

DECEMBER 2023

ECONOMIC IMPACT OF THE CENTRAL COAST AGRICULTURE AND AGTECH SECTOR

REACH

Ideas + Action for a Thriving Central Coast

ACKNOWLEDGMENTS

TIP Strategies would like to thank the staff and leadership of REACH and the REACH Agriculture and Agtech Industry Council for their input and feedback on this document.



REACH is a Regional Economic Action Coalition uniting public, private and civic leaders across the Central Coast of California. REACH's goal is to transform the quality of life on the Central Coast, a region of about 700,000 people in dozens of cities and towns in the Counties of San Luis Obispo and Santa Barbara. The mission of the private sector-led coalition is to increase economic prosperity through big thinking, bold action, and regional collaboration.

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CONSULTING TEAM



TIP Strategies, Inc., is a privately held firm providing consulting and advisory services to public and private sector clients. Established in 1995, the firm's core competencies are strategic planning for economic development, talent strategies, organizational development, resiliency planning, and equity initiatives. TIP is headquartered in Austin, Texas, with offices coast-to-coast.



Lightcast is the global leader in labor market analytics. Formerly Emsi Burning Glass, the firm has over two decades of experience providing businesses, communities, and education institutions with the best labor market data possible. Lightcast's data-driven insight enables better, faster decisions. The firm is headquartered in Boston, Massachusetts, and Moscow, Idaho.

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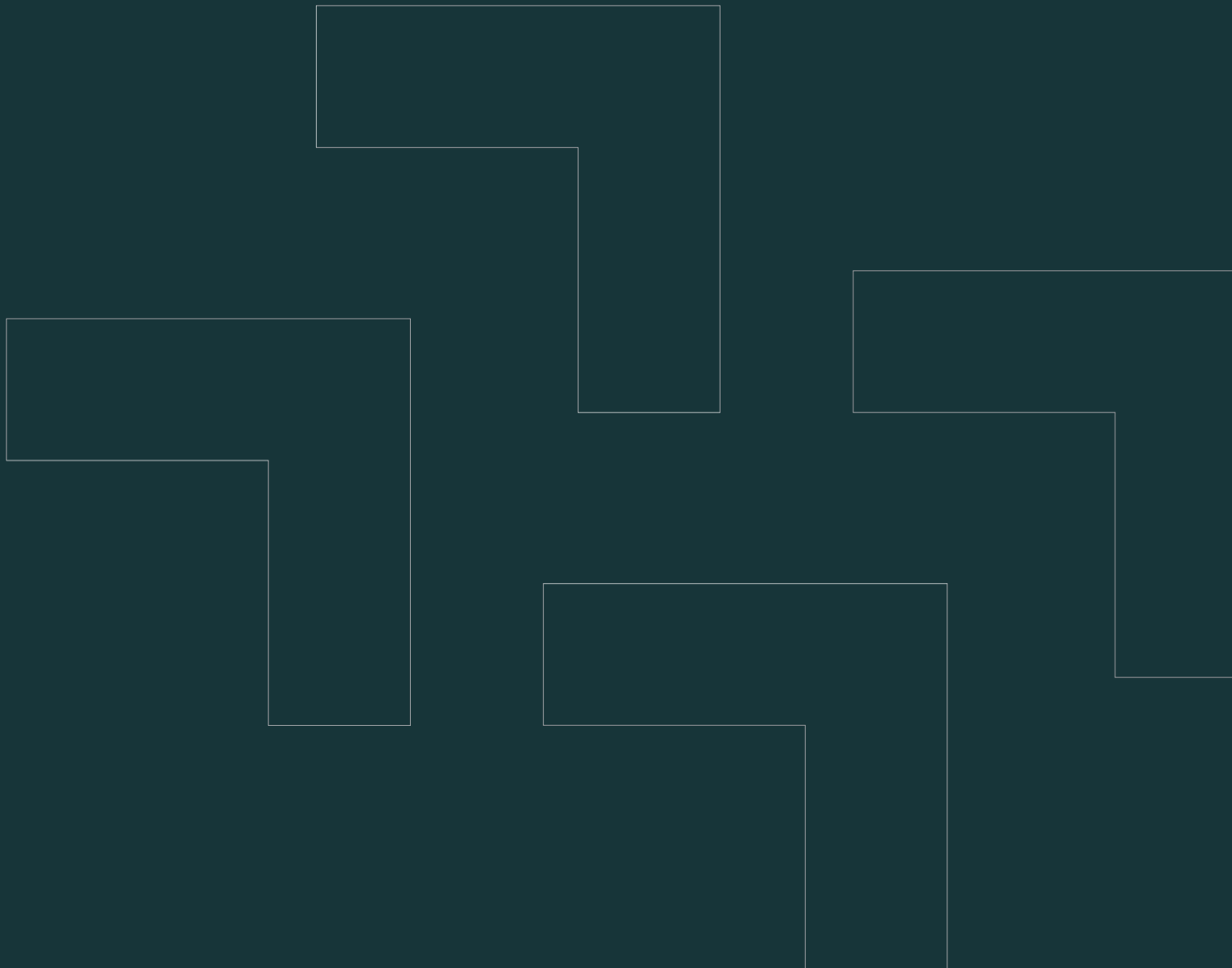
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EXECUTIVE SUMMARY



ABOUT THIS WORK

This analysis was completed as a supplement to the preparation of a comprehensive economic development strategy (CEDS) for the Central Coast region of California, which encompasses the Counties of San Luis Obispo and Santa Barbara. It is one of four studies designed to gauge the economic impact of the region's target sectors. The other three are Aerospace, Defense, and Precision Manufacturing; Clean Tech and Renewable Energy; and Technology. The work was commissioned by REACH, an independent 501(c)(3) organization committed to creating a more prosperous and inclusive economy in San Luis Obispo and Santa Barbara Counties, and supported by funding from the US Economic Development Administration.

CENTRAL COAST TARGET SECTORS

- + Aerospace, Defense, and Precision Manufacturing
- + Agriculture and Agtech
- + Clean Tech and Renewable Energy
- + Technology

This report focuses on the Agriculture and Agtech¹ sector, a robust cluster of industries that encompasses both the production of agricultural products and the growing range of services that support agriculture.² Insights gained from this work, and from industry roundtables conducted as part of the CEDS planning process, will support the region's growth of this critical sector.



¹ The term “agtech” refers to the increasing use of, and dependence on, technology and innovation by agricultural enterprises.

² See Figure 15 (page 29) in the appendices for the definition of the sector used in this report.

Key findings from the team’s research and analysis are summarized in the remainder of this section. It is followed by an exploration of the Agriculture and Agtech sector landscape in terms of its assets, employment trends, and talent pipeline. The quantitative analyses presented in this overview draw on an extensive interactive data visualization created by TIP Strategies using proprietary data prepared by national labor market data provider, Lightcast.³ The final section of the report presents the results of an economic impact analysis—as measured by job creation, earnings, and added tax revenue—conducted by Lightcast. Supporting details, including a list of the industries that were used to define the sector (Figure 15, page 29) and an explanation of the federal classification systems referenced in this work (Classification Systems, page 42), are provided as appendices.

KEY FINDINGS

Significant Agriculture and Agtech assets have the potential to advance a pivotal Central Coast sector.

The Central Coast offers a number of advantages to the Agriculture and Agtech sector, starting with its natural setting. The region’s geography and climate provide ideal conditions for the production of crops ranging from wine grapes and berries to cattle and nursery products. Both Central Coast counties reported record crop values in 2022 (the most recent year available at the time of analysis), with a combined total of \$3 billion in gross production value.⁴ Slightly less than one-half of that amount was attributable to two crops: strawberries (representing 36.1 percent of the counties’ total crop values) and wine grapes (11.9 percent). The latter reflects the Central Coast’s historic roots and present strengths in viticulture, demonstrated by the more than 20 individual American Viticultural Areas designated between the two counties.⁵

From established companies in traditional agriculture to innovators in the emerging agtech field, the area is home to more than 1,200 businesses in the sector.⁶ The presence of University of California, Santa Barbara (UC Santa Barbara) and California Polytechnic State University, San Luis Obispo (Cal Poly) help drive cross-cutting innovation. Several applied research centers and specialized training programs at both institutions support the industry in its efforts to increase crop yield, implement sustainable practices, and boost profitability. For example, the newly constructed JUSTIN and J. LOHR Center for Wine and Viticulture joins the Strawberry Center and other institutes as part of Cal Poly’s top ranked College of Agriculture, Food and Environmental Sciences. UC Santa Barbara’s Bren School of Environmental Science and Management boasts several initiatives aimed at balancing the food-energy-water (FEW) relationship to maximize sustainable food production. These efforts include harnessing the power of data analytics through the UCSB SmartFarm initiative and investigating the role of infrastructure, including sensors, cloud computing, and LED lighting, as part of the FEW research focus at the Institute for Energy Efficiency.

³ The quantitative analyses presented throughout this report use proprietary employment data, including five-year projections, prepared by Lightcast. Employment figures reflect Lightcast’s complete employment data, which includes both employed and self-employed workers. Projections are based on historical trend lines averaged across three scenarios and, therefore, do not capture employment associated with recent and/or planned investments. More information about Lightcast’s data and methodology can be found [in their online knowledge base](#).

⁴ Calculations based on 2022 annual crop reports for the County of San Luis Obispo (\$1.1 billion in crop value) and the County of Santa Barbara (\$1.9 billion).

⁵ Based on a [map of California’s American Viticultural Areas](#) (undated) available via the Wine Institute.

⁶ As reported by GIS Planning [via the REACH website](#).

Growth in the \$4.4 billion sector, supporting 35,000 jobs, is expected to far outpace the state and nation.

The Agriculture and Agtech sector is a significant part of the Central Coast economy, encompassing roughly 35,000 workers, which translates to nearly 1 out of every 10 jobs in the region.⁷ Projections prepared by Lightcast call for a 10 percent increase in Agriculture and Agtech jobs over 2022 levels by 2027, a pace that far exceeds state and national growth rates during the period of 1 percent and 5 percent, respectively. Goods and services produced by Agriculture and Agtech businesses contributed \$4.42 billion to the gross regional product (GRP) of \$52.3 billion (8.5 percent) in 2022. Employment growth in the sector is expected to continue.

Projected expansion in the sector would have additional ripple effects on the economy. An impact analysis conducted by Lightcast identified an employment multiplier of 1.89 for the sector, meaning that each Agriculture and Agtech job results in nearly one additional job in the region.⁸ Based on a scenario in which focused business development efforts accelerated projected job growth over a five-year period, Lightcast's economic impact analysis found that growth in the sector could result in a total of more than 12,500 additional jobs, \$749 million in earnings, and \$118 million in tax revenues when the sector's supply chain and household spending impacts are considered.⁹

In addition to the benefits that are directly attributable to the sector, the region's agricultural activities are also linked to another significant aspect of the Central Coast economy: tourism. Wineries help to draw visitors to the region and contribute to spending by visitors more broadly. Efforts like the SLO County Farm Trail support agricultural enterprises by connecting them to residents and tourists, alike. Furthermore, agricultural landscapes can be a complement to the natural features and open space that help define the region's quality of place.

The sector's continued modernization demands more specialized skills and technology competencies, making talent development vital.

The Central Coast's strong network of postsecondary institutions is a tremendous asset. In addition to driving innovation across multiple industries, the presence of UC Santa Barbara and Cal Poly draws talent to the region in the form of students, faculty, and researchers. And, of course, they play a central role in the region's talent pipeline by supplying graduates. Similarly, the region's community college partners—Allan Hancock College, Cuesta College, and Santa Barbara City College—serve as the backbone of the regional training ecosystem offering upskilling opportunities for incumbent workers along with workforce and career development across a range of age and experience levels. Although the majority of Agriculture and Agtech occupations do not currently require advanced educational levels, the ongoing modernization of the sector in response to challenges, including drought, climate change, pest control, and labor shortages, will demand more specialized skills and technology competencies. Specialized training and curriculum development will be critical to preparing workers for this shift in the industry's talent needs. Allan Hancock College's Creating Precision Agriculture and Crop Protection Career Pathways program is an example. Funded through the National Science Foundation (NSF) Advanced Technological Education (ATE) program, the initiative resulted in the development

⁷ The two Central Coast counties had nearly 363,000 jobs in 2022, according to Lightcast data used in the analysis.

⁸ The employment multiplier of 1.89 for the Agriculture and Agtech sector includes the initial gain of one job (1.00), plus the estimated employment generated by that new job, which in this case is nearly one additional job (0.89). See Figure 11 (page 23) for an illustration of the ripple effects of job growth.

⁹ See Figure 12 (page 25) for details of the analysis.

of multiple degrees and certificates for students with agricultural science backgrounds and a sharp increase in the number of declared majors in the field.¹⁰

Lower-wage traditional occupations continue to lead hiring demand across the sector.

Despite the growing market for precision agriculture and the near-term prospects of applying sophisticated technologies such as robotics, drones, and advanced data analytics to the sector, hiring demand among regional employers continues to fall along traditional lines. An analysis of more than 2,000 job postings highlighted demand for positions related to sales and marketing, transportation and material moving, and office and administrative work.¹¹ The dominance of these positions in the hiring pipeline of Agriculture and Agtech employers reflects the importance of crop production activities and the retailing of agricultural products, including via the region's many wineries.

Many of the top occupations sought by employers based on the job postings analysis tend to be among the region's lowest earning. Median wages for roughly one-third of the in-demand occupations analyzed for this work fall below the regional median of \$20.41 per hour.¹² These low-earning occupations, like retail sales positions and warehouse and distribution workers, are often also among the largest in terms of employment. While these relatively low-skill and low-wage jobs can provide a critical entry point into the labor market, they often do not offer opportunities for career advancement. When earnings are compared against living wage standards, only a handful of occupations being sought by Agriculture and Agtech employers pay enough to sustain a household with two adults and two children. Although they are not well-represented in job postings data, many of these same findings apply to farm workers, which represent just over one-half of the sector's employment (51 percent).

Continuing to support the modernization of the Agriculture and Agtech sector will be critical to its long-term health.

Although current job postings may not yet fully reflect the modernization of the sector, there is little question that Central Coast establishments are leading technological advancement in the Agriculture and Agtech space. Market innovators who are addressing sustainability challenges like water conservation while increasing crop yields and driving profitability include the following companies:

- + Apeel, a Goleta-based agtech company that developed a technology to preserve fresh produce longer.
- + TRIC Robotics, a startup that relocated from the East Coast to incubate at Cal Poly, which is developing a pest control technology using robotic lights.
- + Hortau, a San Luis Obispo-based irrigation management company that develops and implements smart irrigation in direct response to plant and soil needs, which is more sustainable and better for the plants.
- + Bejo Seeds, an Oceano-headquartered seed developer and professional grower for residential and commercial agriculture.

¹⁰ During the 2020-2021 academic year, Allan Hancock College's agricultural science enrollment increased by 14 percent. See ATE Impacts website, [ATE Project Sparks Agricultural Science Enrollment Growth](#) for more information.

¹¹ Job postings data provide valuable insights about the real-time hiring activity of employers. However, some occupations are not well-represented in this data, including farmworkers. These workers are captured in Lightcast's core labor market data which underpins the rest of the quantitative analyses, including the economic impact figures.

¹² All wage and earnings data in this report, including the median hourly wage rate shown here, are drawn from Lightcast's proprietary employment data and may not align with figures reported by other sources.

Supporting the growth of these leading-edge agtech companies, while also helping more traditionally focused operations adopt more modern processes and technologies, will be essential to the future growth and sustainability of the sector.

