



**North San Joaquin Valley
(DRAFT IN PROGRESS) Circular
Bioeconomy
Activation Plan**

January 2025

Prepared by Egon Terplan
on behalf of BEAM Circular and North Valley THRIVE

Table of Contents

Target Sector Strategy - Brief Overview	3
Summary: Circular Bioeconomy Sector Activation Plan.....	3
Overview of sector (from RP2)	3
Why was this sector prioritized?	5
Overview of Tactics/Strategies for this Activation Plan	6
<i>Bioeconomy Strategy 1: Nurture Innovation</i>	6
<i>Bioeconomy Strategy 2: Translate Innovation into Industry.....</i>	7
<i>Bioeconomy Strategy 3: Build an Inclusive Bioeconomy Talent Pipeline.....</i>	8
<i>Bioeconomy Strategy 4: Establish and Expand Community-Centered Sector Support Systems, including a Sector Intermediary</i>	9
Operating Structure to Organize and Execute.....	10
Resourcing Across the Strategy	14
Goals and Metrics Across the Strategy	17
Dependencies and Challenges	19

Target Sector Strategy - Brief Overview

Summary: Circular Bioeconomy Sector Activation Plan

The goal of this sector activation plan is to take critical steps to firmly establish the North San Joaquin Valley as a world leader in circular bioeconomy innovation, developing a cluster of bioindustrial manufacturing industry activities that create quality jobs and make sustainable use of local resources and diverse waste-streams.

This activation will not only help jump-start a high wage sector in the North San Joaquin Valley but will also help accelerate environmental solutions in the region and statewide such as reducing greenhouse gas emissions, improving soil health, and supporting local water and air quality.

Overview of sector (from RP2)

The Bioeconomy represents the segment of the economy based on products, services, and processes that come from biological resources (e.g., plants and microorganisms). This broad sector spans many industries and product categories that use biology and biotechnology to create valuable products from renewable organic materials (biomass). This growing industry plays an increasingly critical role in our environmental future, national security, and global economy, with a forecasted economic impact of \$4 trillion over the next 20 years.

The term “circular” emphasizes sustainable manufacturing practices and solutions that limit waste and strengthen environmental sustainability by repurposing biomass residues that come from existing activities, such as agricultural production, food processing, and municipal waste processing.

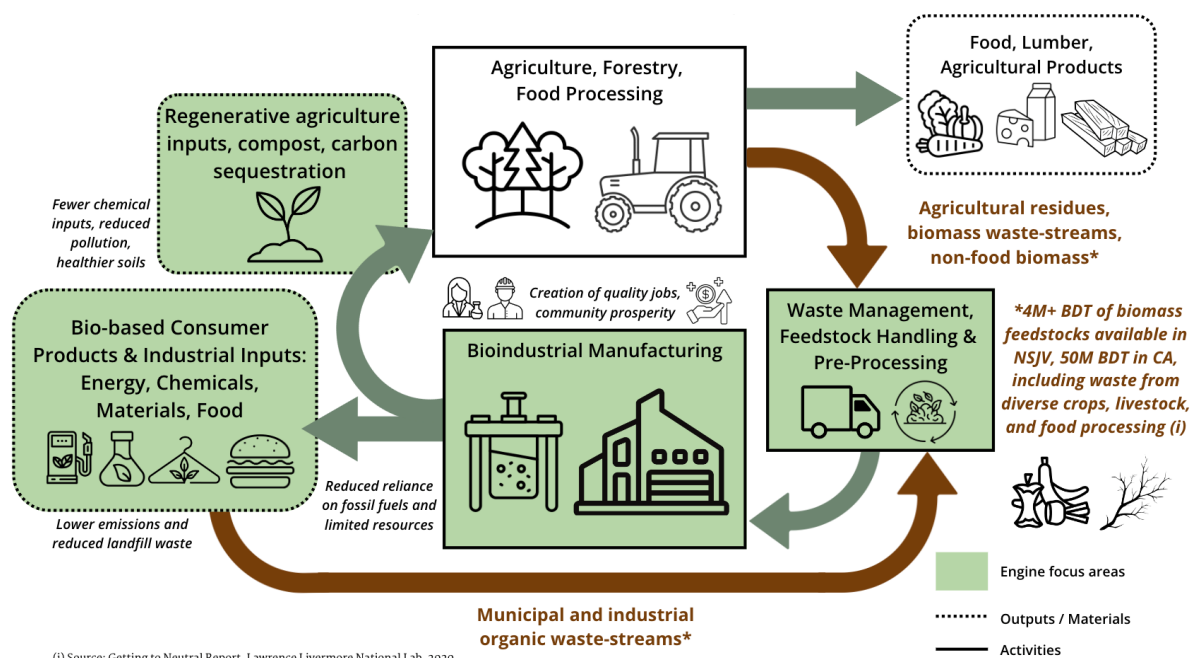
In the circular bioeconomy, materials that would otherwise be wasted serve as inputs to create products and materials that are used and reused as long as possible, without drawing down limited resources or generating wastes that are disposed into the atmosphere, landfills, or rivers, lakes, and oceans.

