biological transformation processes in ways that misalign with current technology. These definitional mismatches, inherited from an earlier era of regulation, create unpredictable compliance burdens that other states simply do not impose. The barrier for California is not incentives; it is predictability.

Finding 4: High Capital Expenditure Requires a Strategy Shift Toward Using Existing Assets

Getting a new biomanufacturing facility out of the ground is a significant capital outlay. This is especially true in California where costs are high across multiple dimensions: labor, land, energy, regulatory risk. As a result, even when a technology is commercially viable and market-ready, companies may not build a new facility because the cost of new construction is prohibitive.

This finding led to a strategic exploration in the NSJV. The region's significant manufacturing assets, especially in food processing, have become an increasingly important competitive advantage. Many companies in the bioeconomy are actively exploring opportunities to retrofit or and repurpose existing manufacturing facilities and equipment, including from adjacent industries such as refining or food processing. Technologies that can "drop in" to existing industrial processes also benefit from clearer pathways to commercial scale-up.

This opportunity aligns with a broader pattern in the bioeconomy: it is common for emerging companies to use contract manufacturers, license technology to existing manufacturers, or develop technologies that slot into existing processes. Only a minority of biomanufacturing projects involve building entirely new plants. The North San Joaquin Valley's manufacturing infrastructure, particularly its food processing facilities, with their tank farms, separation equipment, and cold storage, is a genuine asset when the lens shifts from greenfield development to conversion and partnership.

This finding also reframes bioeconomy development as partly a manufacturing transition story, not just a startup attraction story. Converting a declining or underutilized food processing facility into a bio-based production hub serves multiple purposes: it generates jobs in a community that would otherwise face dislocation, reduces capital requirements for an incoming company, and preserves industrial employment in places where manufacturing has historically anchored the local economy.

Finding 5: The Market Was Not Ready, So Demand Pull Requires Active Engagement

BEAM's initial strategy leaned heavily on feedstock supply. Experience showed that supply push alone cannot create an industry. Demand pull is necessary. No one will adopt a new product just because it uses almond shells if there is no committed buyer for the resulting output.

There is growing demand for bio-based materials, and BEAM's direct engagement with corporate procurement has been one of the most encouraging recent developments. Lululemon, for example, has made sustainability commitments and is actively exploring plant-based nylon.¹ BEAM has worked with companies developing plant-based nylon solutions; Lululemon's procurement team is examining whether the raw material sourcing for those solutions can be more sustainably and domestically sourced — both for lifecycle carbon reasons and for the brand narrative of American manufacturing. FedEx, as a major explorer of sustainable aviation fuel, has engaged on questions of raw material sourcing for SAF production. Mars Pet Food has identified feedstock innovation as a strategic priority.

The pattern emerging from these engagements is significant: demand pull is often strongest not at the intermediate biotech company level, but at the consumer-facing brand level. CPG companies are under ESG pressure and have brand incentives to commit to domestic, sustainably sourced bio-based inputs. They are increasingly examining their full supply chains down to raw material sourcing. However, demand pull is not yet coordinated at scale.

Several dynamics constrain it. First, most bio-based alternatives are not yet cost-competitive with petrochemical incumbents, which represent decades of optimized production. Even brands with genuine ESG commitments are unlikely to pay a substantial premium indefinitely; reaching cost parity requires scale, and reaching scale requires committed off-take volume. This chicken-and-egg problem is one that government procurement commitments, regulatory credit frameworks such as those for sustainable aviation fuel, and coordinated industry demand can help break.

At the same time, supply chain resilience has become a growing priority for global companies, including considering climate and political disruptions that incentivize localized supply chains, and domestic sourcing has emerged as a genuine competitive advantage in a new geopolitical environment. The moment of heightened interest in American manufacturing has benefited BEAM's outreach. Demand must be cultivated intentionally, but the conditions for cultivating it are more favorable now than they were at launch.

