



BIOECONOMY IN SOLANO COUNTY

DEVELOPING A TALENT PIPELINE
INFRASTRUCTURE

Compiled March 2024 by the
Workforce Development Board of Solano County



SUMMARY

Numerous experts anticipate the world will shift to the bioeconomy in the next two decades. The bioeconomy is believed to transform manufacturing processes, be able to support the economic shift to a more environmentally sustainable infrastructure and improve healthcare outcomes for the community. The bioeconomy is anticipated to create 1.1 million high-paying jobs in the US.

This growing economy provides a number of economic and workforce opportunities in Solano County, as a potential hub for regional bioeconomy activities. To capitalize on these opportunities, Solano County will need to build a talent infrastructure and pipeline that begins with strong awareness, accessible on and off ramps into education, and the ability to upskill current workers.



TABLE OF CONTENTS

- INTRODUCTION 1
 - JFF Workforce Communities 1
 - Core Partners 1
 - Methodology..... 1
- THE BIOECONOMY 2
 - Definition..... 2
 - Biotechnology 2
 - Industry Subsectors..... 2
 - Subsectors 2
- BIO OPPORTUNITIES 5
 - National Setting..... 5
 - Local Industry and Workforce 7
- GAPS IN THE TALENT PIPELINE..... 13
 - Lack of Industry and Career Awareness..... 13
 - Training Alignment and Coordination..... 14
 - Ensuring Equity in the Pipeline 15
- NEXT STEPS 17
 - 1. Local Talent Attraction 17
 - 2. In-Demand Certifications 19
 - 3. Upskill Current Workers 20
- ENDNOTES..... 22



INTRODUCTION

JFF WORKFORCE COMMUNITIES

The Workforce Development Board of Solano County applied to participate in the Jobs for the Future (JFF) Workforce Communities of Action initiative, on behalf of the core partners, in summer 2023. This initiative, spanning six months, allowed the Core Partners to learn from national workforce development experts through a community of practice model. The core partners came together to design and begin implementation of an industry-wide, equity-based, talent pipeline strategy for the local emerging bioeconomy.

*Workforce Community of
Action Core Partners:*



CORE PARTNERS

The Solano Workforce Communities of Action group of “Core Partners” was comprised of the Workforce Development Board of Solano County, the City of Vacaville’s Economic Development Department, Solano Community College, and the Solano Economic Development Corporation.

METHODOLOGY

The Core Partners conducted workforce research, including a literature review, a local business stakeholder focus group, a community survey, and eleven (11) individual stakeholder interviews.

The research intended to answer three questions:

1. What are the current and future opportunities in the bioeconomy in Solano County?
2. What is the level of awareness of opportunities in the bioeconomy among Solano’s future job seekers and are there any gaps?
3. What are the training and engagement options currently for Solano residents to enter the bioeconomy field and where are the gaps in equitable access?

The quantitative and qualitative research yielded evidence of a strong foundation of training options, as well as innovative business growth. The key gaps identified are in building awareness of the career and educational opportunities within the industry, as well as in building alignment and coordination of local efforts to grow the industry.

The Core Partners developed an action plan to begin to collaboratively address the gaps identified in the research. Three priorities of action were identified: (1) improving industry and career awareness in the community, (2) utilizing in-demand certifications to strengthen onramps into industry careers, and (3) providing opportunities to upskill current workers.



THE BIOECONOMY

DEFINITION

There are numerous definitions for the bioeconomy. For the purposes of this project, the bioeconomy is defined as economic activity that is driven by innovation and research of biological resources, and that is enabled by technological advances in engineering and in computing.

BIOTECHNOLOGY

Biotechnology is a key element of the bioeconomy that crosses all bioeconomic subsectors. Schmidt Futures defines biotechnology as “the use of biological processes for industrial, agricultural, biomedical, and other purposes, especially the genetic manipulation of microorganisms, plants, and animals for research purposes and to generate useful products.”¹

INDUSTRY SUBSECTORS

The National Academies of Science, Engineering, and Medicine (NAEM) groups the US bioeconomy into three subsectors:

Biomedical Sector

Biomedical manufacturing is Solano’s strongest bioeconomy industry base. The biomedical sector includes life sciences research, development, and manufacturing of pharmaceuticals and medical devices. National Institute for Innovation in Manufacturing Biopharmaceuticals (NIIMBL) is a national leader in making investments in pharmaceutical biomanufacturing industry innovation and workforce development to build the talent pipeline nationally and provides a number of resources regarding the industry subsector.

The CRB Group identifies several industry trends that are guiding the biomedical subsector.² Most drug development now includes cell and gene therapy, for example, which creates more customized production needs. As such, the industry’s leading companies are divesting in large manufacturing operations in order to establish a narrower, more competitive pipeline. Genentech’s recent divestment in Vacaville in 2023 is an example of this trend.

In addition, companies are relying more on long-term contractor relationships to supplement internal manufacturing capabilities, rather than conduct all drug manufacturing in-house. Almost 83% of CRB’s start-up and small business respondents plan to supplement their in-house capabilities with contract manufacturing organizations (CMOs). Contract development and manufacturing organizations (CDMOs) are also growing, as Lonza’s new investment in Vacaville shows. This provides an opportunity to support development of various manufacturing solutions locally for the industry.

SUBSECTORS



BIOMEDICAL

- 83% of life science companies are working on cell therapy production.
- 76% of biomedical industry experts plan to be using AI tools within two years.



AG TECH

- Solano’s surrounding region has a significant potential for biomass resources.
- In the next 30 years, the U.S. will be increasingly more reliant on cultivated meat.



BIOINDUSTRIAL

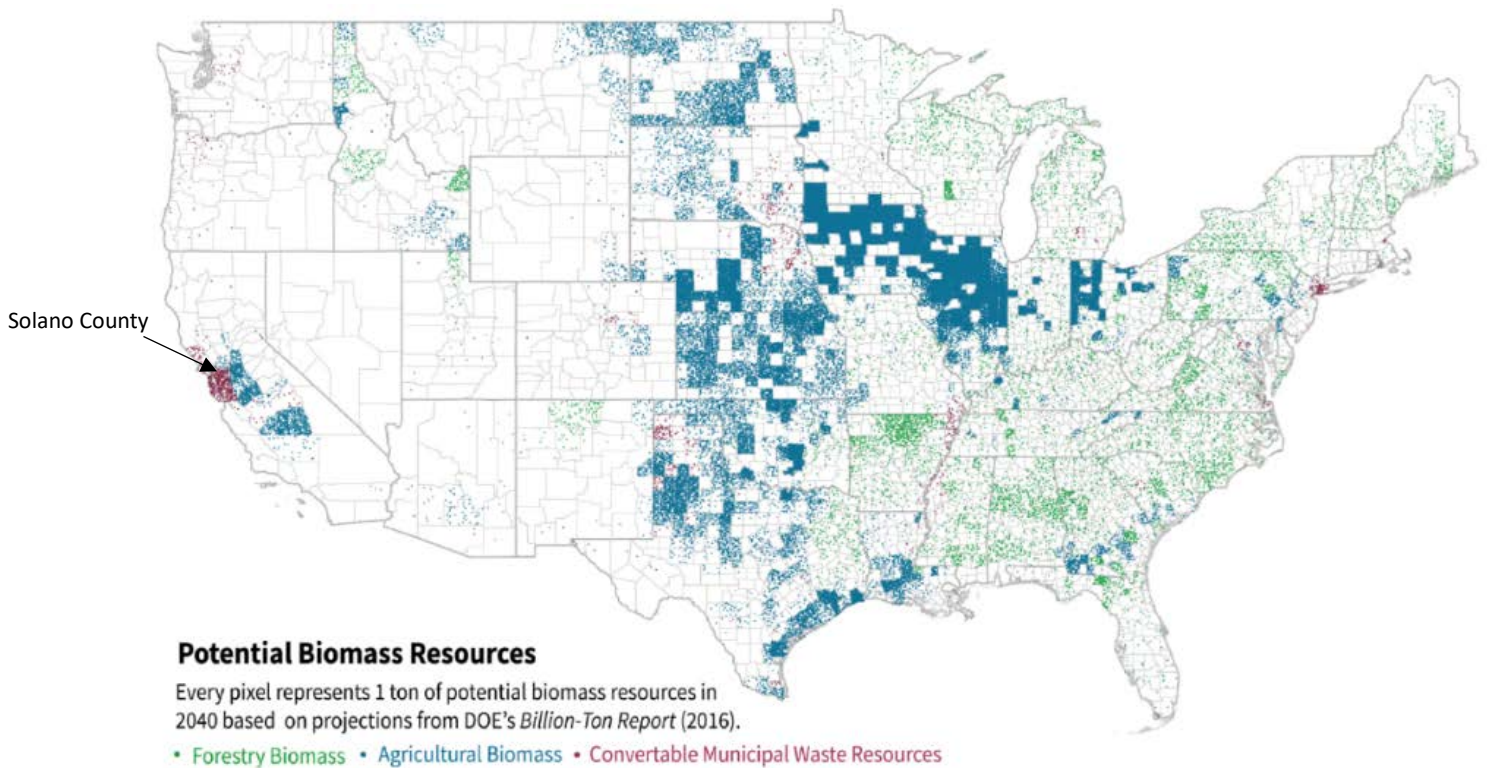
- Genetic editing is easier with technology like CRISPR/Cas9.
- Co-lab spaces are on the rise, supporting a variety of start-up bioindustrial companies.

