



CAPTURING AN INDUSTRY: Biotechnology

Recommendations for extending California's dominance
of the biotechnology industry.

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BACKGROUND

This report was prepared by the Center for Applied Competitive Technologies (CACT), under the 2013-14 Hub grant from the California Community College Chancellor's Office, Economic & Workforce Development (EWD) program.

The CACT helps manufacturers compete successfully in changing markets and the global economy. Through technology education, manufacturing training and services that contribute to continuous workforce development, the CACT provides expertise in technology deployment and business development. Services include onsite training, low-or-no cost technical assistance, and educational workshops, as well as information on how to qualify for state funds to assist with retraining employees and upgrading equipment.

The CACT also provides industry-specific reports on manufacturing & emerging industries/technologies, promotes STEM education through the development of recruitment tools & educational partnerships, and provides many other resources to help industry, educators, and students succeed in California.

The EWD is an integral part of the California Community Colleges, investing funding and resources in key industry sectors. EWD's industry-specific programs invest in the skills of California's workforce – now and in the future – through highly specialized industry training, technical consulting and business development. The end result is the ability for businesses to better understand the trends and labor market pertaining to their industry, and make informed decisions about how to grow and compete.

INTRODUCTION

“I see a bright future for the biotechnology industry...”

-- Freeman Dyson, Scientist



Credit: Wikipedia

California is the undisputed leader in biotechnology. Not only does California have more total jobs & companies than any other state, but the most: research & developing spending, patents filed and venture capital investment. California also awards more bioscience degrees than any other state.

Biotechnology is applicable to many areas, including the environment, medicine, agriculture, human space exploration, law enforcement, and more. Biotech improves our world in many different ways, from advancing medicines to cleaning the environment, all of which enhance our quality of life.

Biotechnology has a substantial impact on economic output. In California alone, more than 175,000 are employed in the biotech industry, with nearly \$50 billion in sales. As a result, through tax incentives and infrastructure investments, several states actively pursue a larger market share of the biotech economy, including Colorado, Maryland and New York.

The biotechnology industry employs everyone from technicians to PhD's. It is one of the most diverse industries for employees with different educational levels. Consequently, there are a unique set of challenges that need to be addressed to ensure a skilled workforce across the educational spectrum.

APPLICATIONS

“Almost everybody is enthusiastic about the promise of biotechnology to cure disease and to relieve suffering.”

-- Leon Kass, Physician/Scientist



Credit: Roche

Biotechnology is applicable to many areas, including the environment, medicine, agriculture, human space exploration, and forensics. Environmental applications are largely within the area of bioremediation (removing pollutants via an organisms metabolic function), which includes waste treatment and pollution prevention. Through biotechnology-related processes, energy can be generated from converting waste into a biofuel.

Biotechnology applications in medicine are extensive. It improves drug production & delivery, gene therapy techniques (which are used to treat certain diseases), pre-natal diagnostic screening, and a plethora of other improvements. In the area of agriculture, biotechnology processes have improved food production, quality and nutritional content. Biotechnology has even helped to advance space exploration, as the life support system on-board the International Space Station is derived from and/or utilizes several biotechnology-related processes.

Whether it's improved DNA testing, combating malnutrition, or helping to advance the frontiers of human space travel, biotechnology plays an important role in many facets of society, with new applications being discovered every year. Consequently, the biotechnology industry has a major impact on the global economy.

ECONOMICS

“Biotech investing is no longer a pie-in-the-sky game.”

-- Edward Tenthoff, Investment Researcher



Credit: Empa

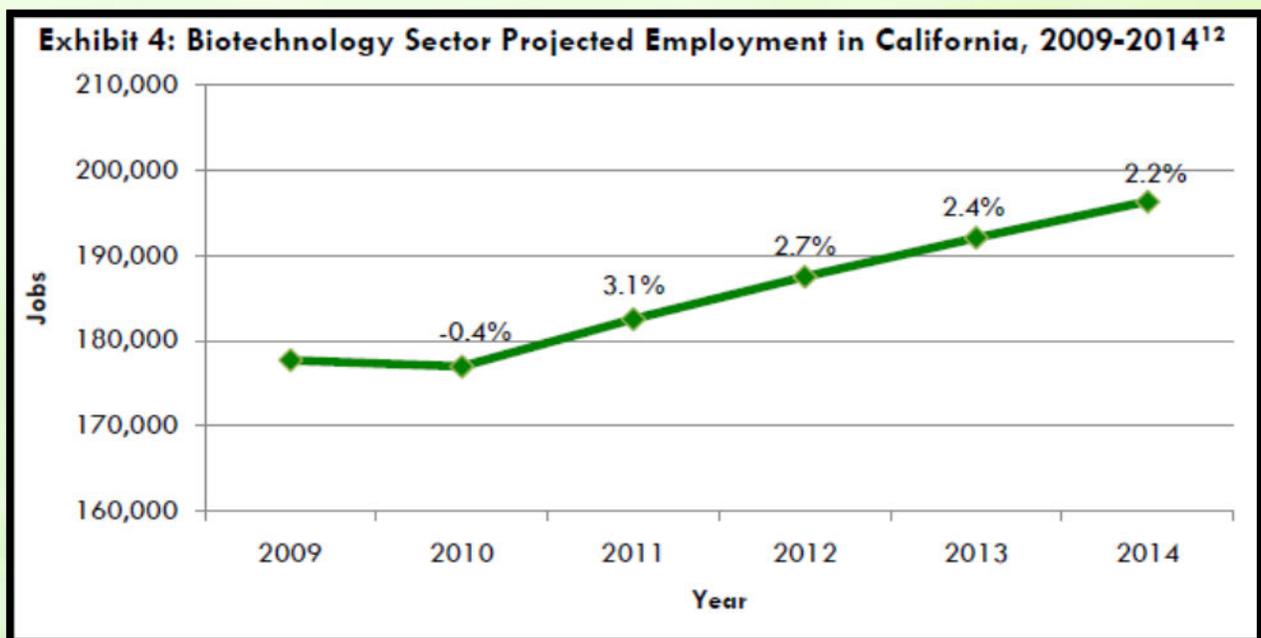
Biotechnology has a substantial impact on California’s economy. From 2004-2009, California’s biotechnology industry received over \$20 billion in investments. In 2009, California’s biotech sector generated over \$47 billion in sales, and in 2011, there was nearly \$5 billion in bio-related venture capital investments.