Section 7: Call to Action: How Regions and States Can Seize the Opportunity

The findings above reflect specific learning from the North San Joaquin Valley case. They reflected realities on the ground that required a change in strategy. Based on that implementation experience of a small group seeking to grow a circular bioeconomy sector in a specific region, the following are six lessons. These seven lessons are meant to be applicable to any region pursuing a bioeconomy strategy (though they are also more broadly applicable to innovation sectors generally). They cover lessons around: local assets, backbone organizational infrastructure, centering community, aligning innovation with commercial viability, the opportunities around delivering new manufacturing, and the critical role for state policy and action given assets and opportunities that cross regional boundaries.

Lesson 1: Your Opportunity Is Shaped by the Specific Assets in Your Region

Place matters. Feedstock matters. Not all types of biomanufacturing make sense in every region. Regions must focus on the specifics of their feedstocks because the inputs determine whether the sector will generate meaningful local jobs. California is unlikely to compete in biomaterials based on conventional corn or soy sugars — those feedstocks are the competitive advantage of the Midwest and major overseas sugar producers. The NSJV's advantage is in specialty crop residues, food processing sidestreams, dairy waste, and proximity to woody biomass. Any regional strategy must start by being honest about what feedstocks are available, at what cost and volume, and for which technologies they are suitable.

Manufacturing infrastructure matters equally. A region with legacy food processing capacity may be well positioned to host bio-based conversion of those facilities, and to specialize in food-grade products. A region with legacy plastics manufacturing may be well positioned for biobased plastics using drop-in technologies. The bioeconomy is not a sector that can be directly copied from one place to another. The feedstock and existing infrastructure shape the opportunity in each place. That specificity is what distinguishes the bioeconomy from sectors where playbooks transfer more directly.

Lesson 2: Invest in Backbone Capacity and Coordination

To grow any sector, you need a coalition and ecosystem. This is especially true for the bioeconomy because most people do not understand it, and because it spans agriculture, manufacturing, innovation, and policy simultaneously. You need farmers and feedstock suppliers, scientists and technology developers, workforce development institutions, regulators, and capital providers all aligned toward common goals. That alignment requires sustained intermediary capacity — an organization whose full-time job is to coordinate the ecosystem.

The BEAM experience suggests that the intermediary should let form follow function: prove the need before creating the institution. But once the need is proven, invest in building the team. The types of capacity required included community engagement, innovation program management, workforce alignment, and capital navigation. This range of skills must be assembled deliberately and do not exist in any single existing organization.

Lesson 3: Build a Big Tent and Center Communities

Growing the bioeconomy will only happen if there is clarity that people and communities will benefit. This is both a moral commitment and a practical requirement. In California, community opposition can halt projects regardless of technical merit or capital availability. Getting to yes in a community is part of the critical path.

This means working on specific issues that are of real concern to residents: explaining what bio-based manufacturing involves, being transparent about potential air quality impacts and uncertainties, centering job quality and local health benefits in the public narrative and addressing practical questions such as how biomass will move through communities. The NSJV experience also suggests that framing the bioeconomy as a jobs and health initiative — rather than primarily as a climate initiative — is often more effective in building the broad coalition required. The county funded this work for economic mobility. That framing has proven more durable and more broadly inclusive, including among residents who may be skeptical of climate framing but are deeply invested in good jobs and community health.

Lesson 4: Focus Innovation on Economic Viability

To grow the sector and create quality jobs, innovation must be aligned with commercial realities. Inventors must think about manufacturing scale, capital intensity, permitting feasibility, and market demand, not just technical elegance. The NSJV experience showed that without market-oriented innovation infrastructure, you can generate excellent research that never converts to jobs.

This is the core argument for the Innovation Campus: catalytic shared infrastructure that unlocks commercialization by giving companies access to demonstration-scale equipment and regulatory certainty, without requiring each company to bear the full cost individually. Not every region needs a full-scale innovation campus, but every region must assess what commercialization infrastructure is missing that would enable the technologies most relevant to their local feedstock and assets, and what investments would lower barriers to scale-up in their target segment of the industry.

The deeper lesson is that R&D in the bioeconomy must be use-inspired, not discovery-driven. Researchers and innovators should be deeply connected to commercial realities — feedstock economics, permitting requirements, off-take commitments — from the earliest stages of development. The CBIO Collaborative model, which directly connects university researchers with manufacturers, growers, and community stakeholders, is designed to enforce that commercial discipline.