Companies are also increasingly using artificial intelligence (AI)-driven tools capable of machine learning and predictive analysis. These tools can improve research success and accelerate timelines from months to days or weeks, leading to a compounding acceleration of innovation in the industry.

Finally, specialized equipment, facilities, utilities, and support systems are required. These include specialized manufacturing and processing equipment, high-tech HVAC and electrical systems, and clean utility systems (such as purified water, clean steam, and clean, dry air).

Agricultural Technology (Ag Tech) Sector

In ag tech, trends include development of sustainable biomass, bio-enabled soil microbes, carbon sequestration methods, synthetic sources of food protein, and efforts to make soil and plants more resistant to climate change. Potential biomass resources can be further broken down into forestry biomass, agricultural biomass, and convertible municipal waste resources.



The map above outlines opportunities for the region in both agricultural and convertible municipal waste resources.³

The bioeconomy is also a key element to effective climate transition practices. Replacing fossil fuels will only address 55% of the nation's carbon emissions needed; remaining emissions must be reduced through changes in manufacturing and food production.⁴ The bioeconomy, therefore, complements current climate transition efforts, while creating a more resilient regional supply chain that supports Solano's agricultural businesses.

Cultivated meat/proteins and controlled agricultural environments are other areas of emerging growth in the ag tech sector. The University of California,

Davis launched the Integrative Center for Alternative Meat and Protein (iCAMP) to accelerate commercialization of alternative proteins.

Solano County is in a position unique to the west coast where life science research, biomanufacturing, and biomass converge. Solano County sits between life science and ag tech research centers in San Francisco and Sacramento, is becoming a growing hub of biomanufacturing in the Bay Area, and is located within an area of multiple potential biomass resources. This confluence of bioeconomy factors in Solano County creates an ideal region for a growing bioeconomic sector.

Bioindustrial Sector

The bioindustrial sector is an emerging industry sector that includes development of degradable plastics and carbon-neutral and carbon-negative commodity chemicals. Innovative companies in Solano County are working in this field, and there is an opportunity to support this emerging local sector.

Bioindustrial manufacturing uses biological systems to create new materials or sustainable alternatives to commercial products, such as microbes (bacteria, yeast, and algae) and feedstocks (corn, soy, and sugar beets).

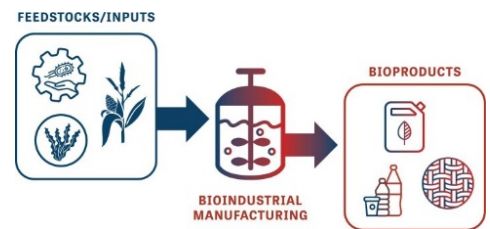
STEMConnector (through a BioMADE project) identified key trends, challenges and recommendations for the bioindustrial manufacturing sector in their environmental scan of workforce development initiatives within the industry in 2022. Recent breakthroughs in technologies; including AI, automation, and streamlined gene sequencing; have particularly impacted bioindustrial methods and workforce needs.⁵

Genetic editing with CRISPR/Cas9 technology, also utilized in the biomedical sector, is one such breakthrough that allows researchers to change sections of the DNA sequence and manipulate genes. This then allows development of genetically modified organisms (GMOs). Automation technology, such as the emergence of robotic “cloud labs,” then allow engineers to transform the digital information in DNA in target organisms.

Despite these promising trends, one challenge facing the growth of the bioindustrial sector is the high cost to move new products from the lab to commercialization. Co-lab spaces, such as Vacaville’s LifeSpace Labs, are seen as a promising practice to support start-up companies in reducing start-up costs and moving products to the next phase of commercialization.

Another challenge is building consumer demand for bioindustrial products. The USDA’s BioPreferred program is one federal government program aimed to increase demand with a voluntary labeling of “USDA Certified Biobased Product label.”

The leading national initiative in bioindustrial manufacturing is the new Bioindustrial Manufacturing and Design Ecosystem (BioMADE), a Manufacturing USA Institute. Solano County is fortunate to have Solano Community College, California Biomanufacturing Center, and nearby University of California, Davis as BioMADE members.



*Image Credited to BioMADE

BIO OPPORTUNITIES

A number of career opportunities exist in the bioeconomy and the opportunities in life sciences are growing exponentially.

NATIONAL SETTING

Bioeconomic innovation is becoming more of a competitive priority at the federal level, which is leading to significant federal investments in future bioeconomic opportunities. The National Science Foundation (NSF), for example, identified biotechnology as one of its five “industries of the future.” In 2020, the Department of Defense invested \$87 million to establish the Bioindustrial Manufacturing and Design Ecosystem (BioMADE), a new Manufacturing USA Institute. The same year, the Department of Health and Human Services invested \$51 million in the Advanced Regenerative Manufacturing Institute (ARMI) to establish the nation’s first “Foundry for American Biotechnology.” Most recently on September 12, 2022, President Biden released an Executive Order – *Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy*. This Order created the National Biotechnology and Biomanufacturing Initiative to accelerate biotechnology innovation and grow the bioeconomy.



Figure 1: Artist Rendition of a Future Biotech Lab

Between 2002 and 2022, the number of U.S. life sciences researchers grew 87%, compared with only 14% growth for all US occupations. The San Francisco Bay Area is the top market for life sciences research talent, as identified in CBRE’s “2023 U.S. Life Sciences Outlook.”⁶ Industry trends show an occupational shift over the past five years from chemistry to biology and a significant increase in data analytics. CBRE’s “2024 U.S. Life Sciences Outlook” highlights that national life science job growth has slowed significantly since 2021, and is most pronounced in biotech research and development, as well as pharmaceutical and medical manufacturing.⁷ This lethargic growth is attributed to high interest rates; the expectation is that when interest rates are reduced, this trend will be reversed.

Nationwide, post-secondary industry training opportunities are growing for bioeconomy occupations as well. There has been a 12.6% increase in biological and biomedical science degrees and certifications since 2018, exceeding the 4.6% growth in all US degrees and certifications over the same period. In the life sciences, San Francisco Bay Area graduates lead the nation in specialization of cell/cellular biology and anatomical sciences degrees, and the Sacramento area is in the top five areas of the nation for specialization in microbiological sciences/immunology and genetics degrees.⁸

Federal Investments

Ag tech has been the focal point of federal bioeconomic development efforts to date, mainly led by the US Department of Energy (DOE) and the US Department of Agriculture (USDA). DOE published the *2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy* evaluating potential biomass resources and feedstocks. In 2019, the Biomass R&D Board, chaired by DOE and USDA, released an implementation framework for the bioeconomy; and in 2020, the USDA outlined their bioeconomy science priorities through 2025.

Recent federal investments are also hoped to spur the biomedical and bioindustrial economy. The Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act of 2022 will provide funding for K-12 science, technology, engineering, and mathematics (STEM) networks that will help to build a future bioeconomy workforce. The Inflation

Reduction Act provides historic investments in clean energy, support for domestic energy production and manufacturing, and incentives for reduction of carbon emissions. These investments, and others, will accelerate advancements of the industry on a national level in the coming years.