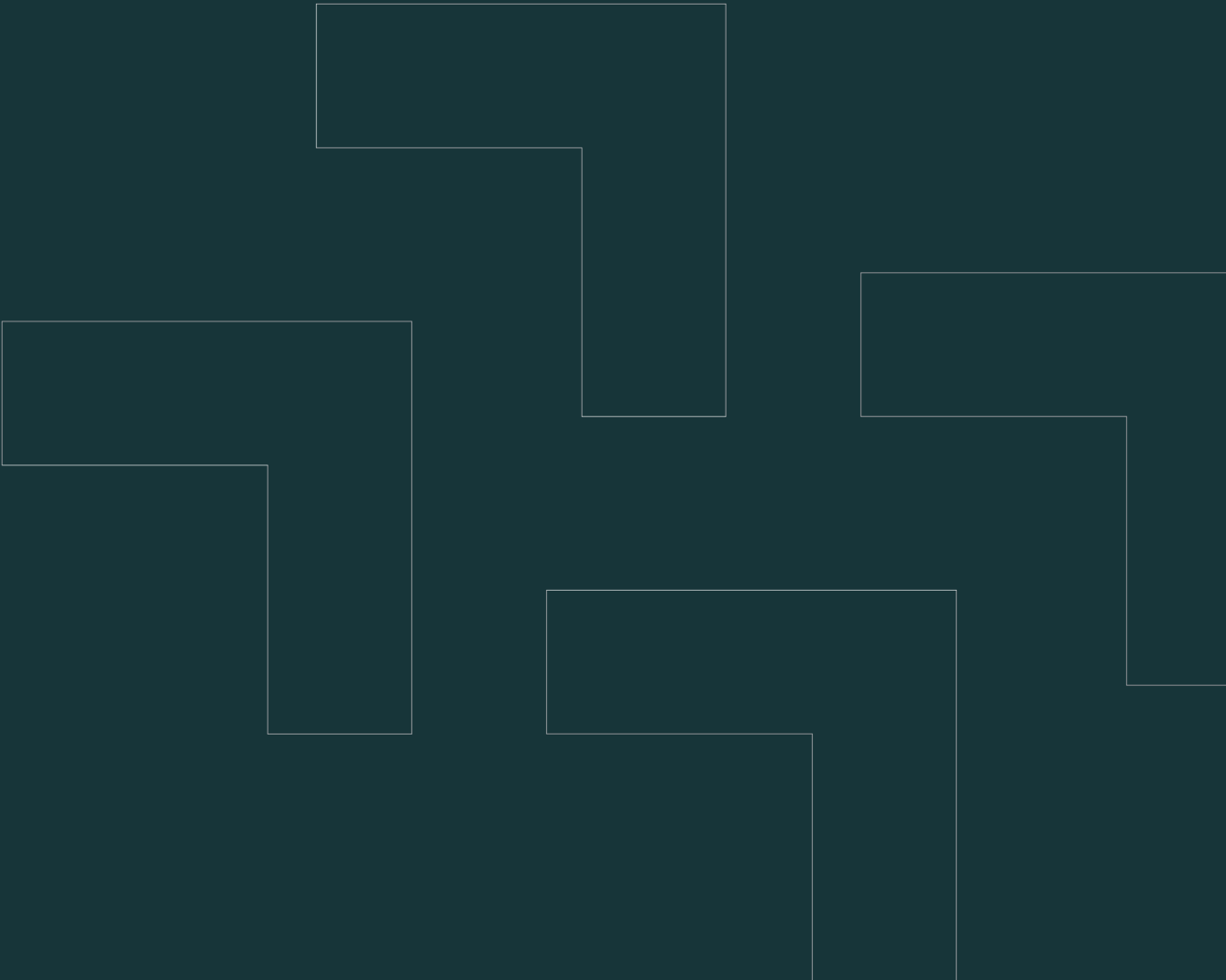
Targeted talent attraction and development efforts will be required to offset regional outmigration of workers.

One significant challenge facing the Central Coast across all sectors is the outmigration of the regional workforce. Data on migration by metropolitan statistical area (MSA)¹³ shows a trend toward the increased net out-migration of workers in both Central Coast counties, although there are important differences. Worker outflows in the San Luis Obispo MSA have been largely characterized by the departure of workers under 25 and are likely driven by the movement of college students. The overall trend in the Santa Barbara MSA is similarly downward but appears to be less tied to academic calendars. Following an upward trend in net in-migration of workers between 2017 and 2018, strong net out-migration since late 2019 has culminated in several thousand fewer workers in the region. Reversing this trend will be important to the health of the Central Coast economy.



¹³ A metropolitan statistical area (MSA) is a designation of the US Office of Management and Budget used by federal statistical agencies. MSAs are composed of one or more counties (or county equivalents, such as parishes) that meet specific thresholds (e.g., population size, share living in urban areas), and which have strong economic ties as illustrated by factors such as employment and commuting. Informal MSA names are used in this report to improve readability. For example, the San Luis Obispo-Paso Robles, CA, MSA is referred to simply as the San Luis Obispo MSA; Santa Barbara MSA is used rather than Santa Maria-Santa Barbara, CA, MSA.

SECTOR LANDSCAPE



SECTOR OVERVIEW

A relatively static part of human survival for millennia, agricultural practices first underwent dramatic change in the Industrial Revolution. Now in the Information Age, the winds of technological change are blowing once again as new innovations are seeping into the agricultural sector from all angles. These changes are global in nature, with California's Central Coast providing leadership as a new agricultural era emerges.¹⁴

TRENDS & DIRECTIONS

Advancements in technology that are completely unrelated to agricultural production are now finding practical applications within the sector. This cross-pollination has spread from renewable energy, LED lighting, broadband connectivity, robotics, phenotyping, gene editing, and data collection and processing. Recently a number of events have converged to speed this process, including climate change and pandemic-induced supply chain instability. Startup companies have emerged to address a number of specific challenges across all aspects of agricultural production, services, and inputs. Examples of technologies being applied to the sector include the following:

- + Drones, automated robotics, sensors, and spectral imaging to monitor plant and animal health.
- + Software and predictive analytics to aid with research, seasonal analysis, scenario modeling, and cost optimization.
- + Marketplace tools to provide new or creative distribution channels.
- + Bioscience innovations to improve seeds and chemicals.
- + Indoor food production methods such as rooftop greenhouses, vertical plant “factories,” and edible walls.
- + Approaches to water purification and reuse to aid water resiliency and drought management.

CENTRAL COAST

California's Central Coast lies at the forefront of advances in agricultural practices and the development and application of pioneering agtech innovations. Local companies that have emerged in recent years include FarmBot (hardware and software for small-scale precision food production), Acre Cloud (farm management software), Hortau (irrigation management), and TRIC Robotics (chemical-free pest control). Cuesta College offers courses in agriculture mechanics and majors in agriculture business and agriculture plant science, ensuring a steady flow of talent into the local ag sector. Allan Hancock College is developing career pathways in precision agriculture and crop protection under an NSF grant, with the goal of facilitating progression from high school through postsecondary, including transfer degrees to four-year degree programs.

Research centers at Cal Poly also provide an intellectual foundation to the region's agricultural innovations and advancements. These research centers include the following:

- + The Dairy Innovation Institute provides research, industry support, and technology transfer.
- + The Irrigation Training and Research Center is a center of excellence offering innovations in agricultural irrigation.

¹⁴ See the appendices for a list of resources that informed this section (Resources, page 43).

-
- + The Strawberry Center provides crop-specific research through primary programs in plant pathology, entomology, and automation.¹⁵
 - + The Center for Sustainability elevates public awareness through demonstration projects in composting, native plant landscaping, grazing management, beekeeping, and culinary arts.

Likewise, UC Santa Barbara offers a number of programs aimed at supporting agricultural advances including the following:

- + The Bren School of Environmental Science and Management is a multi-disciplinary graduate program focused on finding sustainable, data-driven solutions to pressing challenges in areas such as climate change, conservation, and sustainable water and agriculture.
- + Housed in the Department of Computer Science, the SmartFarm research project seeks to improve agricultural sustainability through the use of modern information technology and data analytics.
- + Understanding the food-energy-water (FEW) nexus will be essential to meeting global agricultural needs of the future and is one of three research themes underpinning the work of the Institute for Energy Efficiency.



Photo courtesy of UC Santa Barbara

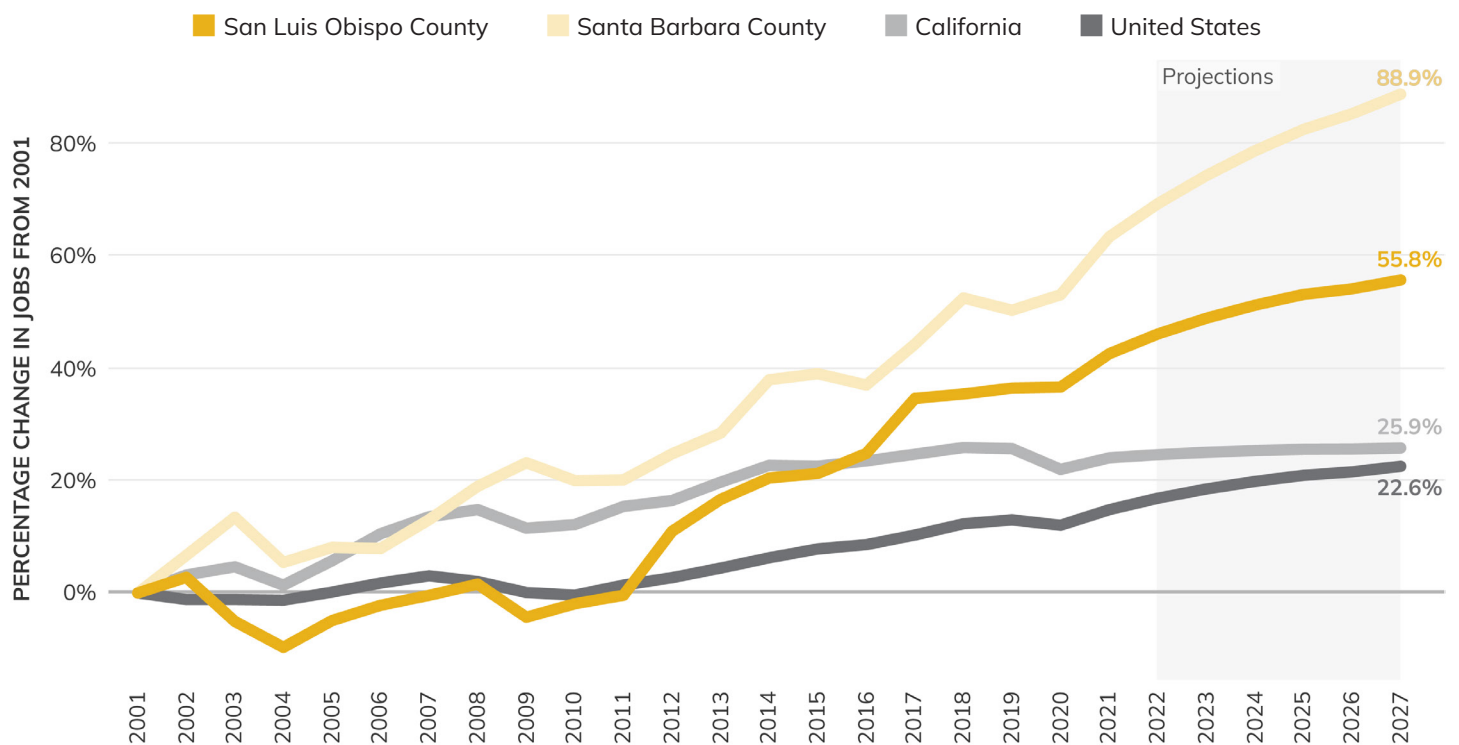
¹⁵ The Strawberry Center was recently awarded a [\\$1 million federal grant](#) in collaboration with the California Strawberry Commission and the US Department of Agriculture Agricultural Research Service. Funds will support sustainable food production by expanding research in strawberry automation and enhancing workforce development efforts.

EMPLOYMENT TRENDS

The Agriculture and Agtech sector accounts for roughly 35,000 jobs in the two Central Coast counties, representing just under 10 percent of the region’s total employment (9.2 percent). Employment in the sector encompasses a range of industries, including activities related to crop production, value-added processing, wholesaling, and professional services. Three out of four jobs in the sector as defined (75 percent) are located in the County of Santa Barbara. The single largest industry in the sector in 2022 was Crop Production (NAICS 111000)¹⁶ with more than 18,000 jobs on the Central Coast (or more than one-half of the sector’s total employment).

As shown in Figure 1, Agriculture and Agtech employment growth in the region has largely outpaced both the state and the US over the past two decades. This upward trend is expected to continue, according to Lightcast, with employment in the sector projected to increase an additional 10 percent on the Central Coast by 2027. Among industries with at least 100 jobs, the largest gains in percentage terms are projected for breweries, fertilizer manufacturing, selected merchant wholesalers, and specialized trucking. Growth rates in the County of Santa Barbara will drive overall gains in the sector. However, Agriculture and Agtech job growth in both counties is projected to outpace state and national rates, which are projected at 1 percent and 5 percent, respectively, during the period.

FIGURE 1. CENTRAL COAST EMPLOYMENT TRENDS IN AGRICULTURE AND AGTECH WITH COMPARISONS TO THE STATE AND US



Source(s): US Bureau of Labor Statistics (BLS); Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

Note(s): The Agriculture and Agtech sector includes 74 detailed industries (6-digit NAICS) which are listed in the appendices.

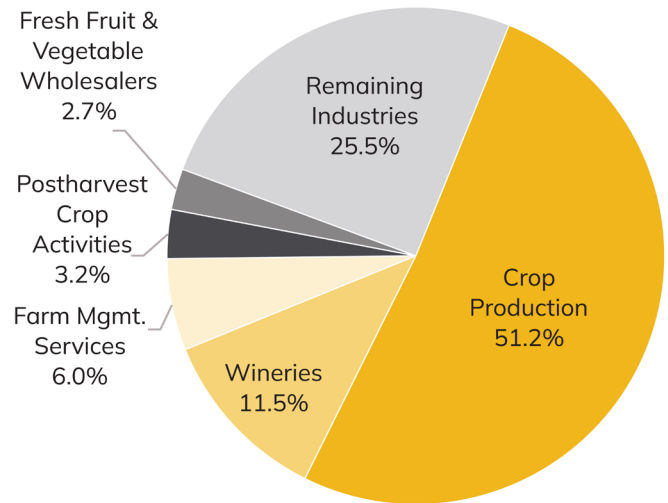
¹⁶ NAICS codes refer to the North American Industrial Classification System, the framework used by federal agencies to classify business establishments for statistical purposes. For additional information, see Classification Systems (page 42).

INDUSTRY DETAIL

Examining the distribution of the sector’s employment by detailed industry helps identify regional strengths. Within the Agriculture and Agtech sector, Crop Production (NAICS 111000) accounts for more than one-half of total employment (51.2 percent), with approximately 18,000 jobs. Employment in Wineries (NAICS 312130) represents the next largest industry with more than 4,000 jobs, or 11.5 percent of the sector’s employment. Only two other industries represent 1,000 or more jobs: Farm Management Services (115116), and Postharvest Crop Activities (except Cotton Ginning) (NAICS 115114), representing 6.0 percent and 3.2 percent, respectively, of Agriculture and Agtech employment in the two counties.

Understanding areas of specialization within the sector can point to areas where industry targeting efforts may be beneficial. Specialization is based on an analysis of location quotients (LQ), a commonly used method for comparing the concentration of employment in an area to national patterns (see box below). For this analysis, an LQ of 2.00 or higher was used to denote a very high level of concentration. Of the 28 industries in the Agriculture and Agtech sector with at least 100 jobs, the region is highly specialized in 14 of them, as shown in Figure 3 (page 12). The strength of the region’s winemaking cluster can be seen in the LQs for Farm Management Services, an industry focused on providing cultivating, harvesting or other support activities to citrus groves, orchards, or vineyards (41.32); Wineries (23.68); and Wine & Distilled Alcoholic Beverage Merchant Wholesaling (2.14).

FIGURE 2. DISTRIBUTION OF CENTRAL COAST EMPLOYMENT IN THE SECTOR BY DETAILED INDUSTRY (6-DIGIT NAICS LEVEL)



Source(s): US Bureau of Labor Statistics (BLS); Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.
Note(s): Total may not sum to 100 percent due to rounding.

LOCATION QUOTIENTS

A location quotient (LQ) analysis is a statistical technique used to highlight areas of relative concentration. LQs are typically calculated as an industry’s share of total local employment divided by the same industry’s share of employment at the national level. For example, if an industry represents 1 percent of US employment and 5 percent of local employment, its LQ would be 5.00, meaning that employment in the industry in the local area is five times as large as would be expected based on national patterns. An LQ of 1.25 or greater can suggest areas for targeting.

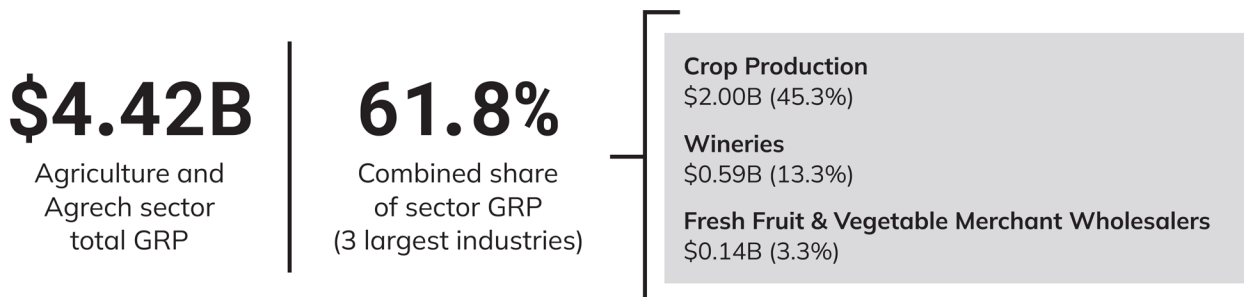
FIGURE 3. HIGHLY SPECIALIZED INDUSTRIES IN THE AGRICULTURE AND AGTECH SECTOR
CENTRAL COAST LQS BY DETAILED INDUSTRY (6-DIGIT NAICS LEVEL)

NAICS CODE	INDUSTRY	LQ	JOBS
115116	Farm Management Services	41.32	2,084
312130	Wineries	23.68	4,015
115113	Crop Harvesting, Primarily by Machine	17.81	546
111000	Crop Production	8.96	17,894
115112	Soil Preparation, Planting, & Cultivating	5.82	497
325314	Fertilizer (Mixing Only) Manufacturing	5.77	128
115114	Postharvest Crop Activities (except Cotton Ginning)	5.46	1,110
424590	Other Farm Product Raw Material Merchant Wholesalers	5.35	154
311411	Frozen Fruit, Juice, & Vegetable Manufacturing	4.34	296
424480	Fresh Fruit & Vegetable Merchant Wholesalers	4.33	931
424930	Flower, Nursery Stock, & Florists' Supplies Merchant Wholesalers	3.24	359
312120	Breweries	3.22	716
311942	Spice & Extract Manufacturing	2.29	141
424820	Wine & Distilled Alcoholic Beverage Merchant Wholesalers	2.14	456

Source(s): US Bureau of Labor Statistics (BLS); Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

Collectively, the dozens of industries that comprise the Agriculture and Agtech sector contributed \$4.42 billion to the Central Coast economy in 2022. Known as gross regional product (GRP), this metric represents the total market value of goods and services produced in an area and is commonly used to show the size and performance of the economy. When viewed at the industry level, Crop Production was the sector’s largest contributor, adding \$2 billion in value, or 45 percent of Agriculture and Agtech’s total GRP. Wineries accounted for an additional 13 percent (\$0.59 billion), followed by Fresh Fruit and Vegetable Merchant Wholesalers (\$0.14 billion, 3.3 percent), with the remaining industries accounting for 2 percent or less of GRP in the sector. At the state level, the Agriculture and Agtech sector added \$135.57 billion to the California economy (known as gross state product) in 2022.

