



California's Manufacturing Industries

Employment and Competitiveness



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Report Overview

In this report, Beacon Economics evaluates the current state of the Manufacturing industry in California, considering employment trends as well as the state's competitiveness in the sector.

Section 2 of the report highlights the role of the Manufacturing industry within the national economy. While, nationally, manufacturing employment has fallen by 32% since 1990, nominal output has increased by almost 40% over this period. This dichotomy is being driven by increases in labor productivity, particularly in durable goods manufacturing, which has become increasingly capital intensive. Increases in labor productivity over this period reveals the extent to which manufacturers are innovating production equipment and manufacturing processes, investing in new technology, and developing high-skilled employees. In fact, each hour of manufacturing labor today produces twice the value of output that it did in 1990 (in real terms). In addition, labor productivity growth in the industry has grown compared to other sectors of the economy. As a result, manufacturing workers are paid a premium compared to other industries.

Section 2 concludes that California is still the largest contributor to the U.S. Manufacturing industry – both in terms of employment and output – and that productivity growth in the state's manufacturing sector has eclipsed the performance of the industry nationally. However, California's diverse economy means it is less reliant on the performance of the Manufacturing sector than is the case in other states. For example, the economies of Indiana, Louisiana, Kentucky, Wisconsin, and Michigan are highly dependent on the performance of the Manufacturing sector for their economic well-being.

Section 3 provides a detailed discussion of Manufacturing employment trends in California, focusing on particular industry sub-sectors, over the past decade. This ten-year retrospective is chosen to compare the performance of the Manufacturing industry to other industries since the Great Recession.

Although the manufacturing sector added jobs from 2010 to 2020, employment growth did not occur across all manufacturing subsectors. Indeed, California is home to a diverse range of subsectors, from high technology industries such as Computer and Electronic Products, Aerospace Parts and Products and Medical Devices, to lower technology manufacturing, such as Apparel and Food Processing. Growth in manufacturing employment has been largely driven by gains in high technology subsectors over the last decade, while payrolls in lower technology subsectors have largely declined. Section 3 closes with a focus on Manufacturing workers, highlighting the occupations in which they are employed as well as the education and experience levels required for entry level positions in the sector. It is clear that the sector still provides jobs across all skill levels, many of which are well-compensated.

Section 4 focuses on the competitiveness of California's Manufacturing industry by considering employment concentration and technological intensity. Employment concentration is a measure of regional specialization (the subsectors in which California has a relative strength) and the clustering of specific types of activity in the region. Technological intensity is a measure of how advanced the manufacturing industry is in the state, using research and development investment as a yardstick. High technologically intensive industries are those that invest a larger proportion of their revenues in R&D. These are industries that are more likely to innovate, improve their production processes and products, gain market share, be competitive in a global economy and generate wealth for the region. The proportion of manufacturing employment in such industries is an indicator of the region's overall competitiveness.

This assessment finds that California is competitive in both high technology industries, including semiconductors, computers, peripherals electronic components, communications equipment, and the sophisticated radar and satellite instrumentation used in aerospace, and also in low technology industries, such as apparel, beverages, machinery and food processing. Trends in California's competitiveness is considered in Section 5.

Section 6 highlights differences in Manufacturing activities in Northern and Southern California, before focusing on the Manufacturing industry in Southern California. With roughly 62% of the state's Manufacturing jobs, Southern California employs more than 777,000 manufacturing workers, accounting for 7.6% of all employment. Manufacturing in Southern California is very diverse, with a combination of low technology Manufacturing industries in fashion and food, and high technology manufacturing in aerospace parts and instrumentation, computer and electronic components, and medical devices.

Despite the long-term downtrend in Manufacturing employment, in some respects, the sector has never been healthier, and California's position as the nation's preeminent Manufacturing center remains.

Manufacturing's Economic Performance

The Manufacturing industry continues to play a vital role in the U.S. economy, generating jobs for millions of workers, providing income for households across the economic spectrum, and producing necessary and innovative products for domestic consumption and export. In relative terms, Manufacturing companies do not employ as many workers as they once did, but the U.S. Manufacturing base is increasingly technologically intensive and consequently yields higher average annual wages.