Nationwide Challenges

There is an industry-wide consensus that access to a skilled workforce is a growing challenge. Congressional Research Services posits that any workforce pipeline development efforts should be multidisciplinary in nature, in order to meet the future needs of the industry.⁸

Schmidt Futures further consolidates the bioeconomy workforce shortages into two major concerns:⁹

1. A near term lack of trained professionals at all levels of education who can design, build, and run bioproduction processes, and a
2. Long term need to build awareness among the general adult public and the nation’s school-aged children about the opportunities for good-paying jobs in a biobased economy.

In addition to life science researchers, a 2019 survey by National Institute for Bioprocessing Research and Training found 78% of biopharmaceutical industry leaders had difficulty filling positions for bioprocess engineers, automation engineers, manufacturing science and technology staff, downstream processing staff; and commission, qualification, and validation engineers.¹⁰ These workforce needs reflect the shifting trends towards AI and data analytics, as well as an increased focus on manufacturing.

The Alliance for Regenerative Medicine identified that, in the cell and gene therapy sector, the shortage in workforce is within manufacturing is expected to be the widest.¹¹ Furthermore, they forecast that the cell and gene manufacturing gap will be seen most among Contract Development and Manufacturing Organizations (CDMOs) due to the industry trend of contracting out therapeutic manufacturing.

The Engineering Biology Research Consortium (EBRC), in their *Actions to Enable an Equitable and Innovative US Bioeconomy*, states that to fill the workforce development needs, the industry must not only build a future workforce, but expand equitable access to careers. The community often thinks bioeconomy jobs are only accessible to those with a postgraduate education, but there are a growing number of engineering biology and biomanufacturing jobs that can be

	Engineering and Manufacturing	Agriculture, Life, and Physical Sciences	Infrastructure	Operations, Management, and Business	Education, Communication, and Outreach
General Educational Attainment	Lead Engineer Senior Fermentation Specialist Senior Computational Scientist	Senior Scientist Senior Natural Resources Engagement Specialist	Design Engineers Architects	Senior Policy Analyst Business Operations Analyst/Manager Lead Attorney	Bioethicist Education Program Manager
	Engineer Computer Scientist Chemist	Physical or Life Scientist Forester Nutritionist	Environmental Health and Safety Manager Plant Manager	Business Operations Assistant Economist Community Partnerships Coordinator	Writer - Editor Public Affairs Specialist Educator Scientific Illustrator
	Computational Technician Winemaker/Fermentor Quality Control Technician	Farmer Physical, Life, or Forestry Sciences Technician Laboratory Assistant	Industrial Equipment Mechanic Safety Technician Plant Operator	Legal Assistant Information Technology Sales Specialist	Educational Aide Graphic Designer

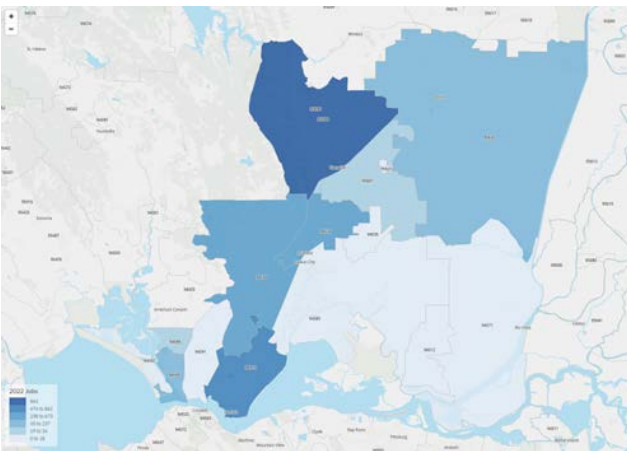
Figure 4. Bioeconomy jobs can promote economic access to technology careers, especially with many jobs only requiring a high school or associate's degree. A table is shown above separating jobs by their general requirements for education. In several of the bachelor degree jobs, career experience may be substituted in lieu of a degree.

obtained with an associate-level degree or industry-recognized certifications. One-third of the total jobs in life sciences require less than a Bachelor’s degree education. The industry, as outlined on the previous page, provides a wide range of opportunities for individuals across skill levels.¹²

LOCAL INDUSTRY AND WORKFORCE

At the end of 2023, there were 2,157 jobs in the bioeconomy sector in Solano County, with average earnings of \$124,693 and approximately 50 new job postings a month. Over 40 employers within the industry sector posted positions in the last 12 months, including Proform Labs, a dietary supplement manufacturer in Benicia; Polaris, a biopharmaceutical manufacturer in Vacaville; and US Military Treatment Facilities at Travis Air Force Base.

Solano’s industry workforce is more racially diverse than the US average, and slightly less gender diverse than the US average. However, the industry does not equitably represent the Solano County community. White and Asian workers are over-represented in the industry (70.9% of the workforce) compared to the general population (53%), while workers within the Hispanic/Latino, Black/African American, and Two or More Races demographic groups are underrepresented. Given that Solano County boasts two cities (Vallejo and Fairfield) on the Top 10 Most Diverse Cities in the U.S., ensuring that all residents are able to access opportunities in this industry is needed to enhance the diversity of the industry’s workforce.



Solano County’s current bioeconomy labor market data show a strong presence of biotechnology, particularly concentrated in biomanufacturing. Solano County’s bioeconomy industry is concentrated in Vacaville, with additional opportunities in Benicia, as seen in the map of Solano County to the left.¹³

The workforce data shows that the COVID-19 pandemic (and resulting economic and supply chain impacts) negatively impacted the local bioeconomy. The Gross Regional Product (GRP) of bioeconomy in Solano in 2019 was \$2.73 billion. By 2022, the industry’s GRP fell by over 70% to \$758.6 million.¹⁴ In addition, the dramatic rise in inflation affected the industry and slowed down purchases and investments. Due to this data, the industry is

expected to continue to decline over the next 10 years. However, qualitative data shows an influx in new businesses and job opportunities centered around Vacaville within the next five years that counter the current quantitative data.

The City of Vacaville has been leading the charge in attracting new biotechnology businesses. Vacaville’s “Biotech and Advanced Manufacturing Attraction Strategies” focus on expanding biotechnology, with an emphasis on attracting biologic manufacturers, research tools and suppliers, and development of industrial and therapeutic biotechnology.¹⁵ Efforts are also underway to target indirect industries such as robotics, automation, supply chain and distribution technologies, and transportation technologies specific to the industry. These attraction investments will position the City of Vacaville to be a hub of biotech incubation, medtech, and related advanced manufacturing. These investments will also lead to a number of indirect new jobs and business opportunities in the area.

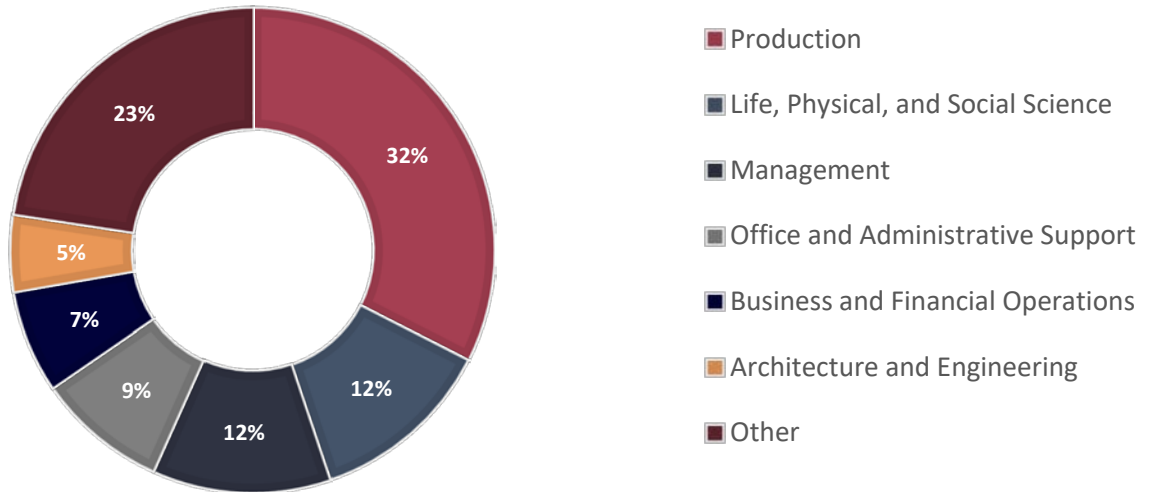
Through these proactive business attraction efforts, a number of biotechnology companies have announced their plans to locate facilities in Vacaville in the next five years, including TransWestern Ventures, Metrel, Mettler-Toledo Ranin, Lonza Biologics, and Agenus Bio. This qualitative data compiled from interviews and knowledge of incoming businesses supports the expectation of a growing bioeconomy industry in Solano County, despite the current labor market projections.