FIGURE 4. GROSS REGIONAL PRODUCT (GRP) IN BILLIONS: AGRICULTURE AND AGTECH SECTOR
TOTAL GRP FOR THE SECTOR WITH SHARE REPRESENTED BY TOP THREE INDUSTRIES, 2022



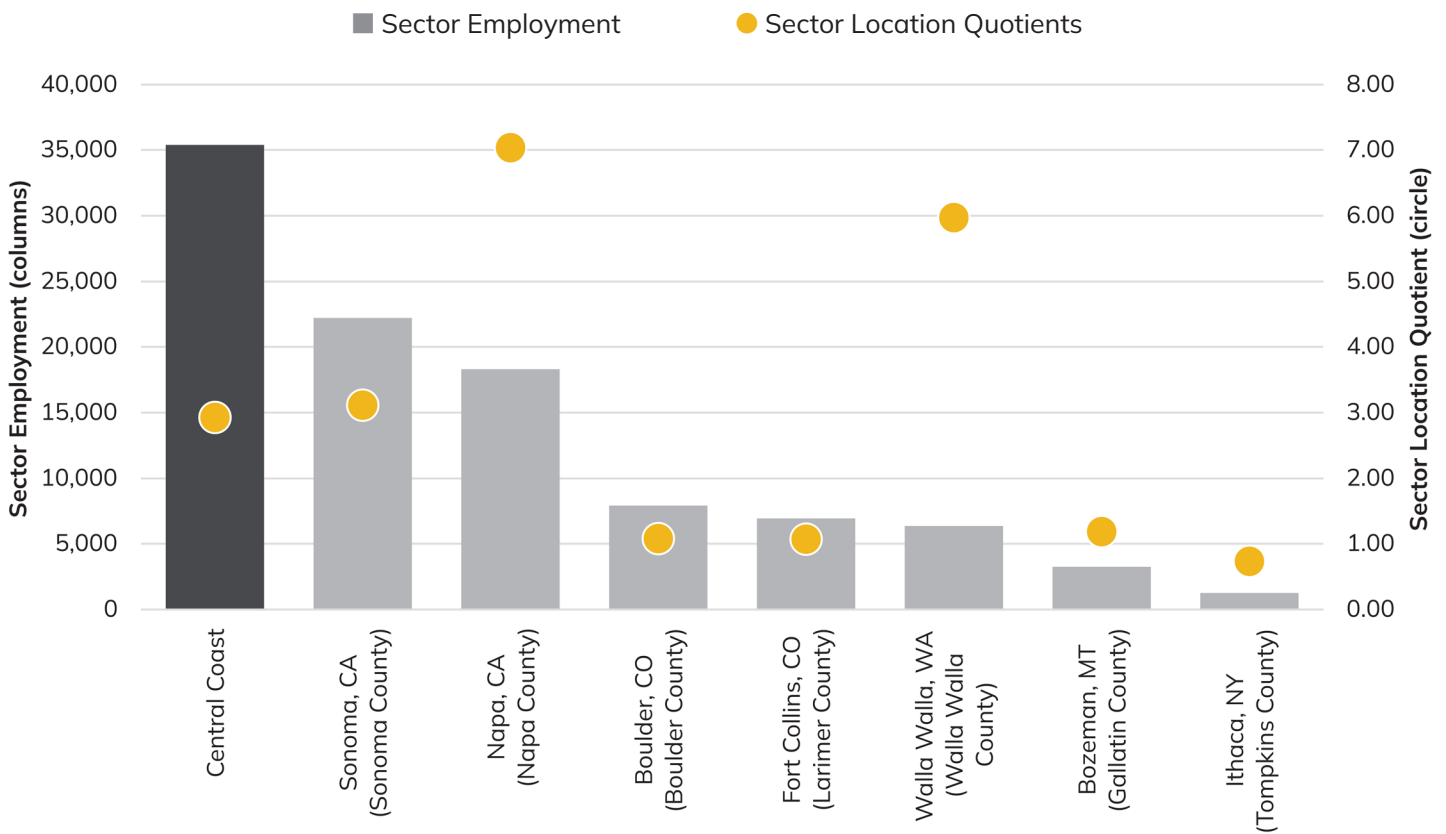
Source(s): Lightcast MR-SAM model, 2022.

Note(s): Total of top three industries may not sum to combined share due to rounding.

PEER METROS

The critical mass of agricultural activities on the Central Coast is notable, particularly when compared to agricultural peers across the US. Overall sector employment exceeds similar West Coast winemaking regions, including Napa and Sonoma in California, and Walla Walla in Washington. The Central Coast’s agricultural employment concentration, as measured by its location quotient, exceeds other lifestyle regions like Boulder, Colorado; Fort Collins, Colorado; and Bozeman, Montana, which are recognized for agtech and sustainability advancements. And most interesting, the Central Coast’s employment metrics far outpace Ithaca, New York, the home of Cornell University, which administers one the most widely respected agricultural departments in the world. A definition of location quotients (LQs) is featured on page 11.¹⁷

FIGURE 5. AGRICULTURE AND AGTECH EMPLOYMENT LEVELS AND CONCENTRATIONS
CENTRAL COAST AND SECTOR COMPARISONS FOR PEER COUNTIES, 2022



Source(s): US Bureau of Labor Statistics (BLS); Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

Note(s): The Sector Location Quotients (circle) represent the LQ for total employment in the sector as defined for this analysis. LQs above 1.00 indicate that the peer county’s employment in the sector comprises a larger share of its total employment than would be expected based on national patterns.

¹⁷ Regional peers were selected by TIP Strategies based on their alignment with business trends, industry development patterns, and academic drivers.

TALENT PIPELINE

Ensuring that the Agriculture and Agtech workforce is aligned with employer needs and that Central Coast residents are equipped to obtain desirable employment is essential to the health of the sector and the region. This section examines the current structure of the Agriculture and Agtech workforce, as well as the region's talent pipeline. The latter includes an analysis of recent job postings, a review of relevant degrees awarded by Central Coast postsecondary institutions, and a look at worker migration in associated industry sectors.

WORKFORCE COMPOSITION

The region's Agriculture and Agtech sector currently employs 35,000 workers with earnings per job of \$62,740.¹⁸ Just under two-thirds of the workforce (61 percent) is male. The age structure of the regional Agriculture and Agtech workforce largely mirrors the sector's statewide workforce; however, the racial and ethnic composition of the sector on the Central Coast is less diverse on average than the state. A demographic overview is provided in Figure 6 (page 15).

Looking at the composition of the sector's workforce by occupational classification, workers in the Farming, Fishing and Forestry Occupations group (SOC 45-0000)¹⁹ account for the largest share of Agriculture and Agtech jobs, with 38 percent of regional employment in the sector. When viewed at the detailed occupation level, Farmworkers and Laborers, Crop, Nursery and Greenhouse (SOC 45-2902) dominates employment, accounting for one in four (24 percent) of the region's Agriculture and Agtech jobs. With 14 percent of sector employment in the region, Farmers, Ranchers and Other Agricultural Managers (SOC 11-9013)²⁰ is the next largest occupation.

Among the sector's 10 largest occupations, all are expected to see job gains on the Central Coast in the coming years, based on Lightcast's projections. Agricultural Equipment Operators (SOC 45-2091) are projected to experience the largest growth (26 percent) between 2022 and 2027. By contrast, Sales Representatives, Wholesale and Manufacturing, Except Technical and Scientific Products (SOC 41-4012) occupations are expected to see the smallest gains among the top 10, with a projected 9 percent job growth during the period.

Most of Agriculture and Agtech's largest occupations do not require a formal educational credential. A few, such as Heavy and Tractor-Trailer Truck Drivers (SOC 53-3032), require the completion of a certificate program or other non-degree award. The sector's size and the lack of formal training required to gain employment provide an option for entry-level workers in the region.

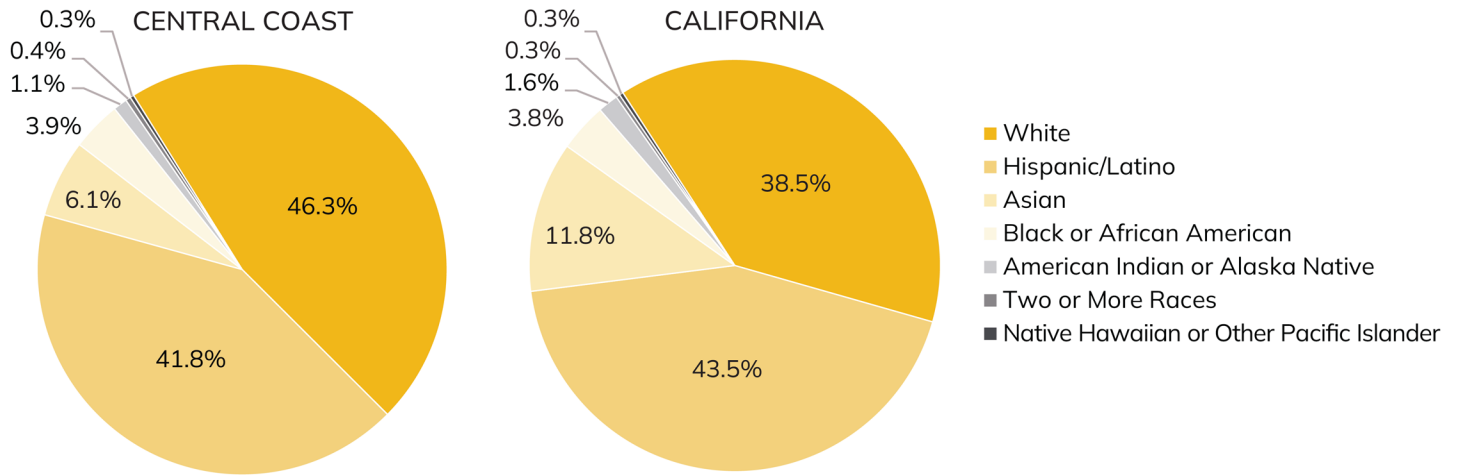
¹⁸ Earnings per jobs is the total industry earnings divided by the number of jobs in the industry. It encompasses a wide range of occupations across all the detailed industries in the sector. As a result, it is not comparable to measures like median hourly earnings, which is calculated for a single occupation or group of related occupations.

¹⁹ Capitalized occupation names and SOC codes shown in this report refer to the Standard Occupational Classification system, the framework used by federal agencies to classify workers into occupational categories for statistical purposes. See Classification Systems (page 42) for more information.

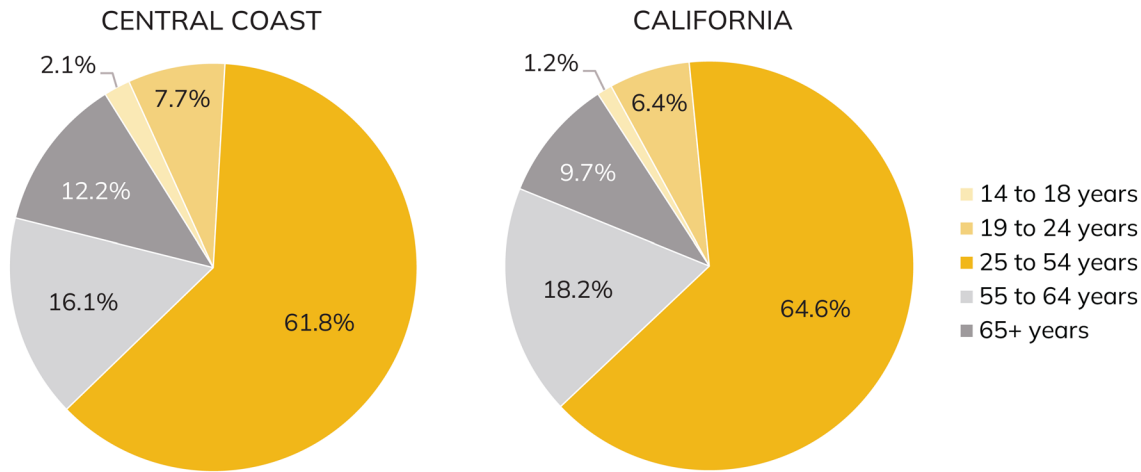
²⁰ Under the SOC system, positions are classified by job duties, as well as specialized skills and education and training requirements. For this reason, farmers, ranchers, and agricultural managers are part of the Management Occupations group (11-0000).

FIGURE 6. DEMOGRAPHIC OVERVIEW OF THE AGRICULTURE AND AGTECH SECTOR

RACE/ETHNICITY



AGE



GENDER



Source(s): Lightcast.

Note(s): Totals may not sum to 100 percent due to rounding. Racial and ethnic groups reflect a social interpretation of race or ethnicity based on self-identification.

EMPLOYER DEMAND

An analysis of job postings issued by Central Coast employers over a 12-month period (February 2022 to February 2023) provides a real-time understanding of the skills, qualifications, and educational requirements of the sector. Companies competing for talent in the region based on this analysis include homegrown powerhouses like Apeel Sciences, Firestone Walker Brewing Company, Hardy Diagnostics, and Jordano’s as well as merchandising roles aimed at advancing the brands and operations of global giants like Keurig Dr Pepper, PepsiCo, and The Coca-Cola Company even though they do not have a corporate office in the region.

Based on the more than 2,000 job postings issued during the period analyzed, demand in the region is largely driven by crop production, wineries, and retailing of agricultural products. Among the top 15 occupations in the Agriculture and Agtech hiring pipeline—the “in-demand” occupations shown in Figure 7 (page 17)—positions related to sales and marketing, transportation and material moving, and office and administrative work dominate. As noted, one of the sector’s largest occupations, farm workers, are not well represented in job postings data. However, the analysis provides important insight for workforce development efforts about the other occupations that play a role in the sector and that are in demand by employers. These include the truck drivers that transport agricultural products, the administrative roles that support both small and large employers across multiple sectors, and sales and merchandising roles that are a liaison between producers and retailers.



A look at median hourly earnings reveals that more than one-third of the in-demand occupations fall below the regional median of \$20.41. Retail workers and warehouse positions were among the lowest earning, while management positions and engineering-related jobs fall well above the Central Coast median. Many of the sector's low-earning occupations, like Retail Salespersons (SOC 41-2031) and Laborers & Material Movers, Hand (SOC 53-7062) are also among the largest occupations in terms of employment. When earnings are compared against living wage standards, only a handful of occupations being sought by Agriculture and Agtech employers at the time of this analysis paid enough to sustain a household with two adults and two children.²¹

FIGURE 7. IN-DEMAND OCCUPATIONS IN THE AGRICULTURE AND AGTECH SECTOR
ANALYSIS OF JOB POSTINGS BY SECTOR EMPLOYERS FROM FEBRUARY 2022-FEBRUARY 2023 WITH A COMPARISON TO FIVE-YEAR EMPLOYMENT TRENDS ON THE CENTRAL COAST (2016-2021)

DESCRIPTION	SHARE OF POSTINGS*	2016	2021	PERCENT CHANGE	MEDIAN HOURLY EARNINGS
Merchandise Displayers & Window Trimmers	9.2%	217	257	18.4%	\$17.26
Heavy & Tractor-Trailer Truck Drivers	4.5%	1,995	2,542	27.4%	\$23.51
Sales Reps, Non-Technical & Scientific Products	4.2%	2,308	2,063	-10.6%	\$30.11
Laborers & Material Movers, Hand	3.7%	3,452	6,887	99.5%	\$18.12
Customer Service Representatives	3.0%	2,737	2,607	-4.7%	\$18.54
Managers, All Other	2.6%	1,207	1,920	59.1%	\$54.86
Sales Managers	2.2%	1,107	1,491	34.7%	\$51.94
Retail Salespersons	2.0%	8,845	7,157	-19.1%	\$14.58
Maintenance & Repair Workers, General	1.9%	3,172	3,312	4.4%	\$22.32
Bookkeeping, Accounting, & Auditing Clerks	1.7%	4,001	3,729	-6.8%	\$22.80
Secretaries & Administrative Assistants, All Other	1.7%	5,661	4,115	-27.3%	\$22.19
Stockers & Order Fillers	1.5%	3,588	4,095	14.1%	\$14.91
Industrial Engineering Technicians	1.4%	66	119	80.3%	\$37.72
Fallers	1.2%	5	5	0.0%	—
Production Workers, All Other	1.2%	532	609	14.5%	\$18.08
<i>Top Occupations Related to Agriculture & Agtech</i>	42.2%	38,893	40,908	5.2%	\$24.16
Central Coast Total Occupations (All Industries)		342,628	356,225	4.0%	\$20.41

*Share of Central Coast job postings among the 74 detailed industries defining the Agriculture and Agtech target in the 12-month period from February 2022 through February 2023.