Manufacturing Output

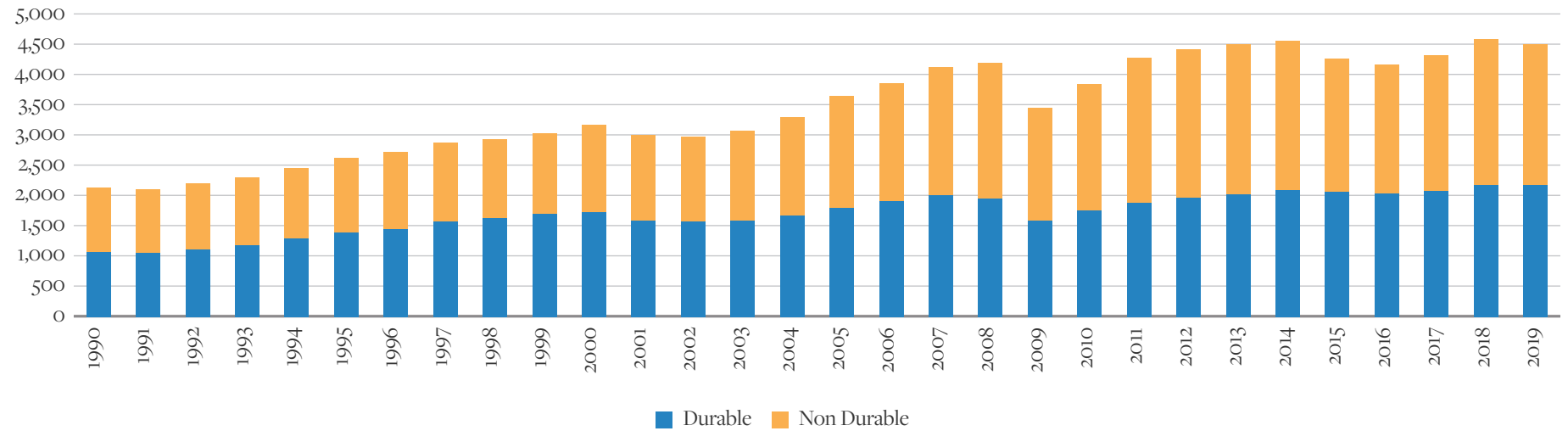
In 2020 (the most recent year for which data is available), Manufacturing accounted for 11.7% of U.S. gross domestic product (GDP) and 8.7% of total employment. The value of production in the Manufacturing sector has more than doubled in nominal terms since 1990, reaching nearly \$4.5 trillion in 2019. Production value in both durable and nondurable Manufacturing has increased by similar margins over the period, with durable goods accounting for 46.4% of the increase and nondurable goods accounting for the remaining 53.6%.

Output levels in the Manufacturing sector have remained largely unchanged over the last decade. Manufacturing output in 2020 had grown 39.9% over 1990, an average annual growth rate of 1.1%. Split between durable and nondurable Manufacturing, performance in durable Manufacturing exceeded that of nondurables, with the output levels in 2020 increasing over that of 1990 by 60.8% and 11.3% respectively.

Compared to other sectors of the economy, however, Manufacturing output growth has not fared as well since the turn of the century. As of 2020, output in the Manufacturing sector has grown 39.9% over its 1990 level, while aggregate output growth in the private sector has risen 114.7% over the period (the latter yielding an average annual growth rate of 2.6%). With the overall increase eclipsing the Manufacturing sector, it is clear the service economy has experienced significant growth and driven much of the nation's expansion in recent years.