Occupations

Solano’s current economic activity is primarily in manufacturing, with data showing most bioeconomy jobs falling within the Production Occupations (one-third of industry employment), followed by Life, Physical, and Social Science Occupations. Further breakdown of occupations within the industry can be seen in the chart on the next page.¹⁶

The average wage of occupational groups within the County’s bioeconomy range from \$21.50/hour in production occupations to \$52.19/hour for management occupations, which provide livable wages for Solano County residents.

SOLANO BIOECONOMY OCCUPATIONS



Within the production occupational groups, there are several opportunities across educational levels. Of the over 700 jobs currently in Solano County in this occupational group, the top five occupations are listed in the table below:¹⁷

	Employed in 2022	Medial Hourly Earnings	Typical Entry-Level Education Requirement
Chemical Equipment Operators and Tenders	165	\$30.63	High School Diploma or equivalent
Packaging and Filling Machine Operators and Tenders	154	\$19.59	High School Diploma or equivalent
Inspectors, Testers, Sorters, Samplers, and Weighers	67	\$23.14	High School Diploma or equivalent
Mixing and Blending Machine Setters, Operators, and Tenders	52	\$23.86	High School Diploma or equivalent
First-line Supervisors of Production and Operating Workers	47	\$36.31	High School Diploma or equivalent

Local Trends and Workforce Needs

As part of this project, a focus group was assembled to provide a forum for Solano biotech executives within the biomedical sector to inform members of the Core Partners about industry perspectives. It was attended by five biotech executives who shared their thoughts about talent, training, and trends in the biotech industry. Locally identified themes aligned with national workforce trends in the industry.

Attendees of the focus group outlined automation and technology changes as key industry trends driving their short and long-term industry needs. Local evaluation of AI-driven tools matched national results from CRB's survey. Local businesses discussed utilizing AI-driven tools capable of machine learning for development of Standard Operating Procedures (SOP), analyzing patient data, scaling operations, and automation of process elements. Local discussion focused on the need to upskill and expand knowledge of current employees to better utilize and leverage AI-driven tools.



Local businesses also shared that recent accelerations in industry innovation are leading to a need to shift traditional mindsets within the industry. The nature of the industry lends itself to a mentality of process and consistency. However, industry innovation requires more willingness to take risks, which can be hard to blend with traditional mindsets.

One local example of promising bioindustrial manufacturing is Mango Materials, who recently relocated to Vacaville. They have invented a proprietary platform that converts methane gas into biodegradable pellets. The pellets are then incorporated into conventional plastics supply chains, fibers for apparel and textiles, and rigid goods for jars and caps.

LifeSpace Labs in Vacaville is a promising example of co-lab spaces, and has been working with other innovators to advance this industry locally. LifeSpace Labs is creating opportunities and awareness for enhanced facilities that can provide the lab equipment needed for new innovations. They have increased the local capacity for bioreactors, and are currently expanding opportunities for DNA sequencing, leading to potential areas of growth in bioinformatics and biologics.

The businesses also identified a number of challenges faced when hiring employees, all of which reflect general labor market trends. Challenges included inability to match compensation desires of job seekers, balancing job seeker desire for remote work with the hands-on nature of the industry, changing concepts of work-life balance, and finding talent with the right skills and experience. Direct hire from Solano Community College was identified as a successful source of hiring. The attendees commented that highlighting a company's brand and mission was becoming a key component to attracting talent. This aligns with the larger labor market trend of job seekers' increased focus on culture and mission of companies.

When asked what they anticipated to be the most critical skills for employees in the next three years, local biotech companies identified workplace essential skills as key. These skills included the ability to anticipate and react to change and the ability to adapt and learn. They also included basic computer skills, writing and math skills, oral communication, and leadership. Specific technical skills included laboratory techniques, production processes, microbiology, fermentation, protein purification, patent law, and Manufacturing, Science, And Technology (MSAT).

Businesses currently provide professional development and upskilling for staff through in-house on-the-job training and mentorship, balanced with online safety and HR-related trainings. Focus group attendees identified support in upskilling current employees as a need. They commented that seminars or classes on regulatory compliance, laboratory methods, and manufacturing processes would be helpful for upskilling employees. In-person, intensive classes for current employees on specific technical topics would be of interest, as well as basic skills such as Hazmat safety or computer skills.

Local Education Providers

Solano Community College

Don Burrus, Director of Economic Development at the City of Vacaville, states that Vacaville's competitive advantage in biotechnology is the biotech program at Solano Community College (SCC). SCC's biotech programs are known nationwide and are highly respected. The college offers biotech certificate of completion programs, an Associate Degree program, and the first of its kind Baccalaureate Degree program. Three professors and two adjunct faculty are dedicated to the program.

The program was founded by Professor James De Kloe, who sits on several advisory boards nationwide and has won numerous awards for his contributions to biotechnology education. Professor De Kloe shared that he created the program so local workers could have good paying jobs in biomanufacturing without needing a Ph.D.



In 2017, SCC added a Biomanufacturing degree program. The BS program applies a holistic approach to biotechnology, including courses in biology, business, engineering, statistics, supply chain, project management, regulatory compliance, facility design, and emerging industry trends. When asked what sets the Biotechnology degree apart, Director Dr. Gulnur Sanden replied that SCC has strength in embedding “hands-on experience from the beginning to the end.” One example of this is the program’s Bioreactor Run, where students experience working a bioreactor to monitor cell growth in eight-hour shifts. She said another point of pride is that students can receive a quality four-year education in biotechnology at SCC at a fraction of the price of a university equivalent.



SCC's First Biomanufacturing BS Graduates, 2019

and Technical Education (CTE) path at both Vacaville High School and Buckingham Charter Magnet High School with SCC dual enrollment options. Their biotechnology CTE course introduces scientific concepts and laboratory research techniques to prepare for careers in biotechnology.

As the department grows, additional opportunities for SCC students are being added. To support further education for graduates, SCC received a nearly \$3 million grant for scholarships from the California Institute for Regenerative Medicine, due to federal STEM education funds. These funds will pay for scholarships and paid summer internships for 25 students. Recent internships have been hosted at UC Davis and Stanford University. These experiences introduce students to the culture of university-based research and provide pathways into graduate-level education.

SCC has also worked with three local high schools to provide articulation from the high school level into SCC’s program. Vacaville Unified School District has developed a biotech Career

Vallejo Unified School District also offers biotechnology courses, with students attending outreach sessions at SCC in an effort to introduce a pathway into the college’s program. These promising initiatives build awareness of, and pathways into, Solano’s future bioeconomy career opportunities. The educational pathway to and from SCC has, therefore, been developed with multiple entry and exit points.¹⁸

Other Training Providers

Department of Energy’s [Bioenergy Workforce Training Opportunities Map](#) shows that the University of California (UC) Davis, Department of Plant Sciences-Biomass and Biofuels is one of only three universities on the west coast for ag tech-related biotechnology. UC Davis now hosts an annual Cultivated Meats conference, and is becoming a national leader in this growing bioeconomy field as well.