Bioindustrial manufacturing uses biotechnology and bioengineering to produce non-medical or non-pharmaceutical bio-based products including bio-based energy, chemicals, materials, food, agricultural products, and other goods.

Overall, the Circular Bioeconomy represents many types of activities, innovations, and technologies that use the power of biology to create useful products and reduce waste.

The following is a visualization of the Circular Bioeconomy and the proposed strategic approach of the NSJV circular bioeconomy strategy. As is evident in the below diagram, the goal is to connect lab-scale R&D to the region’s diverse feedstocks and increase the technology readiness level of projects that use these diverse biomass feedstocks and biomanufacturing operations in order to reach commercial scale production. This will enable both an integrated innovation pipeline and the demonstration of a circular bioeconomy model.

Circular Bioeconomy Model



Based on an initial estimate, the bioindustrial manufacturing segment of the local bioeconomy alone represents about 1% of all NSJV employment, just 8,200 jobs.ⁱ This is a count of jobs located at bioindustrial companies in the region that *could be* or *have the potential to be* performing bioindustrial manufacturing. It is not a reflection of the entire bioeconomy as that also includes major inputs (from agriculture, food manufacturing and other sources). As explained further in Appendix 4B, there is no current source or census that provides a complete list of all the manufacturers in the region (or country) doing confirmed bioindustrial manufacturing.

The 8,200 jobs also include some jobs that are included in the other three priority sectors of the North Valley THRIVE strategy.

NSJV BIOINDUSTRIAL MANUFACTURING EMPLOYMENT

Total NSJV employment in bioindustrial manufacturing:	8,198
Job totals also included in Advanced Manufacturing:	2,669
Job totals also included in Clean Energy:	693

Job totals also included in Carbon Management:	1
Remaining jobs that are exclusively Bioindustrial:	4,835

Why was this sector prioritized?

The sector was prioritized based on a combination of national and global market factors, regional and statewide assets, regional and statewide financial and political support, the presence of existing cluster intermediary institutions ready to implement the work, and an existing body of strategies and initiatives which can be further advanced in the coming year and beyond. Below is more detail on these variables.

Market factors: Nationally and globally, the bioeconomy has potential for major growth. Bioindustrial manufacturing has a forecasted economic impact of \$4 trillion over the next 20 years. Since 2020, private companies have announced over \$20 billion in biomanufacturing investments across the US.

National security benefits: The industry's growth is not limited by global supply chains as feedstocks and inputs are localized (and significant available biomass is currently unused). The growth of the bioeconomy relies on local suppliers (biomass feedstocks and commodity inputs), which are generally near manufacturing. Feedstocks come from both major population areas as well as natural and working lands (e.g. agriculture, forests).

Statewide assets: The Circular Bioeconomy sits at the intersections of biotechnology, manufacturing, and agriculture. California leads the nation in all three, as the most agriculturally productive state, with the largest share of manufacturing activity, and boasting the United States' largest concentration of biotechnology firms and workforce.