Source(s): BLS; Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

Note(s): The top 15 occupations by their share of regional job postings accounting for 42.2 percent of total job postings define the key occupations for the Agriculture and Agtech target. Median hourly earnings are in 2021 USD and represent the Central Coast median for the occupation. Shaded values exceed the regional median for all Central Coast occupations.

²¹ Based on the [Living Wage Calculator](#) developed by Dr. Amy K. Glasmeier and the Massachusetts Institute of Technology. At the time of analysis, the living wage on the Central Coast for two adults (one working) with two children was \$46.47 per hour.

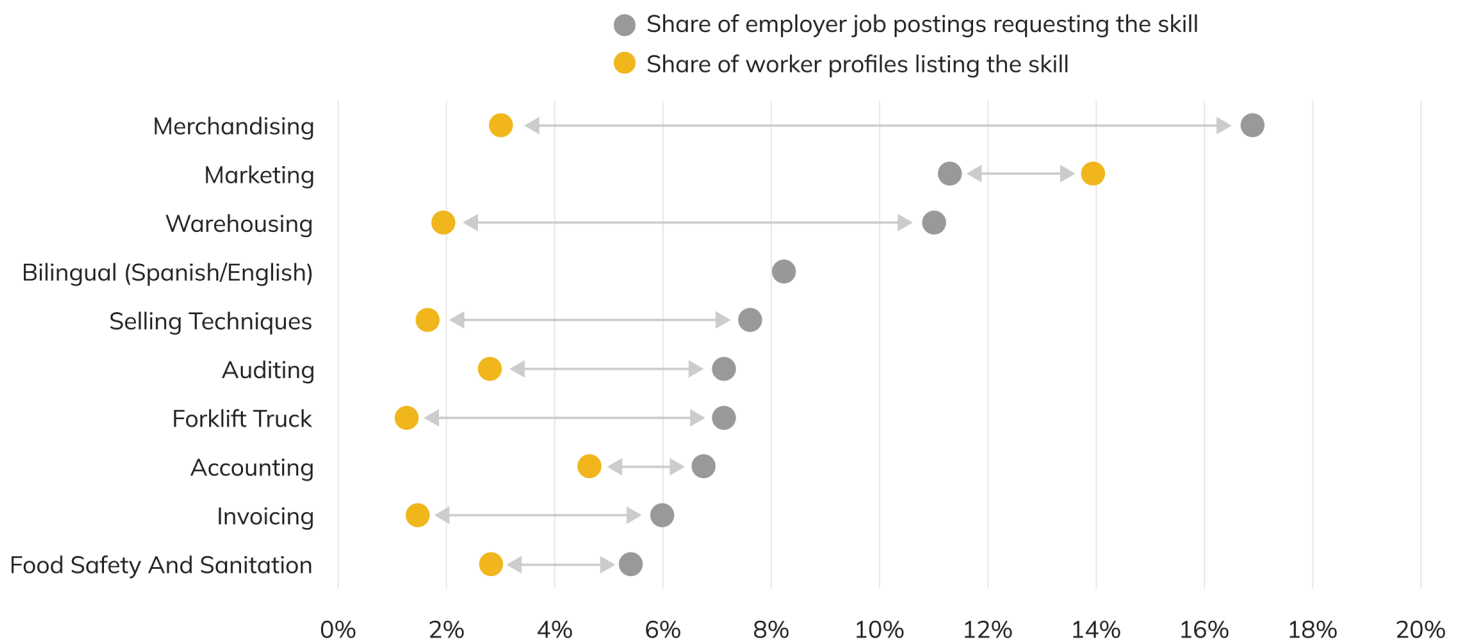
SKILLS & REQUIREMENTS

Specialized skills sought by Agriculture and Agtech employers that are hiring in the region include merchandising, marketing, and warehousing. An examination of skills that are shared across jobs reveals a similar focus on selling, with sales and customer service among the most common basic skills listed among those hiring in the sector. Requested qualifications were minimal, with a valid driver’s license being the most frequent requirement for employment, followed by commercial driver’s license (Class A CDL), and forklift certification. As employers in the sector seek to gain efficiency, software skills are becoming increasingly relevant. Similar to other sectors, experience with Microsoft Office programs, such as Excel and PowerPoint, are the most frequently requested software skills for Agriculture and Agtech positions.

One way to illustrate the gap between the demand for a skill and the supply is to compare job postings (employer demand) with worker profiles (potential workforce). By this measure, there are large gaps between the in-demand specialized skills in the Agriculture and Agtech sector and the availability of those skills among the Central Coast workforce (Figure 8). Only marketing, accounting, and food safety and sanitation are relatively closely aligned, with modest gaps (less than 3 percent) between employer demand for the skill and its availability in the workforce. The largest gap can be seen in merchandising, the most frequently requested specialized skill found in job postings by Agriculture and Agtech employers. For this skill, the share of job postings surpasses the frequency of profiles mentioning this skill by nearly 14 percent.

FIGURE 8. TOP 10 SPECIALIZED SKILLS IN THE AGRICULTURE AND AGTECH SECTOR RELATIVE TO THEIR AVAILABILITY IN THE WORKFORCE*

ANALYSIS OF JOB POSTINGS BY SECTOR EMPLOYERS FROM FEBRUARY 2022-FEBRUARY 2023



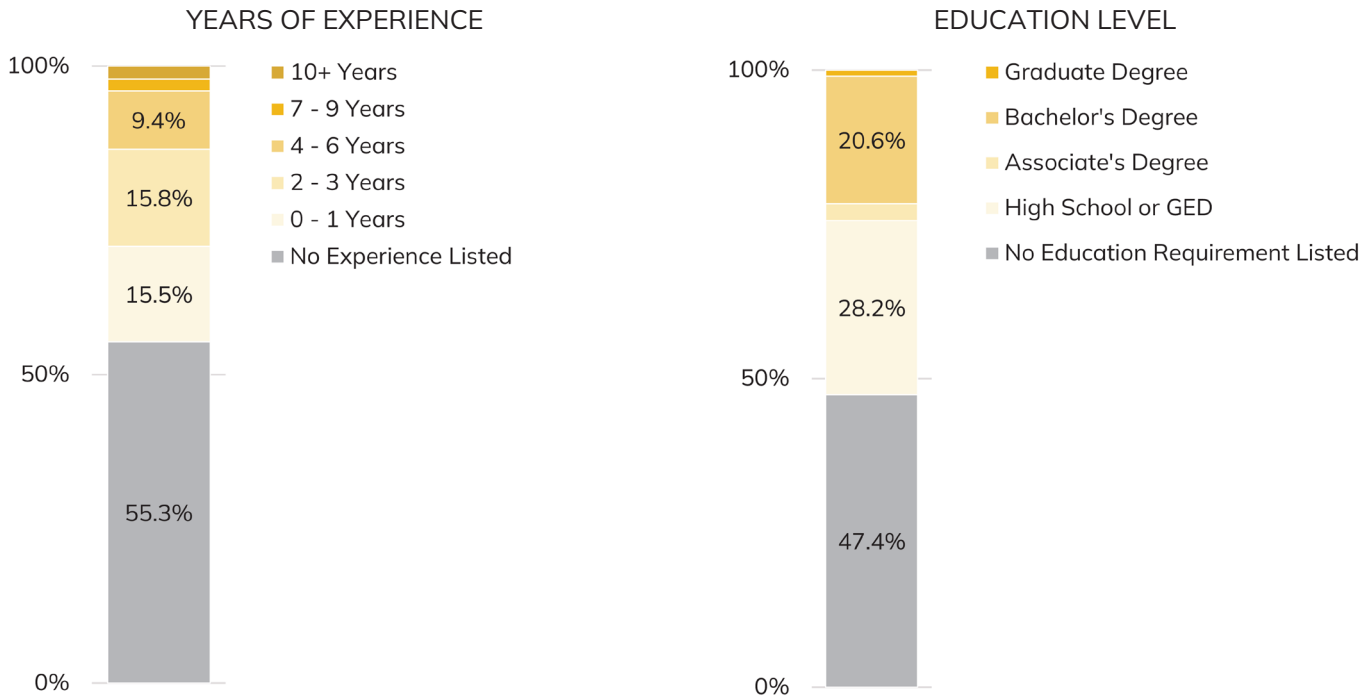
*Worker profile data was not reported for bilingual (Spanish/English) skills.

Source(s): BLS; Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

Note(s): Lightcast’s worker profiles represent self-reported, publicly available information compiled from sources including third-party resume databases and job boards, the recruiting industry, opt-in data from employers and applicant tracking systems, sales and marketing CRM databases, and various consumer/identity databases. Profiles are standardized, de-duplicated, and normalized by Lightcast to facilitate analysis.

Job postings also provide an understanding of the education and experience levels local employers are seeking. Just over one-half (55.3 percent) of positions posted by regional employers in the Agriculture and Agtech sector did not require any experience.²² Slightly less than one-half of postings analyzed did not list any minimum level of education, and roughly one in four were open to job seekers with a high school diploma or equivalency. Slightly more than 20 percent of Agriculture and Agtech job postings required a bachelor's degree or higher.

FIGURE 9. EMPLOYER REQUIREMENTS: AGRICULTURE AND AGTECH SECTOR
ANALYSIS OF JOB POSTINGS BY SECTOR EMPLOYERS FROM FEBRUARY 2022-FEBRUARY 2023



Source(s): US Bureau of Labor Statistics (BLS); Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

Note(s): Includes non-staffing, unique, active job postings for full-time, part-time, and flexible positions between February 2022 and February 2023. Total may not sum to 100 percent due to rounding.

²² The lack of stated experience and education requirements in a job posting does not mean that no requirements exist, simply that none were specified.

DEGREES & AWARDS

Central Coast postsecondary institutions granted just over 30,000 degrees and awards for credit²³ in 2021 across all fields of study, with the region's two public universities—UC Santa Barbara and Cal Poly—accounting for nearly one-half (46 percent) of the total. A table showing the full distribution of awards by institution is provided in the appendices (see Figure 20, page 36).

A look at this data for fields of study relevant to the Agriculture and Agtech sector illustrates the potential supply of talent. The region's postsecondary institutions issued an average of 675 awards in Agriculture, Agriculture Operations, and Related Sciences (CIP 01)²⁴ each academic year between 2017 and 2021. The bulk of the awards made in the most recent year (89 percent) were granted by Cal Poly. Bachelor's degrees comprise the vast majority of awards granted across this field of study, accounting for nearly 9 out of every 10 degrees awarded in the topic during the 2021 academic year. Associate's degrees²⁵ and awards of less than one year were issued by the region's community colleges: Allan Hancock College, Cuesta College, and Santa Barbara City College.

The top five detailed programs in the broad Agriculture, Agriculture Operations, and Related Sciences field of study are shown in Figure 10 (page 21). These detailed programs include Animal Sciences, General (CIP 01.0901), which represented 25 percent of agriculture-related awards in 2021; Agribusiness/Agricultural Business Operations (CIP 01.0102), accounting for 24 percent; and Viticulture and Enology (CIP 01.1004) with 12 percent of the total.

Occupations related to these program areas include the following:

- + Farmers, Ranchers, and Other Agricultural Managers (SOC 11-1903)
- + Farmworkers, Crop, Nursery and Greenhouse (SOC 45-2092)
- + First-Line Supervisors, Farming, Fishing, and Forestry (SOC 45-1011)
- + Landscaping and Groundskeeping Workers (SOC 37-3011)
- + Agricultural Equipment Operators (SOC 45-2091)

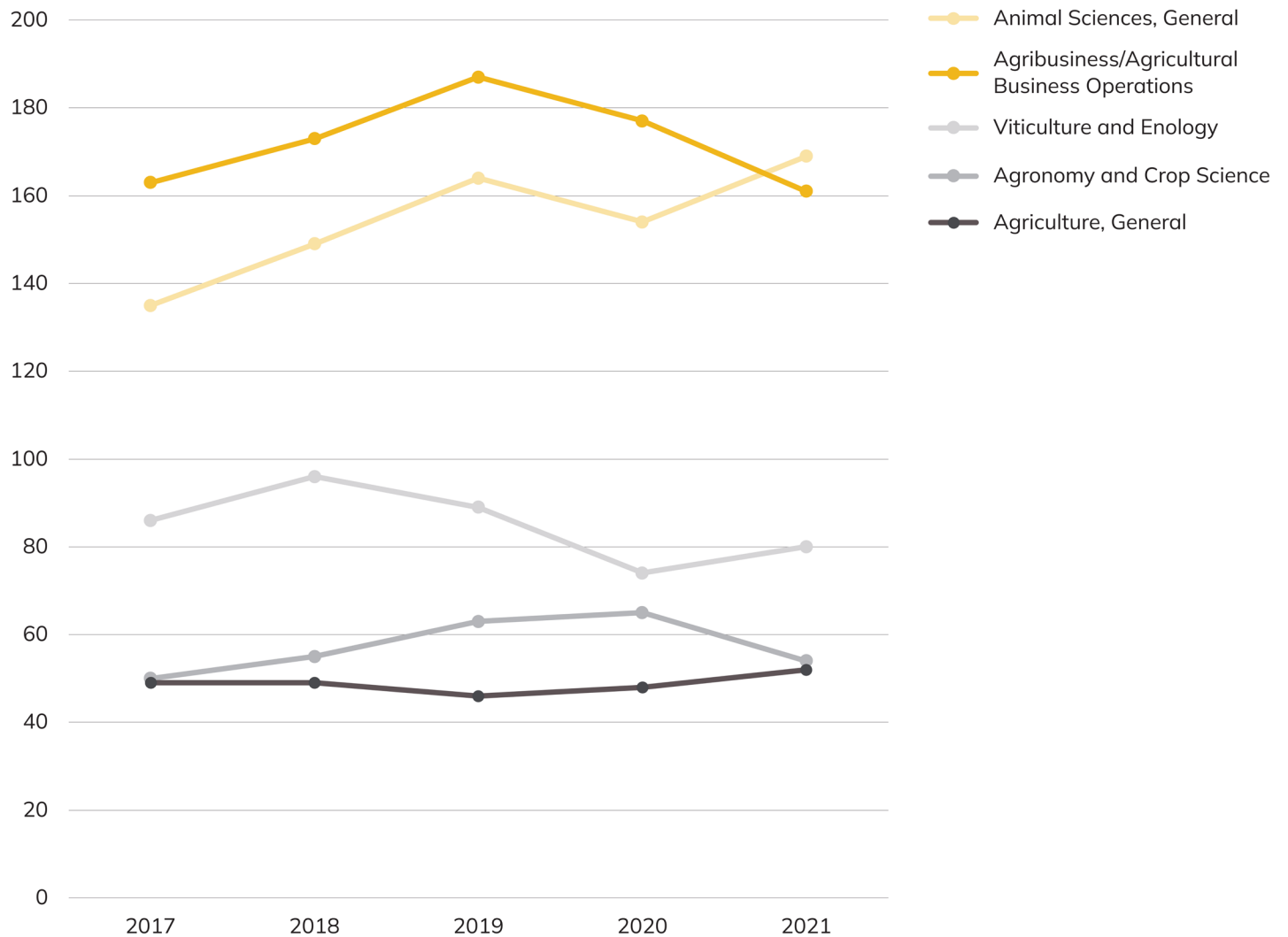
Beyond agriculture, other fields of study that could impact the sector's workforce include Biological and Biomedical Sciences (CIP 26, with 1,196 awards in 2021) and Natural Resources and Conservation (CIP 03, with 623 awards). As technology becomes increasingly integrated into all occupations, supporting fields of study include Computer and Information Sciences and Support Services (CIP 11), with 630 awards granted in the region in 2021.

²³ The federal dataset used in this analysis reports on awards and degrees conferred as part of a formal course of study. [Recognized postsecondary credentials](#) (typically [designated](#) as certificates eligible to be recorded on a transcript) are also included.

²⁴ CIP codes, shown in parentheses, refer to the Classification of Instructional Programs (CIP), the framework developed by the National Center for Education Statistics to categorize completions (degrees and awards granted for credit by eligible postsecondary institutions) within broad, generalized categories for tracking and analytical purposes. Additional information on this classification system can be found in the appendices (see Classification Systems, page 42).