Several states have provided infrastructure-related funding to help increase their share of the biotechnology economy. In 2013, the University of Colorado invested \$160 million in a new biotechnology research center, with one of the primary functions being economic growth. Also in 2013, New York opened the CNY Biotech Accelerator, a \$25 million investment designed to help spur economic growth. States have also put forth economic incentives, in the form of tax credits, to increase their share of the industry. These states include Maryland, New York, Washington, Texas, and Massachusetts.

Some biotechnology companies maintain headquarters in California, but then build manufacturing out-of-state. This is a result of California’s business climate (real or perceived). A 2010 survey, called the *California Industrial Biotechnology Workforce Survey*, highlights this concern:

Of the companies surveyed, 81 percent have their headquarters in California and 91 percent have their research and development facilities in the state. Only half of the respondents locate their pilot scale facilities in California, and an even smaller percent build their commercial scale plants in the state, citing the cost of doing business and the regulatory environment.

Without addressing the business climate, California will continue to lose out on revenue, and not just from the biotechnology industry, but from other industries as well.



WORKFORCE

“Technicians with 2 year community college degrees (and sometimes a 4 year degree, too) are the people who are in demand.”

-- Sandra Porter, Digital World Biology



Credit: Laney College

By some estimates, there are nearly 200,000 employed by California’s biotechnology industry. The biotechnology workforce is unique in that it’s very diverse in its educational levels, requiring everything from a technical degree to a PhD. This presents several challenges to ensuring that quality biotech workers are being produced at all educational levels.

The fastest growing biotechnology occupations are: biomedical engineers (Bachelor’s Degree), medical & clinical laboratory technologists (Bachelor’s Degree), medical & clinical laboratory technicians (Associate Degree), biochemists/biophysicists (PhD) and medical scientists (PhD). Biomedical engineers are paid the most (\$42.55/hr), followed by biochemists/biophysicists (\$39.64/hr), medical scientists (\$38.49/hr) and medical & clinical laboratory technologists (\$35.36/hr).

Although the fastest growing biotechnology job is that of a biomedical engineer, the largest shortage of workers is at the technician level. This has been highlighted in several reports over the last decade, and continues to be a concern today. If this shortage persists, then California will not be positioned to maximize its share of the biotechnology economy.