Regional assets: Within California, the North San Joaquin Valley is well-positioned for the bioeconomy due to access to abundant and diverse feedstocks (from agriculture, forests, municipal solid waste- an estimated 4 million BDT ("bone dry tons") per year of total waste biomass in 2045.), large-scale agricultural production, existing infrastructure (both manufacturing and existing transportation and logistics), proximity to markets and driving-distance to a leading hub of biotech innovation, and access to capital and talent (especially in manufacturing and biotechnology). The region is a premier location for bioproduct start-ups (some nurtured in the Bay Area) who wish to scale production beyond a lab setting and take advantage of the combination of abundant feedstock, manufacturing talent, and a large grower/food processor customer base.

State political alignment: Supporting the growth of the circular bioeconomy advances key state goals in climate (GHG reduction), equity (quality jobs in disinvested communities), and economy (economic diversification).

Financial support: The industry has \$10 million from Stanislaus County funding through ARPA and \$15 million in other state and federal public and philanthropic grant funding. Grant funds include a \$1M National Science Foundation Regional Innovation Engine Development Award to support development of a \$160 million NSF grant proposal. The region also has received a \$30 million venture capital commitment to support biocircular startups in the NSJV over the coming decade.

Regional institutions and existing work to leverage: The region has an existing and growing cluster intermediary organization - BEAM Circular - whose stated mission is to advance the bio-circular economy in rural agricultural regions. (See more on BEAM in the Operating Structure section). The region has also collaborated to form the NSF Engine: “Central Valley Circular Bioeconomy Innovation Engine: Advancing Feedstock Diversification and Scale-up for Bioindustrial Manufacturing” to address the national need for leadership in bioindustrial manufacturing. CBIO is driven by a coalition of industry, academic, government, investor, and community groups across the region.

Overview of Tactics/Strategies for this Activation Plan

The Strategic Plan in Fall 2024 included four broad strategies. These four strategies inform the approach taken in this Activation Plan. The focus of this Activation Plan is to identify the most promising Tactics and Tasks within each strategy area to advance. These four strategies are:

- Nurture Innovation
- Translate Innovation into Industry
- Build an Inclusive Bioeconomy Talent Pipeline
- Establish and Expand Community-Centered Sector Support Systems, including a Sector Intermediary

Bioeconomy Strategy 1: Nurture Innovation

The goal of this strategy is to establish the NSJV as a leading region for circular bioeconomy R&D, strengthening regional innovation capacity while unlocking technologies and models that support the sustainable use of local resources. Through coordinated multi-sector collaboration, the NSJV will create a regional innovation ecosystem that:

- advances high impact innovation to enable the circular bioeconomy.
- facilitates scale-up and translation of innovations to industrial scales.
- is inclusive, connected, and collaborative.

- grounds research in regional industry and community values, concerns, and needs; and
- promotes sustainability, human and environmental health, and economic and social benefits.

The **core tactic to achieve this strategy is to realize and expand the CBIO Collaborative** with tasks such as developing new platform technologies that enable use of more diverse and regionally available waste-streams as feedstocks for bioproducts, coordination of focus groups and review panels for innovators to test ideas, establishing a resource and data hub to support R&D activities, funding seed grants, and increasing access to feedstock samples and farmer/grower/waste originator expertise.

The core problem this strategy and tactic responds to is the disconnect between the innovations coming from world-leading biotechnology and bioengineering experts in the Northern California megaregion and the realities of the San Joaquin Valley, including the food system and the context of the farmers who are the feedstock suppliers and customers of bio-based agricultural products. While local farmers and food processors are interested in reducing waste and capturing higher value for byproducts, they are disconnected from R&D.

The CBIO collaborative is designed to help fill this disconnect and CBIO partners worked together to design a shared governance structure that engages an active and coordinated network of diverse collaborators to form a robust ecosystem for regional innovation. CBIO working groups made up of diverse participants will enable joint project development and steer use-inspired R&D focus areas, shape strategies and partnerships for translation activities, enable workforce system coordination, and conduct ongoing community engagement activities.

Bioeconomy Strategy 2: Translate Innovation into Industry

The goal of this strategy is to create an enabling environment for attracting, commercializing, and scaling sustainable bioindustrial manufacturing activities, including through supportive infrastructure, supply chain advancement, and resources that support local businesses by improving access to capital and innovation.