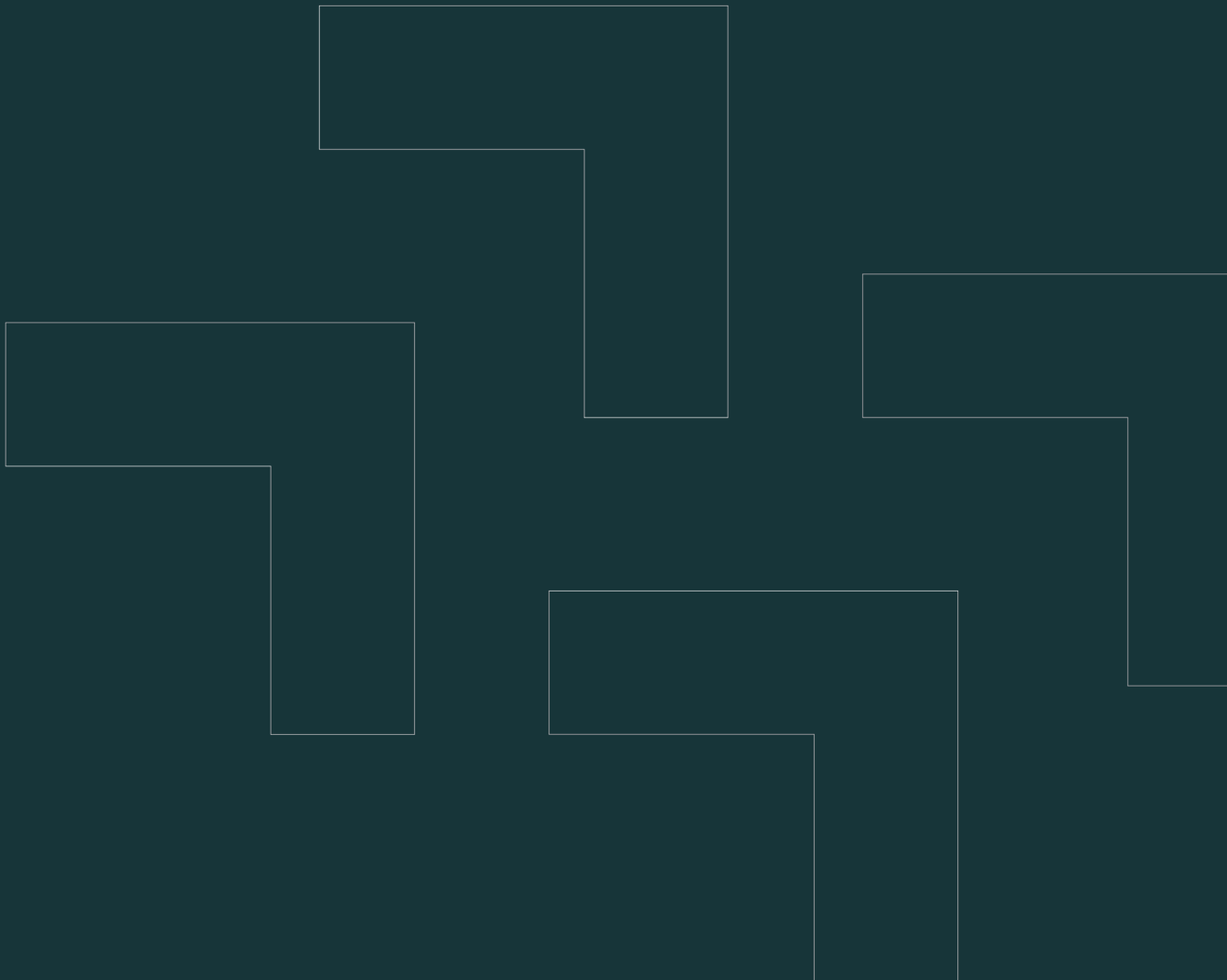
²⁵ Associate's degrees include certificates earned in more than one year and less than four.

FIGURE 10. AWARDS IN SELECTED AGRICULTURE-RELATED FIELDS OF STUDY, 2017 TO 2021
 NUMBER OF AWARDS MADE IN TOP FIVE DETAILED PROGRAM AREAS



Source(s): National Center for Education Statistics (NCES), Integrated Postsecondary Education Data System (IPEDS); Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

ECONOMIC IMPACT



ECONOMIC IMPACT ANALYSIS

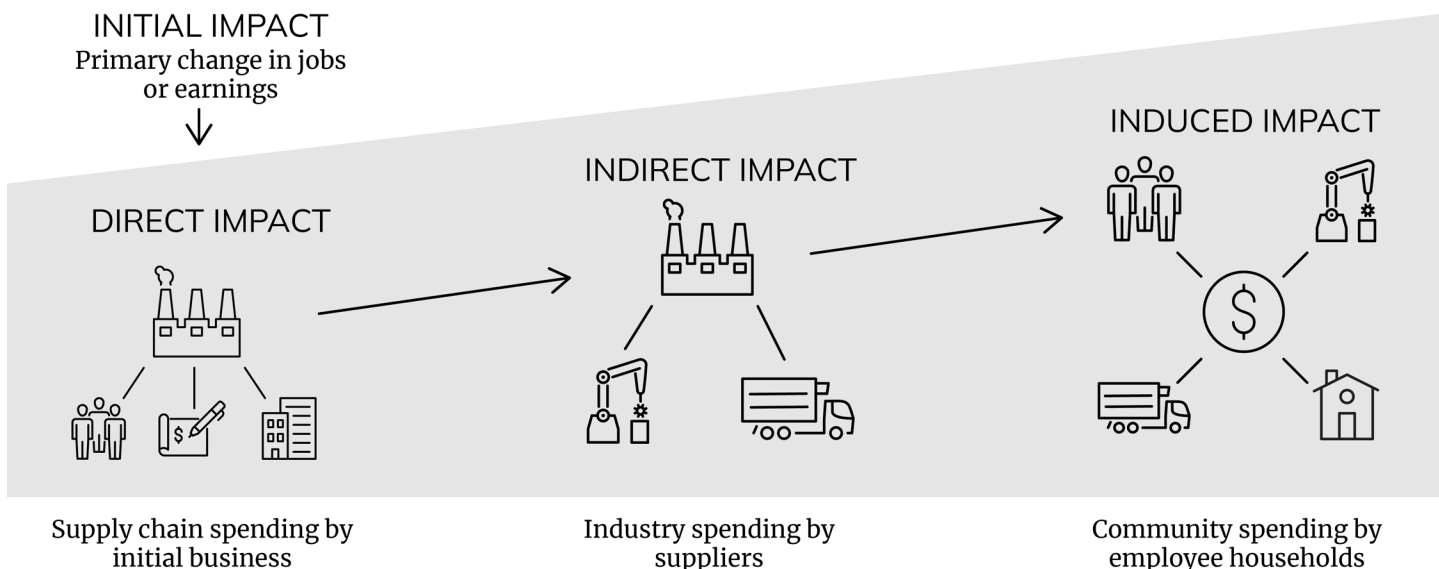
When new businesses are attracted to the Central Coast, or an existing business expands its operations, the regional economy is affected through several mechanisms. These mechanisms include spending on land, buildings, or equipment (capital expenditures); costs associated with hiring workers; revenues generated through the sales of goods and services; and the payment of taxes.

Economic impact analysis provides a tool for understanding how this new economic activity—spending on buildings, equipment, hiring, supplies, materials and so on—ripples through the economy. These ripples occur across all industries in the economy and can be described as one of the following four types of effects:

- + **Initial effect.** The initial shock to the economy caused by the initial purchases.
- + **Direct effect.** Additional activity that occurs as impacted industries spend money in their supply chain industries.
- + **Indirect effect.** Additional shocks as the supply chain industries generate more activity through their inter-industry spending.
- + **Induced effect.** Economic activity created by the household sector as businesses raise salaries or hire more people.

Impacts across these four categories can be measured in terms of changes to employment (the number of full- and part-time jobs required to support the change in activity), changes to sales (a measure of the business revenue generated by increased economic activity), and changes to total income (including labor income, or earnings, and non-labor income received from investments). Figure 11 provides an illustration of the types of impacts.

FIGURE 11. ILLUSTRATION OF RIPPLE EFFECTS OF INITIAL ECONOMIC IMPACT
RIPPLE EFFECTS OF INITIAL ECONOMIC IMPACT



Source(s): TIP Strategies, Inc., illustration of Lightcast's economic impact approach.

METHODOLOGY

Economic impact analysis relies on a complex methodology known as input-output (IO) modeling. In simplest terms, IO models use national data on inter-industry relationships to look at how increased demand in one industry translates to economic activity across all industries. Demand is typically stated in terms of increased sales, earnings, or employment in the industry in question. Regardless of the type of demand used in the analysis—sales, earnings, or jobs—the model uses these complex inter-industry relationships to translate the increased demand into economic impacts across those same indicators. In other words, a scenario in which the anticipated demand is stated as an increase in employment can show the estimated impacts in jobs, as well as in sales or earnings. IO analysis also produces multipliers for these indicators that can be used to estimate the potential impact of a future change in economic activity.

IO modeling is often used to run scenarios in order to understand the impact a new employer might have on regional demand for other industries. If an automaker were to build a new manufacturing facility, for example, the affected industries would include inputs from obvious suppliers (like manufacturers of automotive parts, electronic components, and tires) as well as less apparent goods and services (like logistics operators, advertisers, machinery repair services, and property maintenance) along with the purchases made by these suppliers. As might be expected, the extent to which an industry's purchases are made from suppliers in the region or are imported from firms outside the region can have a major influence on its economic impact. As a result, IO models are calibrated to account for this factor.²⁶

Each round of spending, first by the automaker (the initial effects), then by its suppliers (the direct effects), and its suppliers' suppliers (the indirect effects) also translates to increased demand for labor, both for the automaker and for companies throughout the supply chain. As illustrated in Figure 11 (page 23), this increased demand for goods, services, and labor ripples across the economy again as workers in all industries spend their earnings at local businesses (the induced effects).

As stated, IO models typically use jobs, earnings, or sales as the starting point for economic impact analysis. In the automotive plant example, the regional economic impact can be modeled based on the number of new jobs created by the automaker, the earnings associated with those new jobs, or the expected sales (calculated from the anticipated number of new vehicles produced annually). Likewise, model results can be reported for those same categories.

Lightcast's analysis of the economic impact of the Agriculture and Agtech sector presented in this section measures impacts in terms of the change in jobs and labor income (earnings). While other models focus on sales (or output), Lightcast's IO model, which is described in detail in the appendices, uses income because it provides a more meaningful measure of new economic activity. Unlike sales, which include the costs associated with producing goods and services (such as the cost of labor and materials), income is a net measure that excludes these intermediary costs.²⁷

²⁶ Estimates of in-region and imported purchases for the Central Coast region are provided in Figure 19 (page 35).

²⁷ The value in this approach is supported by economists' use of gross domestic product when considering the growth of national economies, as this measure represents the final value of goods and services after the costs of goods has been subtracted.

Five-year projections of job growth by detailed industry prepared by Lightcast were used as the starting point to model Agriculture and Agtech’s economic impact on the Central Coast economy.²⁸ To reflect the potential contribution that proactive business retention, expansion, and recruitment efforts targeted on the sector could make to regional job growth, Lightcast’s proprietary five-year projection was increased by 10 percent.²⁹ This approach resulted in a total initial figure of 6,651 jobs used to model the sector’s direct, indirect, and induced effects on employment and labor income (earnings). Figure 12 provides a summary of the results of this scenario, including an estimate of the change in tax revenues resulting from growth in the sector³⁰ as well as jobs and earnings multipliers.

RESULTS

Based on Lightcast’s analysis, the addition of 6,651 jobs in this sector through 2027 (the initial impact) would result in another 5,937 jobs from direct, indirect, and induced effects, for a total change of 12,588 jobs. The additional employment gain (5,937 jobs) represents the sum of impacts generated by spending in the industry’s supply chain (direct), additional purchases in the suppliers’ supply chain (indirect), and consumption of goods and services by households of workers in the industry (induced). Stated another way, each job in the Agriculture and Agtech sector supports roughly one additional job on the Central Coast, for a total jobs multiplier of 1.89. Likewise, each dollar earned by workers in the sector generates an additional 93 cents in earnings for workers in other sectors (for an earnings multiplier of 1.93). The remainder of this section presents additional details about the impacts.

FIGURE 12. ECONOMIC IMPACT OF THE AGRICULTURE AND AGTECH SECTOR
SCENARIO: PROJECTED JOB GAINS IN THE SECTOR FROM 2022 TO 2027, PLUS 10 PERCENT

EMPLOYMENT & EARNINGS					
	INITIAL	DIRECT	INDIRECT	INDUCED	TOTAL
Jobs (Number)	6,651	2,193	730	3,014	12,588
Jobs (Multiplier)	1.00	0.33	0.11	0.45	1.89
Earnings (in Millions \$US)	\$388.36	\$128.95	\$42.33	\$189.53	\$749.17
Earnings (Multiplier)	1.00	0.33	0.11	0.49	1.93
TAX REVENUES					
	LOCAL	STATE	FEDERAL	TOTAL	
Added Tax Revenues (in Millions \$US)	\$51.76	\$43.18	\$23.72	\$118.65	

Source(s): Lightcast MR-SAM model, 2022.

Note(s): The model output contains decimal points which are rounded to whole numbers. As a result, figures may not sum to the total shown.

²⁸ Because Lightcast’s IO model captures economic activity at the 6-digit NAICS level, all inputs to the model (jobs, sales, or earnings), must correspond to that industry level. For this work, the initial jobs number represents the sum of the projected job growth, plus 10 percent, for each of the 74 industries included in the Agriculture and Agtech sector definition (see Figure 15, page 29). Where industries were projected to lose jobs, Lightcast assumed that all jobs were retained.

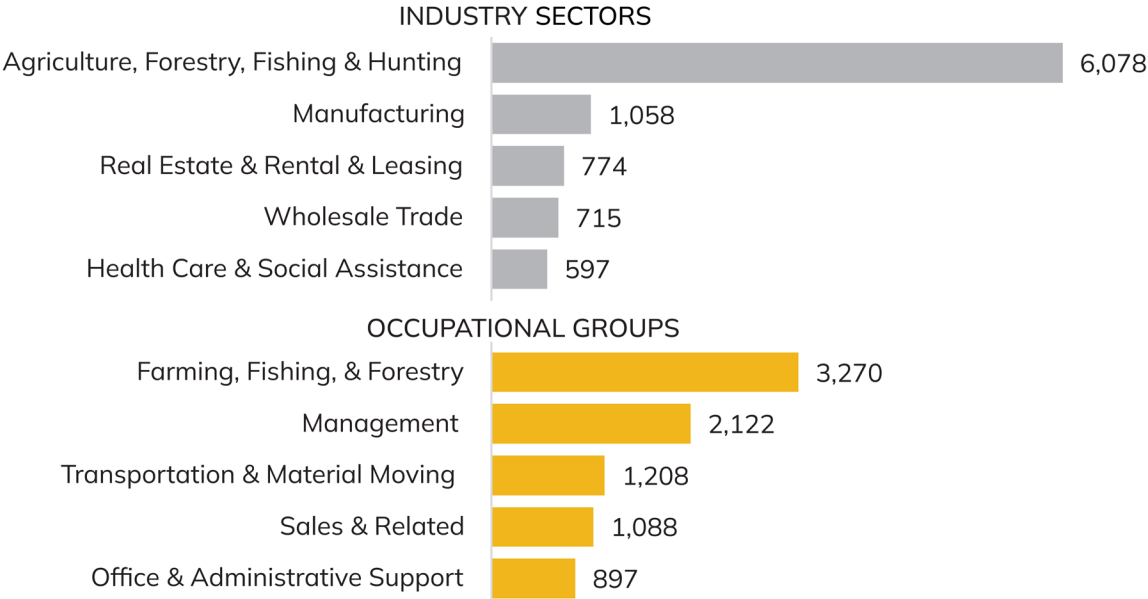
²⁹ Model assumptions, including the 10 percent increase in job growth over initial projections, were determined by Lightcast based on their understanding of economic conditions, expected industry trends, and regional objectives in support of the target sectors.

³⁰ Data represent taxes on production and imports (TPI). The analysis estimates the tax implications of adding jobs in the sector by measuring the change in local, state, and federal tax revenue through increased industry sales, specifically general sales and property taxes. This change in tax revenue corresponds to the ripple effects of job creation and cannot be tied to a specific timeframe. See the Glossary (page 40) for more information on TPI.

Agriculture and Agtech’s employment impact stretches across all sectors of the economy. Figure 13 looks at the largest expected change in jobs by industry and occupation. Not surprisingly, the largest effects from growth in Agriculture and Agtech employment are seen in the Agriculture, Forestry, Fishing and Hunting sector (NAICS 11). Of the total job impact estimated in Lightcast’s analysis, just over 6,000 jobs (48 percent) are in this sector. The Manufacturing sector, with just over 1,000 jobs, accounts for the next largest share, at roughly 8 percent of the anticipated jobs impact.

Likewise, when industry impacts are translated to occupations (using Lightcast’s regional staffing patterns data), Farming, Fishing, and Forestry occupations (SOC 45) experience the largest increase in jobs, followed by Management occupations (SOC 11), a group that includes farmers and ranchers. Transportation and Material Moving occupations (SOC 53) and Sales and Related occupations (SOC 41) would also get a boost, reflecting the central role these positions play in the Agriculture and Agtech sector.