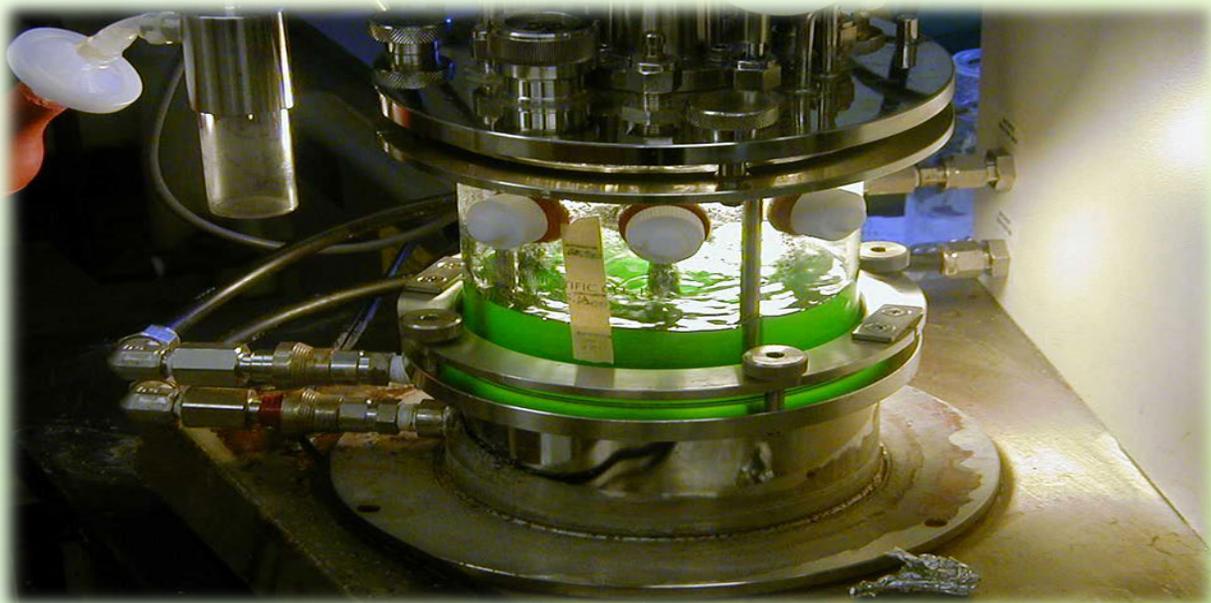
SOC Code	Description	2009 Jobs	2014 Jobs	Change	% Change	Median Hourly Wage ¹⁶	Education Level
19-1042	Medical scientists, except epidemiologists	6,927	8,445	1,518	22%	\$38.49	Doctoral degree
29-2012	Medical and clinical laboratory technicians	2,489	3,070	581	23%	\$19.29	Associate degree
17-2031	Biomedical engineers	1,379	1,955	576	42%	\$42.55	Bachelor's degree
51-2092	Team assemblers	4,740	5,301	561	12%	\$12.10	Moderate-term on-the-job training
29-2011	Medical and clinical laboratory technologists	2,072	2,575	503	24%	\$35.36	Bachelor's degree
19-1021	Biochemists and biophysicists	2,009	2,469	460	23%	\$39.64	Doctoral degree
31-9099	Healthcare support workers, all other	2,770	3,175	405	15%	\$16.17	Short-term on-the-job training
43-4051	Customer service representatives	2,524	2,879	355	14%	\$16.90	Moderate-term on-the-job training
51-9081	Dental laboratory technicians	2,307	2,644	337	15%	\$18.04	Long-term on-the-job training
51-9023	Mixing and blending machine setters, operators, and tenders	2,304	2,640	336	15%	\$14.87	Moderate-term on-the-job training

A description of biotech-related positions, projected growth, average wage and level of education generally required for each position.

RECOMMENDATIONS

“To reach our full potential, we now need to see the entire manufacturing industry embrace biotechnology and start looking for every opportunity to integrate it into our production processes.”

-- Michael Fallon, UK Energy Minister



Credit: Purdue/John Morgan

There are several actions that can be taken to maximize California’s share of the biotechnology industry.

Workforce

Integrating biotech-related equipment into the community college system would enhance workforce skills, thereby providing future employers with workers who are not only qualified for the positions, but potentially reduce the amount of in-house training required to perform the specified operation, which translates into greater economic growth. Due to both demand and the unique requirements of some biotech-related activities, it would also be advisable to provide funding for the addition and/or upgrading of biotech-related labs.

Increasing science, technology, engineering and mathematics (STEM) education at the high school level would help to minimize any future workforce shortages within the biotechnology industry. There are several options for improving STEM education, including adjusting the required high school science graduation requirements from two years to three, increasing participation with Project Lead The Way (a non-profit that integrates STEM education into



middle and high schools), providing more professional development opportunities to high school teachers, and more.

Academia

The UC system has several impressive biotech-oriented facilities, including the California Institute for Quantitative Biosciences, but the CSU lacks that kind of infrastructure. Establishing an integrated biotechnology research center within the CSU system would provide a substantial boost to training the future biotechnology workforce, and increase research & development capabilities, which would maximize funding opportunities and economic output.

For the UC system, funding to acquire state-of-the-art biotech equipment would go a long way in ensuring that students pursuing advanced degrees have the highest quality skill-sets available. By maximizing skill-sets, biotech companies would have to perform less on-the-job training during the initial hiring period, resulting in greater economic growth for the company, and by extension, more revenue for California. Additional equipment acquisition would also expand research opportunities and allow the UC to better compete for federal funding and develop public-private partnerships, thus maximizing economic growth in California.

Industry

The State of California recently passed biotechnology tax credits (sales/use tax exemption for biotech/manufacturing equipment), which is an important step in maximizing California's share of the biotechnology economy, but as previously mentioned, very few biotech companies locate their pilot/commercial facilities in-state. These facilities provide well-paying jobs that spur significant economic activity, and California should be positioned to accommodate these facilities to the greatest extent possible. To address this issue, it would be advisable to provide tax credits for the construction and/or expansion of biotech-related manufacturing facilities. This would encourage outside biotech companies to invest in California, existing companies to expand their California footprint, and encourage start-ups to setup here.

The business climate has been a long-standing concern for various industries, including biotechnology. For a report on California and the business climate, along with solutions for remediation, visit the Centers for Applied Competitive Technologies (www.makingitincalifornia.com) and click on Industry Reports, or visit the following URL: <http://makingitincalifornia.com/documents/Business%20Climate%20Surveys%20-%20Final%20Report.pdf>