Overall, this strategy focuses on investments that:

- Provide support and resources (e.g., infrastructure, services, accelerator programs, funding, knowledge) to mature circular bioeconomy technologies and support the scale-up of biomanufacturing activities in the NSJV.
- Support reliable and efficient access to diverse feedstocks (specifically residues, co- and by-products, and wastes) from the region for use in commercial biomanufacturing processes.

- Attract, grow, and sustain circular bioeconomy development firms and talent including through regional infrastructure and site readiness.

The **primary tactic of this strategy is to establish an Innovation Campus** in the region with a shared testbed facility that enables bioproduction firms to move from the lab to commercial manufacturing, filling a market gap and distinguishing the region as a global center of excellence for circular bioeconomy innovation that advance environmental benefits and community prosperity. The campus will include demonstration-scale fermentation capacity, processing equipment, laboratory space, and technical assistance, aiming to address the challenge of translating bio-based product innovation into commercialization and seize economic opportunities for the North San Joaquin Valley.

A related tactic in the strategy is to establish an **accelerator program** to attract and nurture later-stage bioeconomy startups in the North San Joaquin Valley (NSJV), thereby bolstering the local entrepreneurial ecosystem and enhancing the regional profile to attract employers and investors. The program is beginning with a preliminary pilot cohort, aiming to advance six startup companies and elevate the global profile of the NSJV.

Another related tactic is to establish the **regional economic development support systems** for bioeconomy business growth in the region. There are land use planning and related infrastructure needs to enable the industry growth in the appropriate locations regionally. Activities include overseeing **industrial land supply** and demand analysis and **site availability**, the targeted marketing of priority sites, and delivering infrastructure for site readiness. It could also include general **small business support**. These activities are needed for the bioeconomy but also provide benefit to multiple sectors.

A final area of focus is around **feedstock coordination and aggregation**. This requires both digital and hard infrastructure, activities that could be done at a multi-county level (e.g. San Joaquin Valley) or even statewide. Other important statewide considerations include major policy initiatives that will directly impact the growth and availability of feedstocks and the bioeconomy writ large.

Bioeconomy Strategy 3: Build an Inclusive Bioeconomy Talent Pipeline

The goal of this strategy is to catalyze a leading bioeconomy workforce development ecosystem that:

- Creates awareness of high-quality jobs in the bioeconomy.
- Inspires future generations of diverse STEM and innovation leaders.
- Builds inclusive, equitable, and accessible pathways to high quality jobs.

- Empowers diverse local talent with skills to thrive in the bioeconomy; and
- Evolves capabilities with emerging industry needs.

The **core tactic to realize this strategy is to build a connected pathway and talent pipeline into the bioeconomy** from early career exposure through community college and higher education.

Bioeconomy Strategy 4: Establish and Expand Community-Centered Sector Support Systems, including a Sector Intermediary

The goal of this strategy is to establish appropriate community support and engagement for the growth of the sector in a way that centers the diverse needs and perspectives of the region's residents, emphasizes climate commitments and circularity (i.e. using waste streams as feedstock), and prioritizes innovation. This requires both the presence of a sector intermediary and for existing (and/or new) organizations to take on related and complementary activities to nurture the industry's growth and adherence to key community values.

The **key tactic to realize this strategy is to expand the sector-building intermediary** that will serve as a "center of gravity" for regional bioeconomy activities to coordinate strategy delivery, including informing public policy decisions, integrating local communities into bioeconomy sector development activities, and helping deliver direct economic and environmental benefits to local communities from the growth of the circular bioeconomy.

Related tasks include partnering with existing entities to augment the community, civic, and public sector engagement on economic development broadly, including for the bioeconomy. This could include facilitating **community benefits agreements** for major projects and related investments. It is critical that such a role be outside of the sector intermediary such that the community benefits process is defined more directly through a trusted community institution where the community defines specific community benefits initiatives (such as around standards, projects, and governance).