FIGURE 13. LARGEST EMPLOYMENT IMPACTS FROM AGRICULTURE & AGTECH JOB CREATION SCENARIO
 TOP FIVE INDUSTRY SECTORS (2-DIGIT NAICS LEVEL) AND OCCUPATIONAL GROUPS AFFECTED



Source(s): Lightcast MR-SAM model, 2022.

Job growth in the region will also lead to an increase in earnings, thanks to the extra spending of new employees and the ripple effect these purchases create. The increase in Agriculture and Agtech jobs in Lightcast’s impact scenario would add \$749.2 million dollars in earnings to the Central Coast economy. The majority of the earnings impact—more than \$325 million, amounting to 43 percent of the total—would occur in the Agriculture, Forestry, Fishing and Hunting sector (NAICS 11). Additional earnings in Manufacturing (NAICS 31-33) and Wholesale Trade (NAICS 42) round out the three largest contributors to earnings from job creation in the sector. Additional details are provided in the appendices.

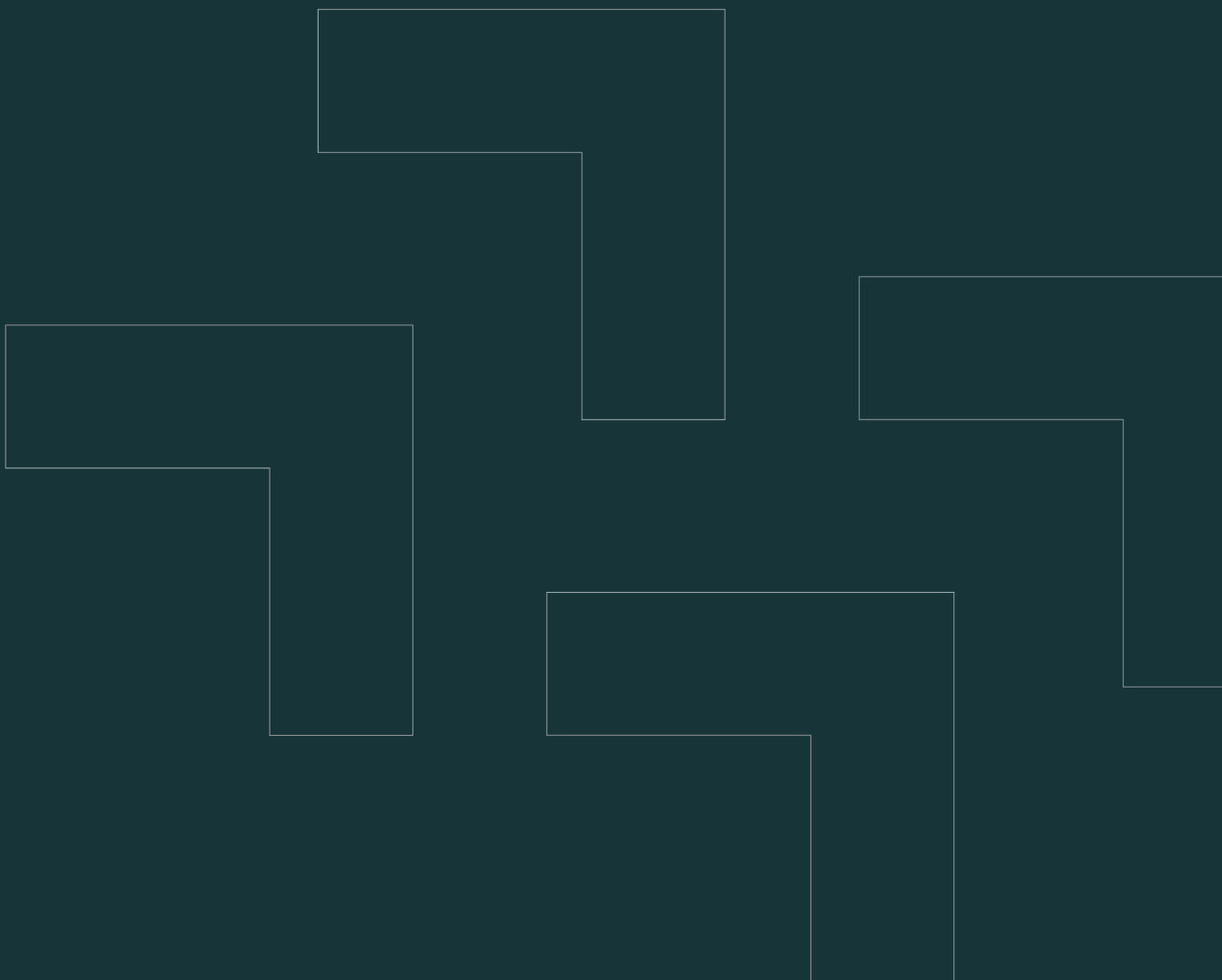
FIGURE 14. LARGEST EARNINGS IMPACTS FROM AGRICULTURE AND AGTECH JOB CREATION SCENARIO
TOP THREE INDUSTRY SECTORS (2-DIGIT NAICS LEVEL) AFFECTED



Source(s): Lightcast MR-SAM model, 2022.



APPENDICES



SUPPORTING DETAIL

SECTOR DEFINITION

The table below represents the detailed industries that comprise the definition of the Agriculture and Agtech sector agreed upon at the outset of the study. It forms the basis of all analyses and exhibits presented in this report. It is based on the North American Industrial Classification System (NAICS), the framework used by federal agencies to classify business establishments for statistical purposes. The identified industries are mutually exclusive across the sectors analyzed in the four studies (i.e., no detailed industry appears in the definition of more than one sector).

FIGURE 15. INDUSTRIES COMPRISING THE AGRICULTURE AND AGTECH SECTOR
6-DIGIT NAICS LEVEL

NAICS CODE	INDUSTRY
111000	Crop Production
112000	Animal Production
113210	Forest Nurseries and Gathering of Forest Products
115112	Soil Preparation, Planting, and Cultivating
115113	Crop Harvesting, Primarily by Machine
115114	Postharvest Crop Activities (except Cotton Ginning)
115116	Farm Management Services
311211	Flour Milling
311212	Rice Milling
311213	Malt Manufacturing
311221	Wet Corn Milling
311224	Soybean and Other Oilseed Processing
311225	Fats and Oils Refining and Blending
311340	Nonchocolate Confectionery Manufacturing
311351	Chocolate and Confectionery Manufacturing from Cacao Beans
311352	Confectionery Manufacturing from Purchased Chocolate
311411	Frozen Fruit, Juice, and Vegetable Manufacturing
311412	Frozen Specialty Food Manufacturing
311421	Fruit and Vegetable Canning
311422	Specialty Canning
311423	Dried and Dehydrated Food Manufacturing
311511	Fluid Milk Manufacturing
311512	Creamery Butter Manufacturing
311513	Cheese Manufacturing
311514	Dry, Condensed, and Evaporated Dairy Product Manufacturing

continued next page

FIGURE 15. INDUSTRIES COMPRISING THE AGRICULTURE AND AGTECH SECTOR (CONTINUED)

NAICS CODE	INDUSTRY
311520	Ice Cream and Frozen Dessert Manufacturing
311812	Commercial Bakeries
311813	Frozen Cakes, Pies, and Other Pastries Manufacturing
311821	Cookie and Cracker Manufacturing
311824	Dry Pasta, Dough, and Flour Mixes Manufacturing from Purchased Flour
311830	Tortilla Manufacturing
311911	Roasted Nuts and Peanut Butter Manufacturing
311919	Other Snack Food Manufacturing
311920	Coffee and Tea Manufacturing
311930	Flavoring Syrup and Concentrate Manufacturing
311941	Mayonnaise, Dressing, and Other Prepared Sauce Manufacturing
311942	Spice and Extract Manufacturing
311991	Perishable Prepared Food Manufacturing
311999	All Other Miscellaneous Food Manufacturing
312111	Soft Drink Manufacturing
312112	Bottled Water Manufacturing
312113	Ice Manufacturing
312120	Breweries
312130	Wineries
312140	Distilleries
325311	Nitrogenous Fertilizer Manufacturing
325312	Phosphatic Fertilizer Manufacturing
325314	Fertilizer (Mixing Only) Manufacturing
325320	Pesticide and Other Agricultural Chemical Manufacturing
325411	Medicinal and Botanical Manufacturing
333111	Farm Machinery and Equipment Manufacturing
333112	Lawn and Garden Tractor and Home Lawn and Garden Equipment Manufacturing
333241	Food Product Machinery Manufacturing
423820	Farm and Garden Machinery and Equipment Merchant Wholesalers
424410	General Line Grocery Merchant Wholesalers
424420	Packaged Frozen Food Merchant Wholesalers
424430	Dairy Product (except Dried or Canned) Merchant Wholesalers
424450	Confectionery Merchant Wholesalers
424480	Fresh Fruit and Vegetable Merchant Wholesalers
424490	Other Grocery and Related Products Merchant Wholesalers
424510	Grain and Field Bean Merchant Wholesalers
424590	Other Farm Product Raw Material Merchant Wholesalers

continued next page

FIGURE 15. INDUSTRIES COMPRISING THE AGRICULTURE AND AGTECH SECTOR (CONTINUED)

NAICS CODE	INDUSTRY
424810	Beer and Ale Merchant Wholesalers
424820	Wine and Distilled Alcoholic Beverage Merchant Wholesalers
424910	Farm Supplies Merchant Wholesalers
424930	Flower, Nursery Stock, and Florists' Supplies Merchant Wholesalers
424940	Tobacco and Tobacco Product Merchant Wholesalers
484220	Specialized Freight (except Used Goods) Trucking, Local
484230	Specialized Freight (except Used Goods) Trucking, Long-Distance
493130	Farm Product Warehousing and Storage
541614	Process, Physical Distribution, and Logistics Consulting Services
541690	Other Scientific and Technical Consulting Services
541714	Research and Development in Biotechnology (except Nanobiotechnology)
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance

Source(s): REACH; Lightcast; TIP Strategies, Inc.

DETAILED IMPACTS

The following tables provide additional detail regarding the anticipated effects on the Central Coast economy by industry (employment and earnings) and by occupation (employment) associated with Lightcast's economic impact analysis.

FIGURE 16. IMPACT OF AGRICULTURE AND AGTECH JOB CREATION BY INDUSTRY

2-DIGIT NAICS LEVEL

NAICS CODE	INDUSTRY SECTOR	CHANGE IN JOBS
11	Agriculture, Forestry, Fishing and Hunting	6,078
31	Manufacturing	1,058
53	Real Estate and Rental and Leasing	774
42	Wholesale Trade	715
62	Health Care and Social Assistance	597
56	Administrative and Support and Waste Management and Remediation Services	415
81	Other Services (except Public Administration)	411
72	Accommodation and Food Services	378
48	Transportation and Warehousing	362
54	Professional, Scientific, and Technical Services	338
23	Construction	300
44	Retail Trade	275
90	Government	247
52	Finance and Insurance	245
61	Educational Services	122
71	Arts, Entertainment, and Recreation	111
51	Information	80
55	Management of Companies and Enterprises	53
21	Mining, Quarrying, and Oil and Gas Extraction	16
22	Utilities	14
TOTAL		12,589

Source(s): Lightcast MR-SAM model, 2022.

Note(s): Figures represent detailed outputs from the economic impact modeling process and do not correspond to a specific point in time. NAICS codes refer to the North American Industrial Classification System, the framework used by federal agencies to classify business establishments for statistical purposes. The model output contains decimal points which were rounded to whole numbers. As a result, figures may not sum to the total shown in Figure 12 (page 25).

FIGURE 17. IMPACT OF AGRICULTURE AND AGTECH JOB CREATION BY OCCUPATION
2-DIGIT SOC LEVEL

SOC CODE	OCCUPATION	CHANGE IN JOBS
45-0000	Farming, Fishing, and Forestry Occupations	3,270
11-0000	Management Occupations	2,122
53-0000	Transportation and Material Moving Occupations	1,208
41-0000	Sales and Related Occupations	1,088
43-0000	Office and Administrative Support Occupations	897
51-0000	Production Occupations	512
35-0000	Food Preparation and Serving Related Occupations	499
13-0000	Business and Financial Operations Occupations	485
37-0000	Building and Grounds Cleaning and Maintenance Occupations	383
49-0000	Installation, Maintenance, and Repair Occupations	336
39-0000	Personal Care and Service Occupations	290
47-0000	Construction and Extraction Occupations	251
31-0000	Healthcare Support Occupations	239
29-0000	Healthcare Practitioners and Technical Occupations	234
27-0000	Arts, Design, Entertainment, Sports, and Media Occupations	183
25-0000	Educational Instruction and Library Occupations	154
19-0000	Life, Physical, and Social Science Occupations	108
15-0000	Computer and Mathematical Occupations	107
17-0000	Architecture and Engineering Occupations	73
21-0000	Community and Social Service Occupations	61
33-0000	Protective Service Occupations	55
23-0000	Legal Occupations	27
99-0000	Unclassified Occupations	5
55-0000	Military-only Occupations	0
TOTAL		12,587

Source(s): Lightcast MR-SAM model, 2022.

Note(s): Figures represent detailed outputs from the economic impact modeling process and do not correspond to a specific point in time. SOC codes refer to the Standard Occupational Classification system, the framework used by federal agencies to classify workers into occupational categories for statistical purposes. The model output contains decimal points which were rounded to whole numbers. As a result, figures may not sum to the total shown in Figure 12 (page 25).

**FIGURE 18. IMPACT OF AGRICULTURE AND AGTECH JOB CREATION ON INDUSTRY EARNINGS (IN MILLIONS)
2-DIGIT NAICS LEVEL**

NAICS	INDUSTRY SECTOR	INITIAL	DIRECT	INDIRECT	INDUCED	TOTAL
11	Agriculture, Forestry, Fishing and Hunting	\$267.78	\$52.73	\$4.01	\$1.04	\$325.57
31	Manufacturing	\$65.51	\$3.96	\$0.67	\$3.12	\$73.26
42	Wholesale Trade	\$40.45	\$11.77	\$1.47	\$3.51	\$57.19
53	Real Estate and Rental and Leasing	\$0.00	\$27.42	\$7.00	\$9.30	\$43.72
62	Health Care and Social Assistance	\$0.00	\$0.15	\$0.07	\$43.42	\$43.64
54	Professional, Scientific, and Technical Services	\$0.35	\$4.87	\$5.81	\$18.27	\$29.30
90	Government	\$0.00	\$0.82	\$0.44	\$24.29	\$25.55
23	Construction	\$0.00	\$1.45	\$2.07	\$17.54	\$21.05
52	Finance and Insurance	\$0.00	\$3.75	\$4.59	\$12.29	\$20.63
48	Transportation and Warehousing	\$9.43	\$5.53	\$1.53	\$2.77	\$19.26
56	Administrative and Support and Waste Management and Remediation Services	\$0.00	\$3.81	\$6.90	\$6.31	\$17.02
81	Other Services (except Public Admin.)	\$4.84	\$2.16	\$1.23	\$8.62	\$16.86
72	Accommodation and Food Services	\$0.00	\$0.68	\$1.28	\$11.28	\$13.25
44	Retail Trade	\$0.00	\$1.50	\$0.40	\$10.57	\$12.47
55	Management of Companies and Enterprises	\$0.00	\$4.81	\$2.30	\$3.19	\$10.30
51	Information	\$0.00	\$1.08	\$1.15	\$6.85	\$9.09
61	Educational Services	\$0.00	\$0.10	\$0.13	\$3.46	\$3.69
71	Arts, Entertainment, and Recreation	\$0.00	\$0.25	\$0.61	\$2.56	\$3.43
22	Utilities	\$0.00	\$1.33	\$0.51	\$0.67	\$2.51
21	Mining, Quarrying, and Oil and Gas Extraction	\$0.00	\$0.78	\$0.15	\$0.46	\$1.38
TOTAL		\$388.36	\$128.95	\$42.33	\$189.53	\$749.17

Source(s): Lightcast MR-SAM model, 2022.

Note(s): Figures represent detailed outputs from the economic impact modeling process and do not correspond to a specific point in time. NAICS codes refer to the North American Industrial Classification System, the framework used by federal agencies to classify business establishments for statistical purposes. Initial, direct, indirect, and induced impacts may not sum to total due to rounding.

IN-REGION & IMPORTED PURCHASES

In-region and imported purchases are important characteristics of the region's industry composition and an integral part of economic impact modeling. In-region purchases describe the purchases a given industry makes from another industry in the region analyzed. Imported purchases describe purchases that occur outside the determined region to meet the local demand. Taken together, these purchases represent the industry's supply chain.

When looking at the Central Coast, the top three NAICS sectors with the highest percentage of in-region purchases are Real Estate and Rental and Leasing (purchasing 92.3 percent in-region), followed by Accommodation and Food Services (90.7 percent), and Agriculture, Forestry, Fishing and Hunting (83 percent). This level of purchasing indicates the region has the ability to supply most of the demand within those industries. At the other end of the spectrum, sectors with the greatest percentage of imported purchases are Manufacturing, with 81.7 percent of purchases being imported to the region, followed by Utilities (73.9 percent), and Mining, Quarrying, Oil and Gas extraction, (73 percent).