Lesson 5: Advanced Manufacturing Requires State-Local Capacity

The bioeconomy is an advanced manufacturing sector. For it to grow, the interaction between regional strategy and state policy must be functional. In California, this means addressing permitting timelines, resolving conflicting statutory definitions of biomass activities, and providing the regulatory predictability that companies need to make long-term investment decisions. The barrier is not incentives; it is predictability.

One specific lesson within manufacturing is that regions that can attract contract manufacturers serve multiple firms simultaneously. This is a particular opportunity for the bioeconomy, where many technology companies are not planning to build their own plants. A regional contract manufacturing base lowers the capex barrier for the entire sector, not just for individual companies.

Lesson 6: Innovation Requires Multi-Regional Collaboration

Startups and technologies are not confined to one region. A bioeconomy strategy must be willing to operate beyond its local boundaries, partnering with innovation ecosystems in other parts of the state or country to bring the best technologies to local feedstocks. This is the logic behind BEAM's engagement with Bay Area startups and national labs: the goal is to connect California's innovation assets to the Valley's feedstock and manufacturing assets, not to force local innovation to start from scratch. This means that state-level alignment is necessary because no single region can build the full bioeconomy value chain alone.

Section 8: Conclusion

The specific assets and attributes of regional economies are key to understanding how and why a specific sector can grow. In the case of the circular bioeconomy, the NSJV had the feedstocks, the manufacturing infrastructure, and the proximity to innovation. It also had, critically, a county government willing to make a politically risky bet with one-time federal funds on a sector and a strategy that had not been tried before in this form. None of that was inevitable.

The Readiness Triangle, feedstocks, manufacturing capacity, and technology readiness, provides the diagnostic framework. For the NSJV, feedstocks and manufacturing capacity were strong, but technology readiness was the binding constraint. That diagnosis drove the strategy: invest heavily in the Innovation Campus and CBIO Collaborative to close the technology gap.

Other regions will have different diagnoses. A Midwestern region may have feedstock and technology but lack manufacturing conversion pathways; a Gulf Coast region may have manufacturing infrastructure but need sustainable feedstock access. The framework is the starting point; the strategy must be tailored to the diagnosed gap. What is not region-specific is the lesson that all three legs must be strong, and that understanding which leg is weak is the first and most important analytical task.

But the bioeconomy case in the NSJV is ultimately a megaregional story: finance and venture capital from the Bay Area, federal laboratory and academic expertise from Berkeley and Davis, and feedstocks and manufacturing capacity from the Valley to the Sierra. Unlocking that combination requires institutions and coalitions that can operate across those geographies simultaneously, and it requires a state government willing to support regional strategies with aligned policy and investment.

Our opening observation bears restating: this bioeconomy sector strategy was not built in pursuit of climate goals. It was built in pursuit of economic mobility. The north star is and always has been about ensuring that the people of the North San Joaquin Valley deserved jobs that paid enough to live on, and that intentional sector strategy was a credible path to generating those jobs. The climate benefits are real and significant: reducing agricultural burning, diverting biomass from landfills, replacing petroleum-based feedstocks with renewables. But they were the co-benefit, not the motivator, of local investment. That sequencing matters, because it suggests that the circular bioeconomy can find political support across a wider coalition than a climate-first framing might generate, in the Valley and beyond.

This means that for any region to be successful in growing its circular bioeconomy, it must start with the Readiness Triangle: the specific feedstocks available, the specific manufacturing assets in place, and the state of the technology and innovation needed to connect them. These are particular to each place, and they are what distinguish the bioeconomy from other sectors that can more easily translate innovation from elsewhere. Then, once a region understands its opportunity, it must build the enabling environment to activate it — infrastructure, community, policy, capital, and the backbone intermediary capacity to coordinate all of them.

That is what this case study offers: what was done, what was learned, and how it can be applied. Every region will do it differently, because the feedstocks are different and the assets are different. But the framework, the institutional design, and the hard-won lessons from BEAM's first three years are transferable. That is the offer of the NSJV case.