Operating Structure to Organize and Execute

Overview

The approach to the organizational model for this sector strategy is to leverage existing institutions, organizations, and collaboratives working to support the bioeconomy in the North San Joaquin Valley region. There is not an intent to create a new and separate governance structure for the implementation of the sector strategy and activation plan. The key entities currently involved include:

- *North Valley THRIVE*: Regional convener for CA Jobs First and the entity focused on establishing and maintaining and long-term regional vision for equitable growth across numerous strategic sectors in the region.
- *BEAM Circular*: Sector intermediary currently leading initiatives and programs in support of a circular approach to the growth of the bioeconomy. BEAM is a co-lead of CBIO
- *UC Merced and Lawrence Berkeley National Labs*: The region's UC campus and nearby National Lab are co-leading the CBIO collaborative with BEAM Circular (see more information below).
- *Community Colleges and other higher education institutions*: In addition to UC Merced, the region's additional institutions of higher education - University of the Pacific, California State University Stanislaus, and community colleges – are also critical partners in the implementation of the strategy.
- *Labor unions and community based organizations*: There are dozens of local and regional CBOs as well as numerous key labor organizations who have been core partners in THRIVE and participants in CBIO and will continue to be important parts of the implementation of this activation plan.
- *The region's three workforce investment boards*: The public sector workforce training ecosystem that will be critical in advancing and implementing the talent pipeline and other workforce initiatives. They have also been partners thus far and will be even more critical in the further shift to implementation.
- *Regional economic development and business organizations*: These include county-level economic development groups and employer groups such as farm bureaus and farming organizations, as well as chambers of commerce, community development corporations (CDCs), small business development centers (SBDCs), community development financial institutions (CDFIs), and community financial institutions (CFIs). Most of these organizations have been partners in THRIVE and participants in CBIO.

The role of CBIO: The Central Valley Circular Bioeconomy Innovation Engine

The primary organization model for executing the sector strategy and linking these groups in a focus on the circular bioeconomy is the “Central Valley Circular Bioeconomy Innovation Engine: Advancing Feedstock Diversification and Scale-up for Bioindustrial Manufacturing” (or CBIO).

CBIO is co-led by BEAM Circular, UC Merced, and the Advanced Biofuels and Bioproducts Process Development Unit (ABPDU) at Lawrence Berkeley National Laboratory (LBNL).

The CBIO Collaborative is a coalition of partners and over 60 regional institutions. CBIO partners include local and state government agencies; agriculture, manufacturing, and biotechnology industry partners; capital investors; regional community colleges and universities; workforce development institutions; non-profit community and environmental organizations; research laboratories; and labor organizations.

Together, CBIO has engaged hundreds of collaborators and community members in development of a strategic to advance the region’s leadership in circular bioeconomy innovation and bioindustrial manufacturing industry development.

The following provides more information on the three key leadership partners of the CBIO collaborative each of which will remain a critical part of the organizational support for the ongoing growth of the sector.

Cluster intermediary organization: BEAM Circular

The region has an existing and growing cluster intermediary organization - BEAM Circular - whose stated mission is to advance the bio-circular economy in rural agricultural regions.

BEAM Circular is the hub organization for the BEAM Initiative (BEAM stands for “BioEconomy, Agriculture, and Manufacturing”). BEAM is hub for the circular bioeconomy in California’s agricultural heartland and manages a portfolio of public and private projects designed to scale the most promising innovations in bioindustrial manufacturing and to advance solutions that support economic and environmental outcomes for local communities. BEAM facilitates strategic planning, program delivery, and community engagement to ensure inclusive and sustainable outcomes, while also providing support to organizations, businesses, and government agencies involved in the circular bioeconomy. Through direct community engagement and collaborative governance, BEAM Circular works to center local communities and partner with a diverse range of stakeholders to oversee and implement regional bioeconomy development efforts.

The BEAM Initiative is prepared to support this industry’s takeoff in the NSJV and statewide, and has secured \$55+ million from private, federal, state, and local sources over its first 18 months. This includes \$10 million from Stanislaus County funding through ARPA, \$15 million in other state and federal public and philanthropic

grant funding, and a \$30 million venture capital commitment to support biocircular startups in the NSJV over the coming decade.