FIGURE 19. IN-REGION AND IMPORTED PURCHASES BY NAICS SECTOR, 2021 (IN MILLIONS)
TOP THREE INDUSTRY SECTORS BY SHARE OF IN-REGION AND IMPORTED PURCHASES ARE HIGHLIGHTED

NAICS CODE	PURCHASES FROM	IN-REGION	% IN-REGION	IMPORTED	% IMPORTED	TOTAL
90	Government	\$3,849.65	52.1%	\$3,545.00	47.9%	\$7,394.65
31	Manufacturing	\$877.00	18.3%	\$3,919.96	81.7%	\$4,796.96
53	Real Estate and Rental and Leasing	\$2,854.07	92.3%	\$239.29	7.7%	\$3,093.35
54	Professional, Scientific, and Technical Services	\$1,795.60	62.6%	\$1,072.52	37.4%	\$2,868.12
52	Finance and Insurance	\$1,586.79	56.8%	\$1,207.31	43.2%	\$2,794.10
56	Administrative and Support and Waste Management and Remediation Services	\$1,590.61	69.6%	\$693.20	30.4%	\$2,283.81
42	Wholesale Trade	\$617.53	33.0%	\$1,251.67	67.0%	\$1,869.20
51	Information	\$913.91	51.5%	\$860.52	48.5%	\$1,774.44
48	Transportation and Warehousing	\$441.10	29.6%	\$1,050.31	70.4%	\$1,491.41
23	Construction	\$1,112.68	74.8%	\$375.01	25.2%	\$1,487.68
55	Management of Companies and Enterprises	\$881.68	62.7%	\$525.01	37.3%	\$1,406.69
22	Utilities	\$185.55	26.1%	\$525.49	73.9%	\$711.04
11	Agriculture, Forestry, Fishing and Hunting	\$547.39	83.0%	\$112.10	17.0%	\$659.49
44	Retail Trade	\$241.49	40.1%	\$360.03	59.9%	\$601.52
72	Accommodation and Food Services	\$383.45	90.7%	\$39.31	9.3%	\$422.76
81	Other Services (except Public Administration)	\$285.46	74.4%	\$98.16	25.6%	\$383.62
21	Mining, Quarrying, and Oil and Gas Extraction	\$100.41	27.0%	\$271.48	73.0%	\$371.90
71	Arts, Entertainment, and Recreation	\$96.06	61.6%	\$59.77	38.4%	\$155.83
62	Health Care and Social Assistance	\$92.42	72.8%	\$34.62	27.2%	\$127.04
61	Educational Services	\$46.86	43.6%	\$60.63	56.4%	\$107.50

Source(s): Lightcast MR-SAM model, 2022.

DEGREES & AWARDS DETAIL

Figure 20 presents the distribution of degrees and awards conferred for credit by the region’s institutions of higher education in all fields of study during the 2021 academic year. Roughly one in four awards (26.2 percent) were made by UC Santa Barbara. For Cal Poly, this figure was closer to one in five (19.8 percent). Taken together, the region’s three community colleges accounted for nearly one-half (48.7 percent) of all awards.

**FIGURE 20. TOTAL AWARDS CONFERRED BY CENTRAL COAST POSTSECONDARY INSTITUTIONS
ALL FIELDS OF STUDY, 2021 ACADEMIC YEAR**

INSTITUTION	INSTITUTION (GROUP)	AWARDS	
University of California, Santa Barbara	Public Universities	7,875	26.2%
California Polytechnic State University, San Luis Obispo (Cal Poly)	Public Universities	5,951	19.8%
Cuesta College	Community Colleges	5,408	18.0%
Santa Barbara City College	Community Colleges	4,676	15.5%
Allan Hancock College	Community Colleges	4,577	15.2%
Fielding Graduate University	Specialized Graduate Institutions	356	1.2%
Westmont College	Private Universities	350	1.2%
Pacifica Graduate Institute	Specialized Graduate Institutions	215	0.7%
International Sports Sciences Association	Career & Technical Institutions	142	0.5%
Laurus College	Career & Technical Institutions	129	0.4%
Antioch University-Santa Barbara	Private Universities	127	0.4%
Center for Employment Training-Santa Maria	Career & Technical Institutions	73	0.2%
Design's School of Cosmetology	Career & Technical Institutions	51	0.2%
San Joaquin Valley College-Atascadero	Career & Technical Institutions	47	0.2%
Central California School of Continuing Education	Career & Technical Institutions	41	0.1%
San Joaquin Valley College-Santa Maria	Career & Technical Institutions	38	0.1%
Santa Barbara Business College-Santa Maria	Career & Technical Institutions	32	0.1%
The Santa Barbara and Ventura Colleges of Law at Santa Barbara	Specialized Graduate Institutions	10	0.0%
TOTAL		30,098	100.0%

Source(s): National Center for Education Statistics (NCES), Integrated Postsecondary Education Data System (IPEDS); Lightcast 2022.4—QCEW Employees, Non-QCEW Employees, and Self-Employed; TIP Strategies, Inc.

Note(s): Only includes general programs with at least 25 average annual completions between 2010 and 2021.

WORKER MIGRATION

A review of migration data by metropolitan statistical area (MSA)³¹ shows a trend toward the increased net out-migration³² of workers in both Central Coast counties. In the San Luis Obispo MSA,³³ this trend is driven by the departure of workers under 25. While this flow is likely driven by college students, a net flow of nearly 700 workers across education levels departed the county in the second quarter of 2021—the sharpest single-quarter decline in a decade. The overall trend in the Santa Barbara MSA is similarly downward but appears to be less tied to academic calendars. Following an upward trend in net in-migration of workers between 2017 and 2018, strong net out-migration since late 2019 has culminated in several thousand fewer workers in the region.

As shown in Figure 21 (page 38) and Figure 22 (page 39), net flows of workers by industry are fairly balanced in both Central Coast counties. Industry sectors with the strongest net out-migration in both counties also tend to be those with relatively low wages, such as food services, retail trade, and administrative support. Both counties have seen modest net in-migration of healthcare workers.

While not an exact match with the Agriculture and Agtech sector that is the focus of this report, both counties experience wide swings in the flow of workers in the Agriculture, Forestry, Fishing, and Hunting industry sector (NAICS 11), reflecting the seasonal nature of the workforce. Even bearing in mind its cyclical nature, the region is experiencing a net downward trend in terms of the net outflow of agricultural workers.

A look at the top destinations for out-migration (regardless of industry) reveals the Central Coast is primarily losing workers to other California locations.

- + On balance, the San Luis Obispo MSA tends to lose young workers (those under 25) to San Francisco, San Jose, and San Diego, while gaining workers with less-than-bachelor's education from MSAs including Santa Barbara, Bakersfield, and Los Angeles. Looking at destinations outside California, young workers in the San Luis Obispo MSA are drawn to the Pacific Northwest, Phoenix, or Las Vegas. Young workers from the Santa Barbara MSA migrate to similar areas of California, although Austin and Dallas appear among the top destinations at different points during the period analyzed.
- + Migration patterns for young adults in both San Luis Obispo and Santa Barbara are, of course, heavily biased by the presence of Cal Poly and UC Santa Barbara. However, a more even distribution of net out-migration across education levels to San Luis Obispo and San Jose suggests that seasoned workers are leaving the Santa Barbara MSA rather than a trend driven by college-age workers leaving for opportunity, as is seen in San Luis Obispo. Santa Barbara also attracts workers of all education levels from greater Los Angeles.³⁴

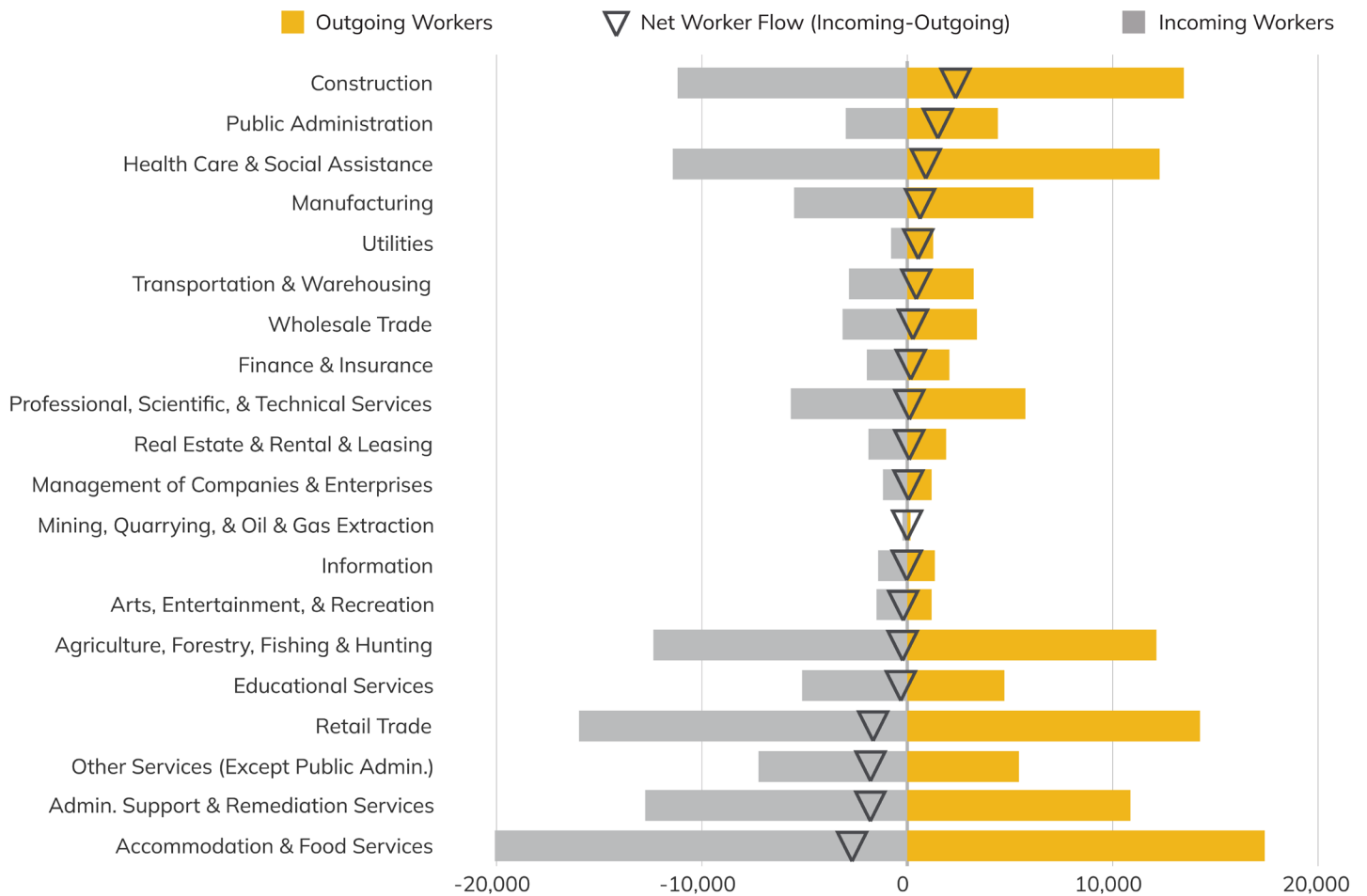
³¹ A metropolitan statistical area (MSA) is a designation of the US Office of Management and Budget used by federal statistical agencies. MSAs are composed of one or more counties (or county equivalents, such as parishes) that meet specific thresholds regarding the size of the population and the share living in urban areas, and which have strong economic ties (as illustrated by employment and commuting).

³² Net out-migration means more workers left jobs inside the region for jobs outside the region.

³³ Informal MSA names are used to improve readability. For example, the San Luis Obispo-Paso Robles, CA, MSA is referred to simply as the San Luis Obispo MSA; Santa Barbara MSA is used rather than Santa Maria-Santa Barbara, CA, MSA.

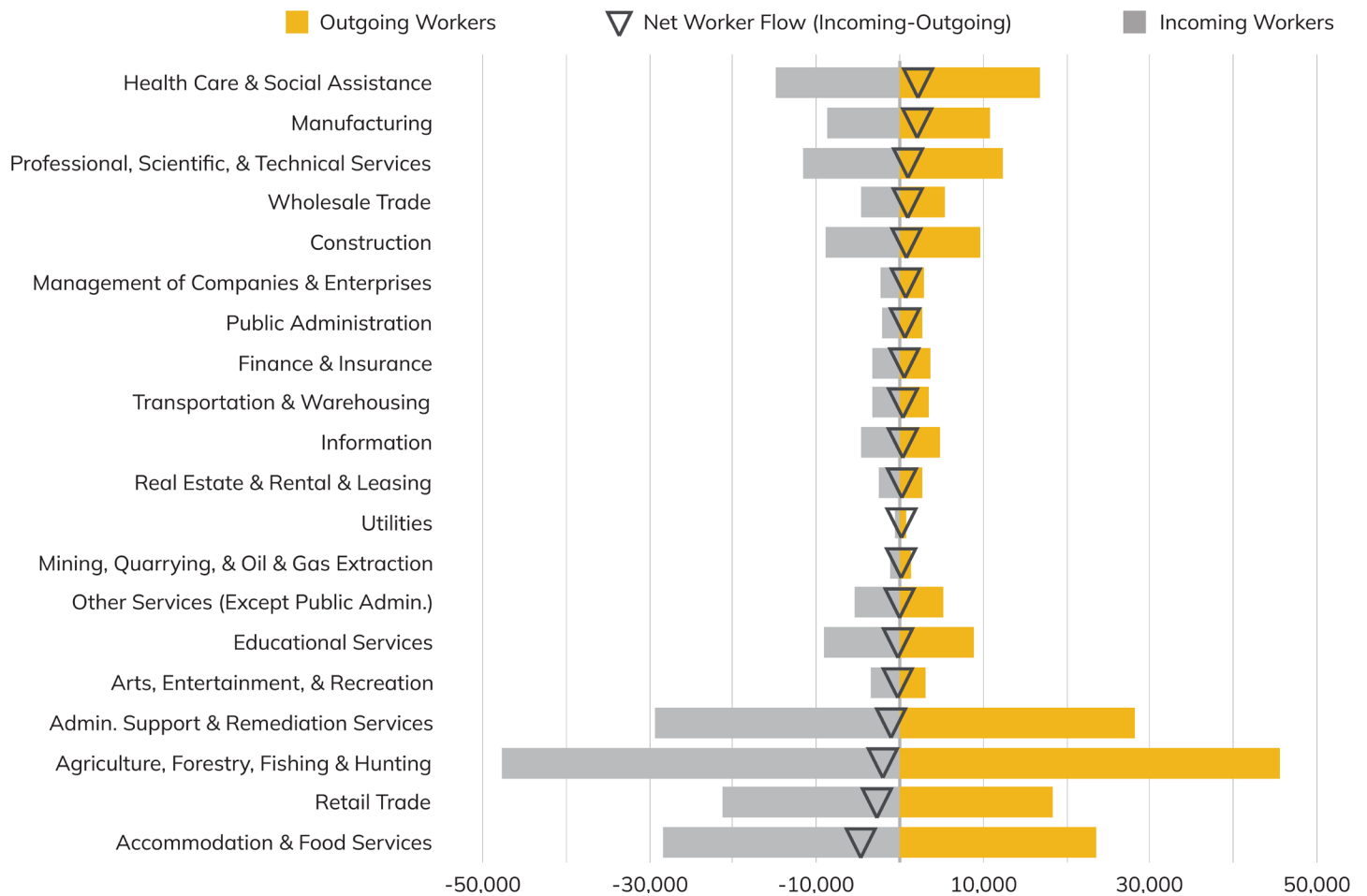
³⁴ Including the Oxnard-Thousand Oaks-Ventura, CA, MSA; the Los Angeles-Long Beach-Anaheim, CA, MSA; and the Riverside-San Bernardino-Ontario, CA, MSA.

FIGURE 21. NET FLOW OF WORKERS BY INDUSTRY SECTOR, 2017 Q1 TO 2021 Q4
SAN LUIS OBISPO-PASO ROBLES, CA, MSA



Source(s): US Census Bureau, Longitudinal Employer-Household Dynamics (LEHD), Job-to-Job Flows (J2J); TIP Strategies, Inc.
 Note(s): Data include hires and separations of workers between establishments who experienced brief unemployment (one quarter or less). Only establishments with unemployment insurance (UI) covered employees are included. Industry sectors reflect the North American Industry Classification System (NAICS) used by federal agencies to classify businesses.

FIGURE 22. NET FLOW OF WORKERS BY INDUSTRY SECTOR, 2017 Q1 TO 2021 Q4
SANTA MARIA-SANTA BARBARA, CA, MSA



Source(s): US Census Bureau, Longitudinal Employer-Household Dynamics (LEHD), Job-to-Job Flows (J2J); TIP Strategies, Inc.
 Note(s): Data include hires and separations of workers between establishments who experienced brief unemployment (one quarter or less). Only establishments with unemployment insurance (UI) covered employees are included. Industry sectors reflect the North American Industry Classification System (NAICS) used by federal agencies to classify businesses.