UC Davis’s Continuing and Professional Education division has recently launched efforts to enhance high-level skills in biotechnology. Their life science workforce training initiative will offer non-credit bearing courses and a series of credit-bearing certificates that combine scientific principles and practical applications with hands-on training. Their first specialized program is Cell and Gene Therapy Manufacturing, through a NIIMBL grant; the summer bootcamp for the Cell and Gene Therapy series is provided in partnership with SCC. A new program in Controlled Environmental Ag just recently launched and intended expansion of the portfolio will include Automation, Supply Chain, Biophotonics, and talk seminars with industry leaders. The division also plans to coordinate with Aggie Square activities, UC Davis’s upcoming innovation hub for life sciences. UC Davis, therefore, can be an important training asset for certifications and employee upskilling.

The California Biomanufacturing Center (CBC) is a new addition to the bioeconomy educational landscape in Solano County. Located in Vacaville and seeded by the City of Vacaville in 2020, the CBC focuses on supporting industry development and workforce training. Launched in the fall of 2023, the CBC’s Rapid Alternative Medtech Pathway (RAMP) training provides a free introduction to careers in biomanufacturing, focusing on careers that do not require a post-secondary degree.

In addition, BioMADE recently launched a project to develop and deliver workshops for the Solano County area for incumbent bioindustrial workers. Curriculum is currently being developed with an anticipated launch of early 2025. These educational and training opportunities create a strong foundation for bioeconomy careers in Solano County.

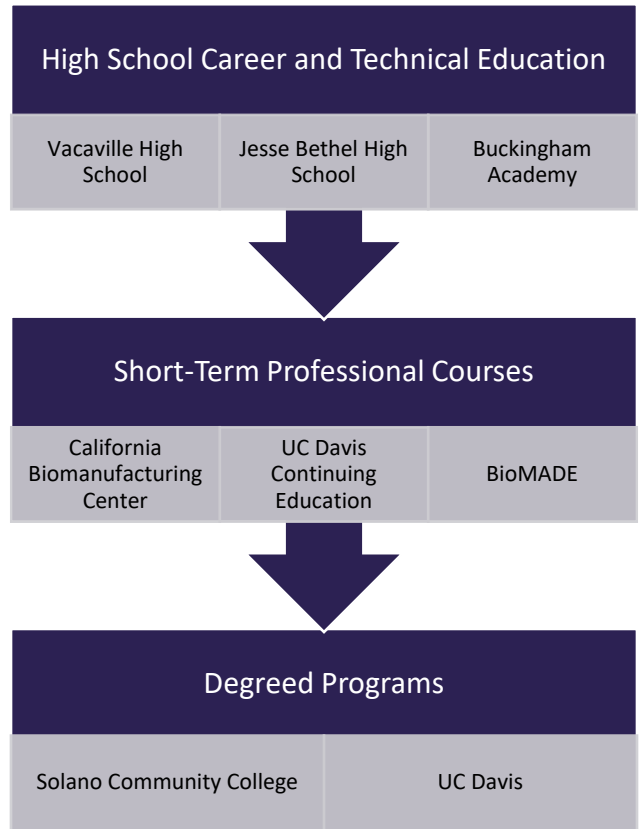
Low Community Awareness

Both literature review and local survey results show that the general public is largely unaware of biotechnology and the growing bioeconomy. In addition, there is little awareness of the biotech training opportunities throughout the region.

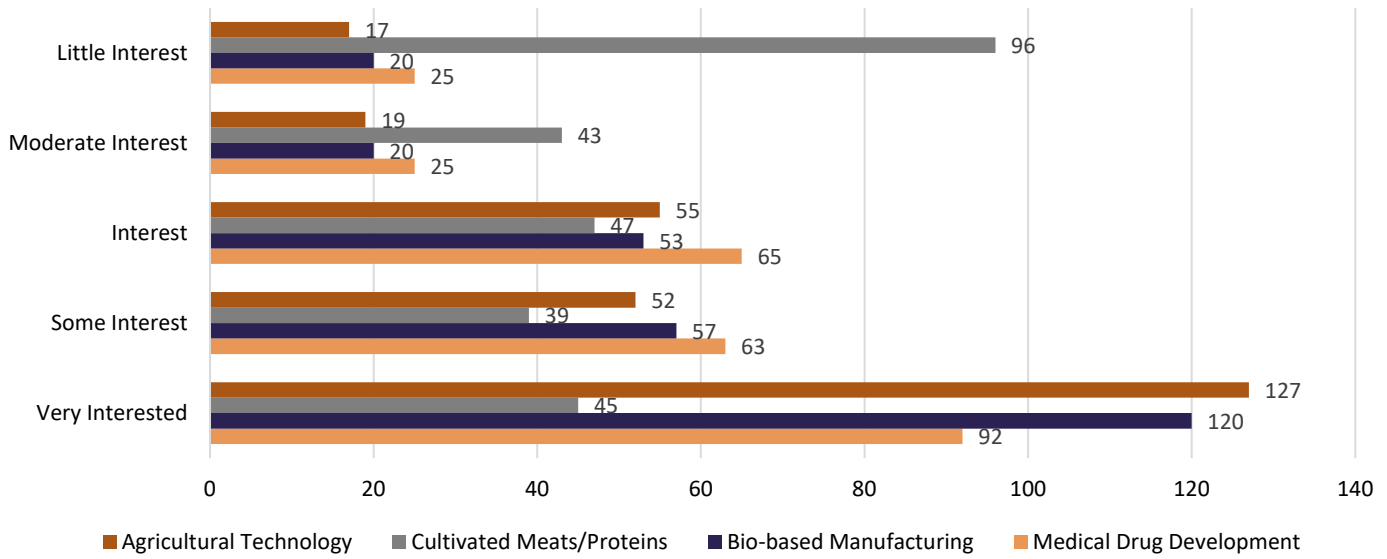
As part of this project, the Core Partners conducted a biotech awareness survey within the community in December 2023. The survey included five questions and was disseminated through school districts, city newsletters, and community distribution lists. Adult schools also supported English as a Second Language classes in completing the survey. The group received 270 responses from Solano County residents, with 45% of respondents representing Vacaville. For those that answered the demographic question, about one-third identified as White or Asian. Therefore, a large percentage of the survey respondents represented racial/ethnic populations not currently well-represented in the industry.

The first question ascertained the respondents’ base knowledge of biotechnology. Most respondents had either never heard of biotechnology, or had heard of it, but did not know what it was. Those who were aware of biotechnology predominantly lived within Vacaville and either worked in the field or were aware of Genentech, the city’s largest biotech employer at the time of the survey.

The survey introduced four areas of biotechnology – medical drug development, bio-based manufacturing, cultivated meats and proteins, and agriculture technology – and asked respondents to rate their interest in each area on a scale of 1 to 5, with 1 being “very little interest” and 5 being “very high interest.” Results of respondent interest can be seen in the chart on the next page:

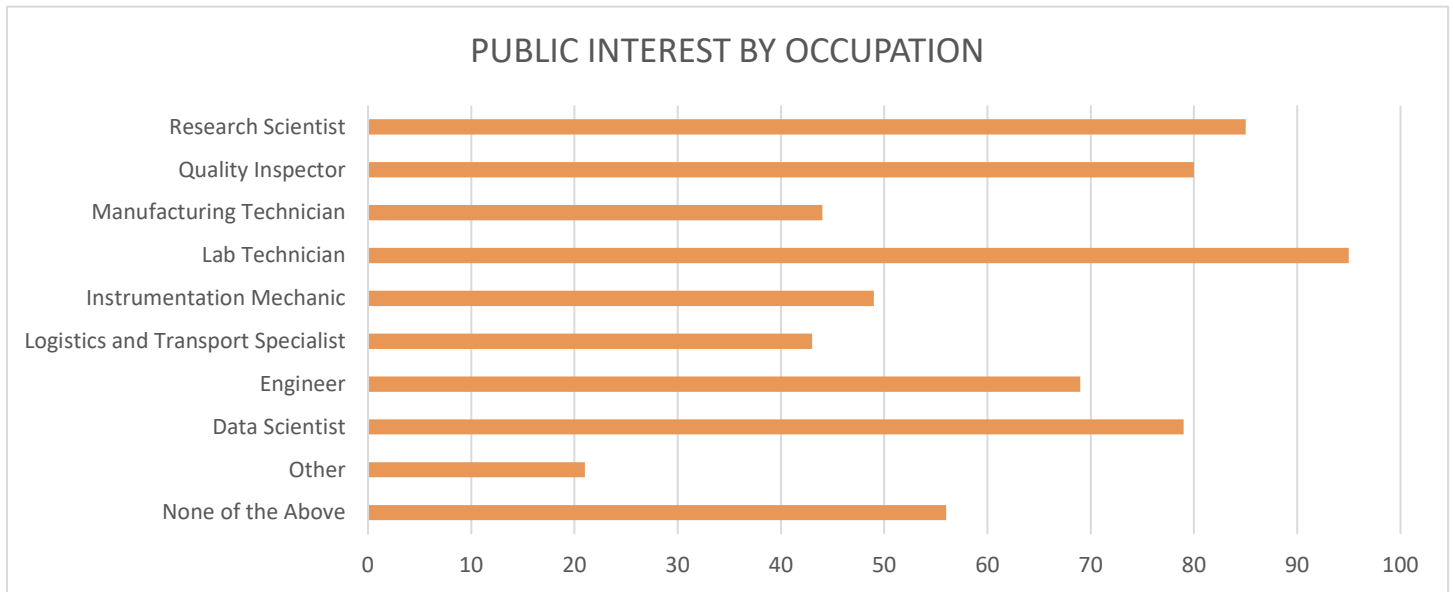


PUBLIC INTEREST BY SECTOR



The areas of highest interest were in agriculture technology and bio-based manufacturing, with the least amount of interest in cultivated meats and proteins.

PUBLIC INTEREST BY OCCUPATION



The survey also provided examples of occupations within the industry and asked respondents what occupations would interest them. Lab Technician and Research Scientist were the occupations with the highest level of interest.¹⁹ The results are summarized in the chart above.

Respondents were open to obtaining high levels of education if no barriers would stand in their way. Of survey respondents, 59% were willing to obtain a graduate level degree and 84 participants were open to obtaining a doctorate degree. This survey showed that although there may not be a large awareness of the industry, there was interest by a number of participants in learning more about the industry and its opportunities.

GAPS IN THE TALENT PIPELINE

The Core Partners identified two key gaps in the talent pipeline: the public awareness of the industry and its employment opportunities; and the need for a coordinated approach across training and workforce entities. A number of best practices around the country exist of entities working to address these gaps. These best practices can provide examples and a road map for how to address anticipated talent pipeline gaps in Solano County.

LACK OF INDUSTRY AND CAREER AWARENESS

The technical nature of biotechnology inadvertently creates barriers of access to the industry. In order to build career awareness of opportunities within the bioeconomy, there is a need to build general public awareness of the industry and to build consumer awareness for bio products. Workforce and education intermediaries can play a critical role in informing the public and policymakers about this industry.

Community Labs

Community labs are one promising practice to increase awareness of the bioeconomy and to facilitate public involvement in research. Community labs allow individuals to learn or engage in research outside a traditional academic or industry environment, often taking the “citizen scientist” approach and connecting industry capabilities to local problems. In addition, community labs can provide a space where future scientists can learn and experiment, becoming more comfortable with the techniques and technologies of careers in the industry.

There are numerous examples of community labs throughout the country; some focus on incubation spaces to spur entrepreneurship, others focus on developing solutions for local issues, and yet others focus on building public knowledge of biology research.

Examples of community laboratory spaces throughout the US include:

1. [Baltimore Underground Science Space \(BUGSS\)](#), in Baltimore, MD, offers classes, Open Mic nights, and lab access for the public to engage with hands-on biotechnology activities. They are part of the [DIYbiosphere](#) international network, an open-source project connecting do-it-yourself biology initiatives worldwide.
2. [BioCurious](#), in Santa Clara, CA, is a working laboratory and library for entrepreneurs. They have a training center and a meeting place for citizen scientists to innovate and learn about biology.
3. [BOSlab](#), in Boston, MA, provides community space to support DIYBio projects, educational workshops, and social events. Activities include a 2-day molecular biology introductory course, journal clubs, community projects, and open house events.
4. [Counter Culture Labs](#), in Oakland, CA, is a community supported microbiology maker space. It is a full stocked biology wet-lab built in the spirit of hacker spaces and maker spaces. They provide weekly working meetings focused on various aspects of biology.
5. [SoundBio Lab](#), in Seattle, WA, works to foster original research projects and provide hands-on STEAM education in their biomakerspace. They provide community workshops and bring hands-on science to schools through science nights and outreach events.



Figure 2: Counter Culture Labs

Other community lab initiatives include a YouTube microbiology club, outdoor nature talks, and digital fac labs.

Intermediaries could also organize initiatives such as community events, presentations, workshops, or marketing campaigns to increase community awareness if the development of a community lab is not feasible. Building a community lab, or at least opportunities in the community to engage in a hands-on way with the bioeconomy, will build a general awareness of the industry, as well as build interest in career opportunities within the industry.

TRAINING ALIGNMENT AND COORDINATION

Alignment and coordination of training opportunities available to the community is needed, so current and future workers understand their employment and training options for advancement. Best practices around the country show a strong connection across training, workforce, government, and industry partners leads to the best training alignment. These collaboratives coordinate and align educational opportunities across entities to build a coordinated approach to building the biotech skills of the community. Solano County has a strong base from which to strengthen training alignment and coordination.

Certifications

Industry-recognized certifications are emerging in the bioeconomy. A few entities have created industry-recognized certifications to validate industry skills attainment. Biotility, hosted by the University of Florida, developed the Biotechnician Assistant Credential Exam (BACE) to assess core skills and knowledge sets. The [Center for Professional Innovation and Education \(CfPIE\)](#) focuses on life sciences training and hosts eighteen (18) certifications in biotech, pharmaceutical, and medical devices. BioCom California Institute’s Technician Certification (BioTC) offers a certification for manufacturing technicians. These certifications are building alternative education and career pathways for the bioeconomy workforce. Bioscience Core Skills Institute (BCSI) offers practical skills assessments with digital credentials.

Together, area training providers could strengthen an infrastructure of stackable certifications and educate businesses on how certifications can support recognition of industry skills attainment.

K-12 Education Preparation

Improving awareness of bio-based occupations also includes building stronger preparation for bioeconomy in the K-12 system. To effectively align the skills with today’s biotech needs and engage students, secondary education providers must provide more hands-on and experiential instruction of secondary biology education and be provided the tools and resources to do so.

Our K-12 teachers, therefore, need exposure to this higher level of science, and our educational systems will need to be able to accelerate the curriculum development and implementation process to stay up to date with current industry needs. There are a number of best practices across the country of experiences built to expose teachers to industry concepts, as well as tools and resources for developing curriculum for biotechnology skills.

Examples of collaboratives that provide teacher exposure and coordinated trainings can be seen in the table below:

Initiative	Offerings
Biotility , in Florida	<ul style="list-style-type: none"> • Biotechnology lab field trips and mobile lab experiences for groups of students • Industrial Biotechnology Teacher Experience (IBTE), an 80-hour hybrid professional development program designed for educators teaching biotechnology courses
BioBuilder , in Massachusetts	<ul style="list-style-type: none"> • Synthetic biology training with opportunities to integrate biology and engineering • Teacher professional development opportunities • An Idea Accelerator and a BioBuilder Club for students • A BioBuilder Summer Research Program for high school students • A summer apprenticeship challenge

<p>Northeast Biomanufacturing Center and Collaborative (NBC2) in Pennsylvania</p>	<ul style="list-style-type: none"> • A National Science Foundation Advanced Technology Education regional center • Professional development opportunities for college and high school faculty <ul style="list-style-type: none"> ○ BIOMAN conferences ○ BIOMAN High School Academies ○ <i>Protein is Cash</i> workshops • Curricular material, Standards Operating Procedures (SOPs), presentations, and hands-on experiences in biofuels, industrial biotechnology, and stem cell technology.
<p>Project Lead the Way (PLTW)</p>	<ul style="list-style-type: none"> • Instructor support in every grade to help students be STEM-successful through an annual membership • Curriculum for PreK through high school tracks • Core Training for teachers in a hands-on learning environment

A few key organizations that provide instructor support and curriculum include:

Initiative	Offerings
<p>BioTrain, in Maryland</p>	<ul style="list-style-type: none"> • Biotech associate degree and certificate programs • Four-week, evening Biotechnology Bootcamp to prepare for entry-level biomanufacturing jobs • Information sessions, community events, and youth days at the Biotechnology Lab • Two levels of workshops for incumbent workers: <ul style="list-style-type: none"> ○ BioTrain, which focuses on emotional intelligence skills and industry relevant skills ○ BioTrac, laboratory training workshops for graduate and post-graduate level research scientists on current research methodologies
<p>Department of Energy's Bioenergy Technologies Office</p>	<ul style="list-style-type: none"> • <u>Bioenergy Research and Education (BRIDGES) program</u> - a three-hours case-study based education curriculum from high school to university level to encourage future careers in bioenergy, focused on ag tech.
<p>InnovateBio (National Biotechnology Education Center) in Texas</p>	<ul style="list-style-type: none"> • Information on bioeconomy degrees and certifications • Resources on the bioeconomy • Bioscience skills standards • Course in a Box
<p>NIIMBL</p>	<ul style="list-style-type: none"> • NIIMBL bioLOGIC – entrepreneurship-based outreach curriculum for high school students • Faculty fellows program • Education and Training database

Employee Upskilling

Based on feedback received in the biotech focus group, a training gap was found in incumbent worker upskilling opportunities. Training for incumbent workers could include knowledge on automation, technology, tools such as CRISPR/Cas9, and how to maximize Artificial Intelligence (AI) tools. These skills required specialized and targeted training that our current education system is not yet equipped to meet. Emerging programs from UC Davis Continuing Education and BioMADE may be able to fill this gap.

ENSURING EQUITY IN THE PIPELINE

Vacaville City Councilmember, Michael Silva, summarizes the industry as “accessible in a traditional sense.” He highlights a lack of demographic diversity in the industry, stating minorities “don’t see themselves in the industry.” Post-secondary education can be a huge financial commitment, a commitment people with barriers won’t make, Silva said, if they can’t see the return on their investment upfront. To overcome this lack of diversity and increase accessibility, stakeholders could provide mentors to help students work through internal issues and navigate the system.



SCC Biotech Students Represent Solano County

The White House, in its report *Building the BioWorkforce of the Future: Expanding Equitable Pathways into Biotechnology and Biomanufacturing Jobs*, highlighted the need to provide supportive services, expand skills-based hiring, and support mentoring programs as part of the approach to diversifying and expanding the bioeconomy's talent pool.²⁰ Transportation, childcare support, and emergency aid, can help provide non-traditional students the supports needed to be successful in completing training programs.

Access is particularly important for people with disabilities, for whom engagement at an early age, including through access to extracurricular activities like science and coding camps, is critical to ensure their access to and later advancement in bioworkforce careers. Additional accommodations will need to be considered for testing and certification processes.

BioscienceLA is one organization working in California to promote diversity, equity, and inclusion in the bioscience industries. Their BioFutures Program, for example, connects students from historically under-represented backgrounds to subsidized internships and career development, mentorship opportunities with individuals from organizations like BCLA and Women in Bio, networking events, and an alumni program.

EBRC emphasizes that programs should include an intentional design of services and supports for families in order to enable opportunities for all individuals. Strategies recommended include identifying mentors to help navigate the complex academic culture of university labs, and creating peer communities of like-minded individuals who serve as collaborators and counselors. EBRC highlights examples of expanding equitable opportunities, such as NIH's Initiative to Maximize Student Development (IMSD), the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), the Annual Biomedical Research Conference for Minority Students (ABRCMS), and the AfroBioTech Conference.

NEXT STEPS

Based on the research, the Core Partners identified a number of potential activities that would propel the development of a local bioeconomy talent development pipeline forward.

The key is to have the right local talent prepared to take advantage of the coming opportunities. This preparation must be at all levels of talent – including business owners and managers who need access to up-to-date industry trends, highly-educated or skilled staff, and future workers aware of the best pathways into the industry.

The bioeconomy already has a strong economic base in Vacaville. Developing a coordinated business attraction and retention ecosystem for the bioeconomy will set the stage for Solano to be a leader in this emerging industry. In addition, a multi-targeted talent development strategy will allow all Solano residents and businesses to take advantage of future growth.

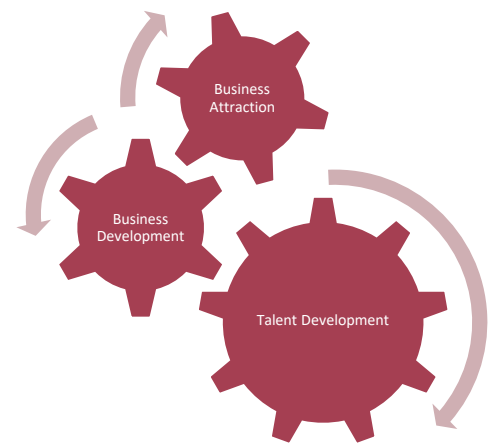
Coastal cities, such as Vallejo, Benicia, or Rio Vista would have an opportunity to capitalize on the growing need to convert agricultural biomass and municipal waste resources. If the community coordinates efforts, Solano County stakeholders can strategically apply for state and federal grants across departments to enhance capabilities in the bioeconomy.

Solano County also has opportunities within the bioindustrial sector. Already, there are seeds within the County for an emerging local industry. These include companies such as Mango Materials in Vacaville and ProForm Labs in Benicia. Start-ups located at LifeSpace Labs in Vacaville are working on promising new products and Congressman Garamendi has secured support for this this local subsector through a bill to create a “comprehensive community-to-career pathway” for bioindustrial jobs. With the right support, Solano will be able to capitalize on this emerging subsector.

The Core Partners narrowed next steps down to three key priorities that would further develop the talent pipeline for the local bioeconomy:

- 1. Create a local talent attraction plan that encourages more diverse representation throughout career entry points.**
- 2. Provide the needed certifications that demonstrate current in-demand skills identified by industry.**
- 3. Upskill incumbent workers so that local small businesses can take advantage of emerging industry opportunities.**

A Coordinated Approach



1. LOCAL TALENT ATTRACTION

A. Community Awareness

There is a long-term need to build awareness among the general adult public and school-aged children about both current and future opportunities in the bioeconomy. To ensure equity of access to the industry's career opportunities, awareness-raising campaigns about the bioeconomy and career opportunities must include targeted campaigns within Solano's underrepresented communities of Vallejo, Suisun City, and industry-underrepresented Black and African American and Latinx populations.

The Core Partners' Action Plan includes:

- Engage in a series of at least three (3) community and educational events in 2024 across the core partners to build awareness of the bioeconomy and career opportunities, including at least one community event in Vallejo;
- Evaluate participants' experience to inform future events;
- Develop tours for workforce and educational professionals at local companies to better understand Solano's bioeconomy landscape; and
- Launch an awareness-raising local media campaign.

Bioville 2024 is the first community and educational event, to be held in April 2024. This event, organized by the California Biomanufacturing Center, in partnership with the City of Vacaville and other stakeholders. It coincides with National DNA Day on April 25th and will celebrate the biotechnology and biomanufacturing community in Vacaville.



In addition, the Core Partners intend to host a community-awareness event in Vallejo, through support from Jobs For the Future's Workforce Communities of Action seed funding. The goal of this event will be to bring hands-on, experiential awareness of the bioeconomy and its careers to youth and their families in targeted underserved communities of Vallejo.

Future efforts to expand events could include exploration of creating community lab experiences in Solano County, such as pop-up booths at existing community events. Efforts could also include a BioSummit for policy makers and community leaders on the industry and its potential impact on local communities and economic growth.

B. Career Mapping

A number of stakeholders agreed that an easy-to-understand roadmap for career and training pathways would help people better understand the opportunities within the bioeconomy at all levels of education.

Therefore, the Core Partners' Action Plan includes:

- Develop a bioeconomy career map of local career opportunities and pathways that includes labor market information and educational requirements.

In pursuit of this effort, the Workforce Development Board (WDB) of Solano County has contracted with Lightcast to develop a career map for the local bioeconomy with anticipated completion of late summer 2024.