Grant funds include a \$1M National Science Foundation Regional Innovation Engine Development Award to support development of a \$160 million NSF grant proposal. BEAM Circular with co-leadership from Lawrence Berkeley National Laboratory and UC Merced have formed a coalition of partners called CBIO Collaborative that includes over 60 regional institutions, and which engaged hundreds of collaborators and community members in development of a strategic vision for a Regional Innovation Engine that will advance the region's leadership in circular bioeconomy innovation and bioindustrial manufacturing industry development. University of California, Merced is a Minority-Serving Institution with research, education, and practice strengths in business ecosystems, bio-based products, regenerative agriculture, and other areas of multidisciplinary research and development. Lawrence Berkeley National Laboratory (LBNL) is a national leader supporting the science and scale-up of bio-based fuels, chemicals, and materials and houses the Advanced Biofuels and Bioproducts Process Development Unit (ABPDU).

The BEAM Initiative is led by a diverse, cross-sector coalition of partners including:

- Industry leaders from food, agriculture, and biomanufacturing
- Local, regional, and state governments partners
- Education and workforce development institutions, including all six of the community colleges and four-year universities in the NSJV region
- Labor, environmental justice, economic dev., and community-based organizations
- Regional and national bioeconomy innovation institutions; national laboratories

University of California, Merced is a Minority-Serving Institution with research and practice strengths in business ecosystems, bio-based products, sustainable materials, regenerative agriculture, innovation practice, and other areas of multidisciplinary research and development. UC Merced is a co-lead of the CBIO initiative and brings experienced leadership of multidisciplinary research and development teams, and provide expertise in value-creating service systems, in renewable energy and biomass conversion, and in innovation cultures and managerial practice.

Lawrence Berkeley National Laboratory (LBNL) is a national leader supporting the science and scale-up of bio-based fuels, chemicals, and materials and houses the **Advanced Biofuels and Bioproducts Process Development Unit (ABPDU)**. ABPDU provides a key de-risking step for bioprocess scale-up, both for the local innovation hub as well as biomanufacturing companies and researchers across the country and internationally. ABPDU uses its position in the National Lab system to strategize around solving deep technical challenges in scale-up, such as variability in

feedstock performance, culture heterogeneity, downstream process development, gas fermentation, data frameworks for advanced modeling and security, and more.

Resourcing Across the Strategy

Total costs summary

The total costs of the strategy as written are \$435 million. Of this, the largest amount is for the proposed Circular Bioeconomy Innovation Campus, at \$350 million. The total amount secured thus far is approximately \$25 million, with additional amounts in commitments from private investors.

There is currently a total gap of over \$410 million.

Note: These amounts above do not include the \$30 million in commitment from Reservoir (formerly Hawk Tower) for investments into biocircular start-ups in the North San Joaquin Valley. While those funds will help realize the vision of the broad sector strategy, they are not included as a key cost item in the budget as they are not a specific activity of the activation plan.

Bioeconomy Strategy 1	High-End Estimate	Secured	Sources	Gap remaining
Innovation Engine/CBIO Collaborative	\$16,000,000	\$1,476,163	Stanislaus County & National Science Foundation	\$14,523,837

Bioeconomy Strategy 2	High-End Estimate	Secured	Source	Gap remaining
Circular Bioeconomy Innovation Campus	\$350,000,000	\$1,432,980	Stanislaus County & Vanguard National	\$348,567,020
Accelerator program	\$15,000,000	\$500,000	CA EDD	\$14,500,000
Bioproducts Value Chain Technical Assistance Vouchers	\$1,500,000	\$400,000	CA EDD	\$1,100,000
Knowledge Transfer Programs & Innovation Vouchers	\$3,000,000	\$600,000	CA EDD	\$2,400,000
Matching Grants and Application Assistance for Commercialization Funds	\$3,000,000	\$900,000	Stanislaus County & CA EDD	\$2,100,000

Anchor Firms Development Fund - Targeted Incentives for Large Employers	\$15,000,000	\$2,000,000	Stanislaus County	\$13,000,000
Feedstock access development	\$10,000,000	\$ 9,700,000	Schmidt Sciences	\$300,000
Wet labs and facilities fund	\$5,000,000	\$1,500,000	Stanislaus County	\$3,500,000

Bioeconomy Strategy 3	High-End Estimate	Secured	Source	Gap remaining
Bioeconomy Workforce Development Fund	\$4,000,000	\$1,255,000	Stanislaus County & CA EDD	\$2,745,000