GLOSSARY

Earnings (labor income)	Income that is received as a result of labor, i.e., wages. It excludes non-work sources of income such as stock dividends or interest, rents, and Social Security.
Earnings per job	Total pre-tax industry earnings divided by the number of jobs in the industry in the same year. Industry earnings consist of two values: wages and salaries (including bonuses, stock options, and severance pay), and supplements (which consists of employer contributions to pension funds; health insurance; and federal, state, and local government programs). Because it is calculated for industries (which encompass a mix of occupations) it is not comparable to occupation-based measures, like median annual wages or median hourly earnings.
Gross state/regional product (GSP/GRP)	Measure of the final value of all goods and services produced in a state after netting out the cost of goods used in production. Alternatively, gross state product (GSP) equals the combined incomes of all factors of production, i.e., labor, land, and capital. These include wages, salaries, proprietors' incomes, profits, rents, and other. GSP is also sometimes called value added or added income. Gross regional product (GRP) represents this same measure for a region.
Imported purchases	The amount of money the selected industry spends on the goods of that industry from suppliers from outside of the selected region.
Income (industry)	<p>Industry income is synonymous with value added gross state product (GSP). Unlike sales, income is a net measure that excludes the cost of production. For this reason, income provides a more meaningful measure of the impact of the sale.</p> <p><i>Example:</i> A bakery sells a loaf of bread for \$5.00. The cost of production is \$3.00 (i.e., the amount of money spent on ingredients, labor, a portion of space rental and equipment costs, and so on needed to make the loaf of bread), meaning the income derived from the sale is \$2.00.</p>
Initial effect	The initial change in jobs or earnings used to model economic impacts. (See page 23 for a discussion of direct, indirect, and induced impacts.)
Input-output analysis	Relationship between a given set of demands for final goods and services and the implied amounts of manufactured inputs, raw materials, and labor that this requires. When institutions pay wages and salaries and spend money for supplies in the state, they also generate earnings in all sectors of the economy, thereby increasing the demand for goods and services and jobs.
In-region purchases	The amount of money the selected industry spends on the goods of that industry from suppliers within the selected region.
Intermediary costs	The costs associated with producing goods and services. Examples include payroll, rent, equipment, and raw materials.

Multiplier effect (earnings)	Additional income created in the economy as employees spend money in the region. It consists of the income created by the supply chain of the industries initially affected by the spending of the employees (i.e., the direct effect), income created by the supply chain of the initial supply chain (i.e., the indirect effect), and the income created by the increased spending of the household sector (i.e., the induced effect).
Multiplier effect (jobs)	Additional employment created in the economy as a result of an initial change in jobs in the sector. It consists of employment created by the supply chain of the industries initially affected by the change in jobs (i.e., the direct effect), employment created by the supply chain of the initial supply chain (i.e., the indirect effect), and employment created by the increased spending of the household sector (i.e., the induced effect).
Net cash flow	Benefits minus costs, i.e., the sum of revenues accruing from an investment minus costs incurred.
Net present value	Net cash flow discounted to the present. All future cash flows are collapsed into one number, which, if positive, indicates feasibility. The result is expressed as a monetary measure.
Non-labor income	Income received from investments, such as rent, interest, and dividends, and other non-work sources (e.g., Social Security).
Sales (or output)	Sales include all the intermediary costs associated with producing goods and services. It differs from income, which nets out (excludes) those costs.
Taxes on production and imports (TPI)	TPI consists of state and local taxes—primarily non-personal property taxes, licenses, and sales and gross receipts taxes—and federal excise taxes on goods and services. Special assessments are also included. It is one of the four components of gross regional product (GRP); the other elements are earnings (labor income), profits/property income, and subsidies.

Source(s): Lightcast; TIP Strategies, Inc.

CLASSIFICATION SYSTEMS

This section provides a brief overview of the three federal classification systems referenced in this report, along with links for more information.

- + The **North American Industry Classification System (NAICS)** is used by federal agencies to classify North American business establishments in order to better collect, analyze, and publish statistical data related to the business economy. The NAICS taxonomy categorizes industries into six levels using codes ranging from 2- to 6-digits as illustrated below. Visit the US Census Bureau [NAICS overview page](#) for more information.

EXAMPLE

Sector: 23 Construction
Subsector: 236 Construction of Buildings
Industry Group: 2362 Construction of Nonresidential Buildings
NAICS Industry: 23621 Industrial Building Construction
National Industry: 236210 Industrial Building Construction

- + The **Standard Occupational Classification System (SOC)** is used by federal agencies to classify workers into occupational categories for statistical purposes. The SOC system classifies occupations at four levels as illustrated in the example below. Visit the US Bureau of Labor Statistics [Standard Occupational Classification page](#) to learn more.

EXAMPLE

Major group: 51-0000 Production Occupations
Minor group: 51-4000 Metal Workers and Plastic Workers
Broad occupation: 51-4040 Machinists
Detailed occupation: 51-4041 Machinists

- + The **Classification of Instructional Programs (CIP)** was developed by the National Center for Education Statistics (NCES) to categorize completions (degrees and awards granted for credit by eligible postsecondary institutions) within broad, generalized categories for tracking and analytical purposes. It consists of three levels: 1) the two-digit series, 2) the four-digit series, and 3) the six-digit series. As illustrated below, the CIP moves from broad field of study to general instructional area to detailed program area. For more information, visit the NCES [CIP User Site](#).

EXAMPLE

14. Engineering
14.09 Computer Engineering
14.0901 Computer Engineering, General
14.0902 Computer Hardware Engineering
14.0903 Computer Software Engineering
14.0999 Computer Engineering, Other

RESOURCES

ECONOMIC IMPACT (LIGHTCAST MODEL)

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BACKGROUND: CENTRAL COAST

- + General resources for this section include the websites of regional postsecondary institutions (i.e., Cal Poly, UC Santa Barbara, Cuesta College, Santa Barbara City College, and Allan Hancock College), Crunchbase, company websites, and local news sources.

LIGHTCAST MR-SAM

Lightcast's Multi-Regional Social Accounting Matrix (MR-SAM) model represents the flow of all economic transactions in a given region. It replaces Lightcast's previous input-output (IO) model, which operated with some 1,000 industries, four layers of government, a single household consumption sector, and an investment sector. The old IO model was used to simulate the ripple effects (i.e., multipliers) in the regional economy as a result of industries entering or exiting the region. The MR-SAM model performs the same tasks as the old IO model, but it also does much more. Along with the same 1,000 industries, government, household and investment sectors embedded in the old IO tool, the MR-SAM exhibits much more functionality, a greater amount of data, and a higher level of detail on the demographic and occupational components of jobs (16 demographic cohorts and about 750 occupations are characterized).

This appendix presents a high-level overview of the MR-SAM. Additional documentation on the technical aspects of the model is available upon request.

DATA SOURCES FOR THE MODEL

The Lightcast MR-SAM model relies on a number of internal and external data sources, mostly compiled by the federal government. What follows is a listing and short explanation of these sources. The use of these data will be covered in more detail later in this appendix.

Lightcast data are produced from many data sources to produce detailed industry, occupation, and demographic jobs and earnings data at the local level. This information (especially sales-to-jobs ratios derived from jobs and earnings-to-sales ratios) is used to help regionalize the national matrices as well as to disaggregate them into more detailed industries than are normally available.

- + **BEA Make and Use Tables (MUT)** are the basis for input-output models in the US. The make table is a matrix that describes the amount of each commodity made by each industry in a given year. Industries are placed in the rows and commodities in the columns. The use table is a matrix that describes the amount of each commodity used by each industry in a given year. In the use table, commodities are placed in the rows and industries in the columns. The BEA produces two different sets of MUTs, the benchmark and the summary. The benchmark set contains about 500 sectors and is released every five years, with a five-year lag time (e.g., 2002 benchmark MUTs were released in 2007). The summary set contains about 80 sectors and is released every year, with a two-year lag (e.g., 2010 summary MUTs were released in late 2011/early 2012). The MUTs are used in the Lightcast MR-SAM model to produce an industry-by-industry matrix describing all industry purchases from all industries.
- + **BEA Gross Domestic Product by State (GSP)** describes gross domestic product from the value added (also known as added income) perspective. Value added is equal to employee compensation, gross operating surplus, and taxes on production and imports, less subsidies. Each of these components is reported for each state and an aggregate group of industries. This dataset is updated once per year, with a one-year lag. The Lightcast MR-SAM model makes use of this data as a control and pegs certain pieces of the model to values from this dataset.
- + **BEA National Income and Product Accounts (NIPA)** cover a wide variety of economic measures for the nation, including gross domestic product (GDP), sources of output, and distribution of income. This dataset is updated

periodically throughout the year and can be between a month and several years old depending on the specific account. NIPA data are used in many of the Lightcast MR-SAM processes as both controls and seeds.

- + **BEA Local Area Income (LPI)** encapsulates multiple tables with geographies down to the county level. The following two tables are specifically used: CA05 (Personal income and earnings by industry) and CA91 (Gross flow of earnings). CA91 is used when creating the commuting submodel and CA05 is used in several processes to help with place-of-work and place-of-residence differences, as well as to calculate personal income, transfers, dividends, interest, and rent.
- + **Bureau of Labor Statistics Consumer Expenditure Survey (CEX)** reports on the buying habits of consumers along with some information as to their income, consumer unit, and demographics. Lightcast utilizes this data heavily in the creation of the national demographic by income type consumption on industries.
- + **Census of Government's (CoG)** state and local government finance dataset is used specifically to aid breaking out state and local data that is reported in the MUTs. This allows Lightcast to have unique production functions for each of its state and local government sectors.
- + **Census' OnTheMap (OTM)** is a collection of three datasets for the census block level for multiple years. All three of these are used in the commuting submodel to gain better estimates of earnings by industry that may be counted as commuting. This dataset has holes for specific years and regions. These holes are filled with Census' Journey-to-Work described later.
 - + **Origin-Destination (OD)** offers job totals associated with both home census blocks and a work census block.
 - + **Residence Area Characteristics (RAC)** offers jobs totaled by home census block.
 - + **Workplace Area Characteristics (WAC)** offers jobs totaled by work census block.
- + **Census' Current Population Survey (CPS)** is used as the basis for the demographic breakout data of the MR-SAM model. This set is used to estimate the ratios of demographic cohorts and their income for the three different income categories (i.e., wages, property income, and transfers).
- + **Census' Journey-to-Work (JtW)** is part of the 2000 Census and describes the amount of commuting jobs between counties. This set is used to fill in the areas where OTM does not have data.
- + **Census' American Community Survey (ACS) Public Use Microdata Sample (PUMS)** is the replacement for Census' long form and is used by Lightcast to fill the holes in the CPS data.
- + **Oak Ridge National Lab (ORNL) County-to-County Distance Matrix (Skim Tree)** contains a matrix of distances and network impedances between each county via various modes of transportation such as highway, railroad, water, and combined highway-rail. Also included in this set are minimum impedances utilizing the best combination of paths. The ORNL distance matrix is used in Lightcast's gravitational flows model that estimates the amount of trade between counties in the country.

OVERVIEW OF THE MR-SAM MODEL

Lightcast's MR-SAM modeling system is a comparative static model in the same general class as RIMS II (Bureau of Economic Analysis) and IMPLAN (Minnesota Implan Group). The MR-SAM model is thus not an econometric model, the primary example of which is PolicyInsight by REMI. It relies on a matrix representation of industry-to-industry purchasing patterns originally based on national data which are regionalized with the use of local data and mathematical

manipulation (i.e., non-survey methods). Models of this type estimate the ripple effects of changes in jobs, earnings, or sales in one or more industries upon other industries in a region.

The Lightcast MR-SAM model shows final equilibrium impacts—that is, the user enters a change that perturbs the economy, and the model shows the changes required to establish a new equilibrium. As such, it is not a dynamic model that shows year-by-year changes over time (as REMI's does).

NATIONAL SAM

Following standard practice, the SAM model appears as a square matrix, with each row sum exactly equaling the corresponding column sum. Reflecting its kinship with the standard Leontief input-output framework, individual SAM elements show accounting flows between row and column sectors during a chosen base year. Read across rows, SAM entries show the flow of funds into column accounts (also known as receipts or the appropriation of funds by those column accounts). Read down columns, SAM entries show the flow of funds into row accounts (also known as expenditures or the dispersal of funds to those row accounts).

The SAM may be broken into three different aggregation layers: broad accounts, sub-accounts, and detailed accounts. The broad layer is the most aggregate and will be covered first. Broad accounts cover between one and four sub-accounts, which in turn cover many detailed accounts. This appendix will not discuss detailed accounts directly because of their number. For example, in the industry broad account, there are two sub-accounts and over 1,000 detailed accounts.

MULTI-REGIONAL ASPECT OF THE MR-SAM

Multi-regional (MR) describes a non-survey model that has the ability to analyze the transactions and ripple effects (i.e., multipliers) of not just a single region, but multiple regions interacting with each other. Regions in this case are made up of a collection of counties.

Lightcast's multi-regional model is built off of gravitational flows, assuming that the larger a county's economy, the more influence it will have on the surrounding counties' purchases and sales. The equation behind this model is essentially the same that Isaac Newton used to calculate the gravitational pull between planets and stars. In Newton's equation, the masses of both objects are multiplied, then divided by the distance separating them and multiplied by a constant. In Lightcast's model, the masses are replaced with the supply of a sector for one county and the demand for that same sector from another county. The distance is replaced with an impedance value that takes into account the distance, type of roads, rail lines, and other modes of transportation. Once this is calculated for every county-to-county pair, a set of mathematical operations is performed to make sure all counties absorb the correct amount of supply from every county and the correct amount of demand from every county. These operations produce more than 200 million data points.

COMPONENTS OF THE LIGHTCAST MR-SAM MODEL

The Lightcast MR-SAM is built from a number of different components that are gathered together to display information whenever a user selects a region. What follows is a description of each of these components and how each is created. Lightcast's internally created data are used to a great extent throughout the processes described below, but its creation is not described in this appendix.

COUNTY EARNINGS DISTRIBUTION MATRIX

The county earnings distribution matrices describe the earnings spent by every industry on every occupation for a year—i.e., earnings by occupation. The matrices are built utilizing Lightcast’s industry earnings, occupational average earnings, and staffing patterns.

Each matrix starts with a region’s staffing pattern matrix which is multiplied by the industry jobs vector. This produces the number of occupational jobs in each industry for the region. Next, the occupational average hourly earnings per job are multiplied by 2,080 hours, which converts the average hourly earnings into a yearly estimate. Then the matrix of occupational jobs is multiplied by the occupational annual earnings per job, converting it into earnings values. Last, all earnings are adjusted to match the known industry totals. This is a fairly simple process, but one that is very important. These matrices describe the place-of-work earnings used by the MR-SAM.

COMMUTING MODEL

The commuting sub-model is an integral part of Lightcast’s MR-SAM model. It allows the regional and multi-regional models to know what amount of the earnings can be attributed to place-of-residence vs. place-of-work. The commuting data describe the flow of earnings from any county to any other county (including within the counties themselves). For this situation, the commuted earnings are not just a single value describing total earnings flows over a complete year but are broken out by occupation and demographic. Breaking out the earnings allows for analysis of place-of-residence and place-of-work earnings. These data are created using Bureau of Labor Statistics’ OnTheMap dataset, Census’ Journey-to-Work, BEA’s LPI CA91 and CA05 tables, and some of Lightcast’s data. The process incorporates the cleanup and disaggregation of the OnTheMap data, the estimation of a closed system of county inflows and outflows of earnings, and the creation of finalized commuting data.

NATIONAL SAM

The national SAM as described above is made up of several different components. Many of the elements discussed are filled in with values from the national Z matrix—or industry-to-industry transaction matrix. This matrix is built from BEA data that describe which industries make and use what commodities at the national level. These data are manipulated with some industry standard equations to produce the national Z matrix. The data in the Z matrix act as the basis for the majority of the data in the national SAM. The rest of the values are filled in with data from the county earnings distribution matrices, the commuting data, and the BEA’s National Income and Product Accounts.

One of the major issues that affect any SAM project is the combination of data from multiple sources that may not be consistent with one another. Matrix balancing is the broad name for the techniques used to correct this problem. Lightcast uses a modification of the “diagonal similarity scaling” algorithm to balance the national SAM.

GRAVITATIONAL FLOWS MODEL

The most important piece of the Lightcast MR-SAM model is the gravitational flows model that produces county-by-county regional purchasing coefficients (RPCs). RPCs estimate how much an industry purchases from other industries inside and outside of the defined region. This information is critical for calculating all IO models.

Gravity modeling starts with the creation of an impedance matrix that values the difficulty of moving a product from county to county. For each sector, an impedance matrix is created based on a set of distance impedance methods for that sector. A distance impedance method is one of the measurements reported in the Oak Ridge National Laboratory's County-to-County Distance Matrix. In this matrix, every county-to-county relationship is accounted for in six measures: great-circle distance, highway impedance, rail miles, rail impedance, water impedance, and highway-rail-highway impedance. Next, using the impedance information, the trade flows for each industry in every county are solved for. The result is an estimate of multi-regional flows from every county to every county. These flows are divided by each respective county's demand to produce multi-regional RPCs.