C. Bioeconomy Workforce/Training Information

To build the community's awareness of the bioeconomy and its career opportunities, individuals need a basic understanding of what the industry does, what opportunities are available, the economic mobility possibilities provided within the industry. In addition, individuals must understand the skills needed to enter careers in the bioeconomy and how to gain those skills.

As such, the Core Partners' Action Plan includes:

- Determine the best entity to host the microsite; and
- Develop and implement branding and microsite content strategy.

To develop a bioeconomy microsite for the region will require cross-entity collaboration and articulation. Yet, alignment and coordination of information across workforce, economic development, and training providers would help consolidate and introduce the industry and its opportunities in easy-to-understand terms for the general public.

2. IN-DEMAND CERTIFICATIONS

A. Short-Term Certification Programs

Solano County has opportunities to expand and develop all three bioeconomy subsectors, with biotechnology as the link between subsectors. The training provided at Solano Community College can be a base for other trainings.

DeepStack Bio is a company working with LifeSpace Labs to develop entry-level training on DNA sequencing that will lead to Research Assistant opportunities. This business-led, targeted skills training is currently being developed with a joint investment from the County of Solano and the City of Vacaville through American Rescue Plan Act (ARPA) funding.

The WDB is currently partnering with SCC faculty to support students in gaining industry-recognized certifications that build upon SCC's coursework. For example, SCC classes in Supply Chain Management, Six Sigma and Lean Manufacturing, and Project Management can lead to industry-recognized certifications that improve students' marketability in the industry. This allows individuals to build stackable credentials that translate to required work skills.

Future opportunities include expanding the ability to offer industry-recognized biotech certifications at other local training institutions and exploring use of bioeconomy-specific certifications.

B. A Stackable Training Approach

A number of industries have clearly defined training milestones that can be stacked to build economic mobility lattices. There is an opportunity to support the building of a stackable training lattices in biotechnology as well.

Bridge programming, or onramps, at CTE high school programs or short-term occupational adult school programs can provide both a traditional and non-traditional training pathway into the bioeconomy. Assessment of competencies learned at this level could include microcredentials or digital badges, such as those provided by Bioscience Core Skills Institute (BCSI). BCSI's five essential skills certifications, for example, include "Safety: Hazard Assessment," "Documentation and SOP," "Numeracy" skills, "Aseptic Technique: Lab Bench Level," and "Small Volume Metrology." This type of bridge programming should provide the prerequisite skills needed to enter a community college program.

Future opportunities exist to invest in programs, networks, and events aimed at providing research opportunities to diverse undergraduate and graduate students, and to build a mentor network to help students navigate the complex academic culture of university labs and creating peer communities.

A visual of a potential training pathway can be viewed on the following page.

C. Pathway for Vallejo Youth

To ensure equitable access to bioeconomy careers, the Core Partners identified a desire to strengthen pathways into the industry for youth in the Vallejo Unified School District. The Core Partners plan to engage local secondary school systems to develop a summer and/or after-school program for high school students that augments Vallejo's Career and Technical Education (CTE) pathways.

3. UPSKILL CURRENT WORKERS

Training for current workers in the bioeconomy was identified as a need in the local business focus group. To support this goal, the Core Partners identified future opportunities for upskilling employees. The WDB, for example, has supported a local bioeconomy business with incumbent worker training to upskill employees on using clean steam processes.

Potential professional development needs include:

- Emerging industry trends, tools, and approaches;
- Specialized equipment and facilities service needs, such as specialized HVAC, waste removal, and electrical systems;
- Educational modules to learn the regulatory approval process; and
- AI-driven tools and skills in digital strategies.

Most biotech companies offer tuition reimbursement. Once employed, this is a field that provides a tremendous opportunity for upward mobility. With additional supports from community and training partners, Solano's small businesses within biotech fields or in secondary markets (such as HVAC) could take advantage of the growth of this emerging industry.

The Core Partners believe these action steps will help strengthen and grow Solano's bioeconomy talent pipeline.

BIO CAREERS

TRAINING ROADMAP

1

PREREQUISITES

- Fulfills SCC Prerequisites: BIOT 10 (chemistry and biology), English, and Math (Statistics)
- Could be fulfilled at CTE high school or Adult School program
- **Credential Type:** microcredential, digital badging
- Prepare graduates for **Lab Assistant** position (ability to prep media, buffer)

2

ENTRY CERTIFICATIONS

- Four course program at SCC
- Short-term programs
 - CA Biomanufacturing Center (CBC)
 - LifeSpace Labs for research path
- Prepares graduates for
 - **Lab Technician** (bioreactor grow cells and protein purification)
 - **Research Associate** (DNA sequencing)
- Potential Industry-Recognized **Credentials:** BACE, BioTC

4

UPSKILLING

- Courses and certifications to keep professional skills current
- Could be fulfilled by SCC, CBC, UC Davis - Continuing Education, Adult Schools, BioMADE
- Skills such as:
 - Digital Literacy, Writing and Communication Skills, Leadership, HazMat safety
 - AI Technology and Automation Trends
 - Industry Trends - CRISPR, Cell Therapy
 - Patent law and regulatory affairs
 - Six Sigma, PMP, and Supply Chain Mgt

3

DEGREES

- Biomanufacturing Degree at SCC for direct entry into industry or articulation into research scientist path
- Degrees at nearby four-year colleges and universities for entry into research scientist path
- Graduate degree leading to post-doctorate entry level research position



ENDNOTES

- ¹ Schmidt Futures, [“The U.S. Bioeconomy: Charting a Course for a Resilient and Competitive Future,”](#) April 2022.
- ² CRB, [“Horizons: Life Sciences 2023,”](#) 2023.
- ³ Albert W. Hinman and Douglas C. Friedman. [Actions to Enable an Equitable and Innovative U.S. Bioeconomy.](#) *Engineering Biology Research Consortium.* 2022.
- ⁴ Schmidt Futures, [“The US Bioeconomy.”](#)
- ⁵ Ziker, C., Johnson, J., and Paredes, P., [“Opportunities and Challenges in Bioindustrial Manufacturing: An Environmental Scan of Workforce Development in the Industry,”](#) *STEMConnector,* 2022.
- ⁶ CBRE, [“2023 U.S. Life Sciences Outlook,”](#) April 2023.
- ⁷ CBRE, [“2024 U.S. Life Sciences Outlook,”](#) January 2024.
- ⁸ CBRE, [“2023 U.S. Life Sciences Outlook,”](#) April 2023.
- Congressional Research Services, [“The Bioeconomy: A Primer,”](#) September 19, 2022.
- ⁹ Schmidt Futures, [“The US Bioeconomy.”](#)
- ¹⁰ CBRE, [“2023 U.S. Life Sciences Outlook,”](#) April 2023.
- ¹¹ Alliance for Regenerative Medicine, [“Workforce Report: Gap Analysis for the Cell and Gene Therapy Sector,”](#) March 2023.
- ¹² EBRC, [“Actions to Enable an Equitable and Innovative U.S. Bioeconomy.”](#)
- ¹³ Lightcast Q4 2023 Data Set, [“Industry Snapshot Report: Bioeconomy in Solano County, CA.”](#)
- ¹⁴ Ibid.
- ¹⁵ City of Vacaville, CA, [“Biotech and Advanced Manufacturing Attraction Strategies,”](#) presented to Vacaville City Council on April 28, 2020.
- ¹⁶ Lightcast Q4 2023 Data Set, [“Industry Snapshot Report: Bioeconomy in Solano County, CA.”](#)
- ¹⁷ Lightcast Q4 2023 Data Set, [“Staffing Patterns in Bioeconomy in Solano County, CA.”](#)
- ¹⁸ James DeKloe, [“Solano College Industrial Biotechnology and Biomanufacturing: Training a Workforce to Change the World, Impact Tomorrow, Today.”](#)
- ¹⁹ It is important to note that due to the concentration of respondents who work in the field or were Solano Community College students, the data may be skewed towards these occupations and higher levels of education.
- ²⁰ The White House, [“Building the Bioworkforce of the Future: Expanding Equitable Pathways into Biotechnology and Biomanufacturing Jobs,”](#) June 2023.