Bioeconomy Strategy 4	High-End Estimate	Secured	Source	Gap remaining
BEAM Fellows	\$1,000,000	\$250,000	Stanislaus County	\$750,000
BEAM Circular (Sector Intermediary)	\$12,000,000	\$5,688,643	Stanislaus County, CA EDD, Various Private Philanthropic Sources	\$6,311,357

Source of funding for resources secured

- \$10 million Stanislaus County allocation of its American Rescue Plan Act (ARPA) funds to advance the Stanislaus 2030 Traded Sector Development Strategy
- \$3.6 million Economic Development Pilot Grant from the CA Economic Development Department through the CA Jobs First program.
- \$1 million National Science Foundation Regional Innovation Engine Development Award (co-led by UC Merced, BEAM Circular, and Lawrence Berkeley National Laboratory) to support proposal development for a \$160 million NSF investment in the region's circular bioeconomy innovation ecosystem. The coalition of partners driving this effort is called the CBIO Collaborative.
- \$11.2 million in private philanthropic support, including from Schmidt Sciences, Beard Land Improvement Company, Vanguard Charitable, San Joaquin Community Foundation, Silicon Valley Community Foundation, Almond Board of California, and other sponsors.

- \$30 million commitment from Reservoir (formerly Hawk Tower) over the next 10 years for investments for early-stage startups developing bio-based innovations from ag by-products in the North San Joaquin Valley.

Current Gap and Strategy to Close It

As noted above, there is a gap of \$410 million to meet the overall vision of this sector strategy. The partners in this activation plan seek to close the remaining funding gap by pursuing a blended capital stack that combines both public and private sources, including but not limited to federal, state, and local government grants, private philanthropic contributions, corporate sponsorships, zero- to low-interest loans.

The team is already pursuing each of these.

Additionally, the joint team from CBIO has been selected as a semi-finalist in a \$160 million National Science Foundation (NSF) Engines award. Being named a semi-finalist enhances the region's credibility and positions the region to attract further investments from both public and private sectors into the bioeconomy. This diversified approach allows the region to access a wide array of financial support to implement the key tactics in this action plan.

Goals and Metrics Across the Strategy

General outcomes

There are several broad outcomes of this work. They include:

1. *Establish a world-leading ecosystem for circular bioeconomy innovation in the NSJV* to advance bioindustrial manufacturing and the sustainable use of diverse waste streams. Unlike other regions nationally, the North SJ Valley has the potential to unlock underutilized biomass feedstocks—agricultural byproducts, food processing waste, forestry residues, and other organic materials. Overall, the activities in the sector strategy will accelerate the transition to a net-zero carbon economy through advancement of bio-enabled climate solutions.
2. *Enable a more resilient and sustainable food and agriculture system* by reducing waste, enabling regenerative practices, and creating new value opportunities for local farmers and food producers. This includes repurposing organic waste into products such as bio-based fertilizers and soil amendments, supporting regenerative agricultural practices that improve soil health and biodiversity. These actions will also improve environmental and public health outcomes among vulnerable local communities.
3. *Advance environmental sustainability and climate change mitigation* through reducing greenhouse gas emissions. By converting agricultural residues, food processing waste, and other organic waste streams into high-value bio-based products, the sector strategy implementation will prevent methane emissions from landfills and reduce the need for fossil-fuel-based production methods. Diverse biomass feedstocks will also reduce reliance on fossil fuels and petroleum-based products. This will contribute to national and global efforts to mitigate climate change, while supporting the transition to a low-carbon economy.

Specific sector-level outcomes and metrics

More specific sector-level outcomes include:

- Growth of jobs in our regional bioeconomy, specifically in bioindustrial manufacturing.
- An increase in the median salaries of locally-available bioeconomy jobs, helping to address the region's shortage of jobs that pay family-sustaining wages.

- An increase in entrepreneurship and innovation capacity in the region, measured through new company formations, new patents, and investment capital flows into local ventures.
- A decrease in emissions from waste sources including the region's agricultural and manufacturing activities.

Shorter-term measures

The following are several Shorter-term measures to track shorter-term progress towards desired sector-level outcomes. They include:

- 2 year milestones
 - Advance the “technology readiness level” (TRL) of one feedstock agnostic conversion technology.
 - Advance the TRL of one feedstock specific conversion technology.
 - Demonstrate a process from waste material to purified product at pilot scale.
- 5 year milestones
 - Have one feedstock agnostic conversion technology operating at pilot scale and coordinating samples to users of output.
 - Have one feedstock specific conversion technology operating at pilot scale and coordinating samples to users of output.
 - Develop a process from waste material to purified product to production scale with demonstrated customer offtake.
 - Have a portfolio of at least five conversion technologies that have been researched and developed or sunsetted by CBIO.
 - Have portfolio of three agriculture input products that have been field tested.

Expectations for reporting progress

The institutions in the region will need to report progress on both sector-wide metrics as well as more tactical near-term activities. The sector-wide analysis will need to be conducted and maintained by an enduring institution (such as the Center for Business and Policy Research). The metrics more related to details within the sector will come from partners in the CBIO collaborative (such as “Advance the “technology readiness level” (TRL) of one feedstock agnostic conversion technology”).

The expectations are that these goals and individual metrics will be made readily available and public to all such that they can be easily used for sharing with the media, investors, public agencies, or the public.

Dependencies and Challenges

The cornerstone tactic of the entire activation plan strategy is the creation of the **Circular Bioeconomy Innovation Campus**, which has risks associated with raising funds and project delivery.

But there are also risks associated with growth of the bioindustrial manufacturing industry overall and the competitiveness of individual bioeconomy firms that grow.

Some of these risks are from market forces and cost pressures external to the region. Others are political and regulatory risks which are both within the region but more often at the state level.

The following are some of these risks identified at a high level and ways the strategy will mitigate these risks:

Risk 1: Permitting and Entitlements. State and local permitting and entitlement risk is the single biggest risk to growing the bioeconomy in California. To get a project off the ground requires going through CEQA and securing timely approvals from CARB. The approval processes required through CEQA and CARB do not exist in other states. This is in part why the Innovation Campus remains a key strategic play for the state as it would provide a clear and approved growth pathway for firms looking to scale (who would otherwise have to go through CEQA and secure permits on their own for each new facility).

Risk 2: Funding. There is a risk to fully raise the capital stack necessary to begin/complete construction of the Innovation Campus. The partners have begun building the capital stack but will need to determine when they have secured sufficient capital to begin construction. Diversification of sources of capital across public and private investors as well as the potential for international partnerships is one way to mitigate the risks associated with securing sufficient funding.

Risk 3: Infrastructure. There is a risk to fully deliver the needed infrastructure to support the campus and the industry overall. This includes access to reliable water, sewer, and electricity. In particular, electricity costs and reliability is a major risk across California and one of the reasons the state is less competitive in capturing manufacturing industries relative to other states. Mitigating this risk will involve working closely with existing utility providers and identifying the places in the region with existing infrastructure to support industry growth.

Risk 4: Political support. Local/regional political support is critical to the growth of the sector. Political support is also contingent on building a diverse cross-sector coalition to support the industry's growth in a responsible way and for mitigating potential conflicts or concerns. This includes identifying a location for the campus as

well as mitigating potential impacts such as from truck movement to gather feedstock or from specific impacts associated with the operations of bioindustrial facilities. Mitigating this risk will involve working in deep partnership with the range of political voices and organizations across the region and being transparent about both impacts, opportunities, and tradeoffs.

Risk 5: Feedstock availability and aggregation. There have long been challenges with the aggregation of biomass feedstock. While this strategy identifies specific actions to overcome those, there is a risk that these are not sufficient to provide an ongoing and enduring supply of feedstock for the industry (and for the Innovation Campus and companies that locate there). Working across regions (i.e. with the Sierra and Central San Joaquin Valley) is one way to mitigate this risk.

Risk 6: Market risks. The market risks include the cost of developing products for consumers and the likely ongoing competition from fossil fuel based products. Many of the bioeconomy products have not yet reached cost parity with fossil fuel sourced products. Improvements to production processes within bioeconomy firms will help with cost parity. In the near term, this risk can be mitigated identifying early adopter markets (sometimes governments) willing to (at least initially) pay a cost premium for a product produced through a circular economy process.