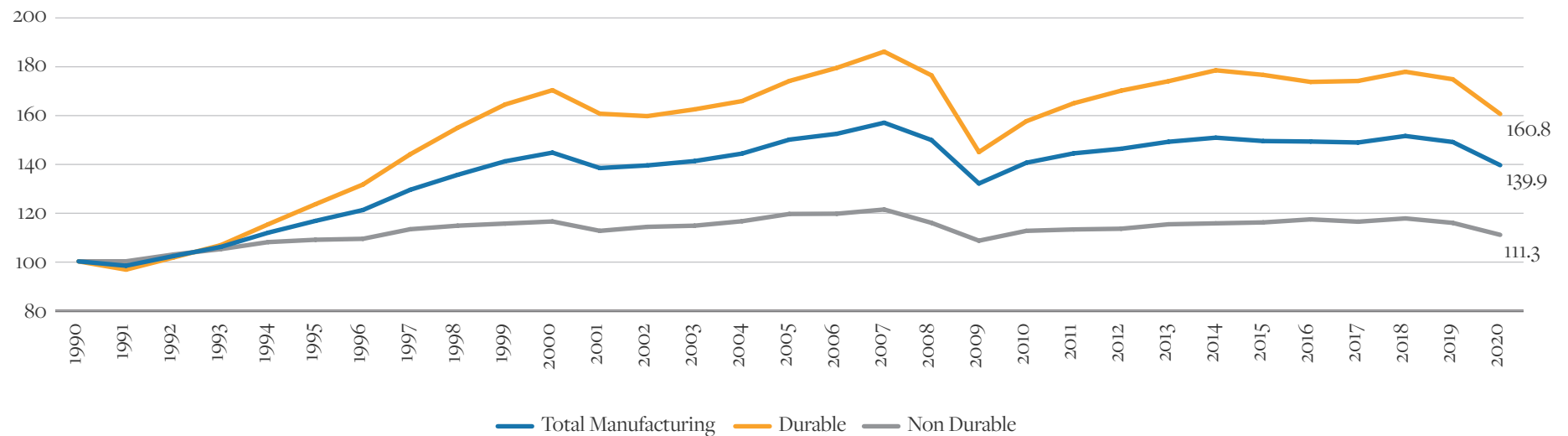
As output levels are not keeping up with other industries, Manufacturing's contribution to GDP has declined over the last decade, accounting for under 12% of total national growth over the last five years.

2-1 U.S. Manufacturing Value of Production (Billions of current dollars)



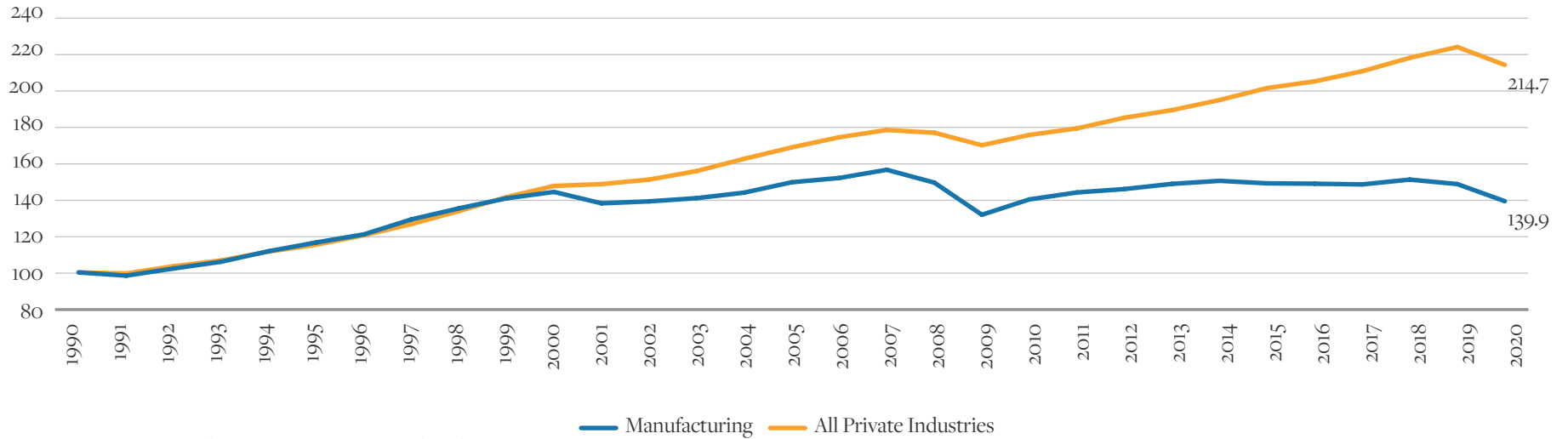
Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

2-2 U.S. Manufacturing Output Indexed Growth (1990=100)



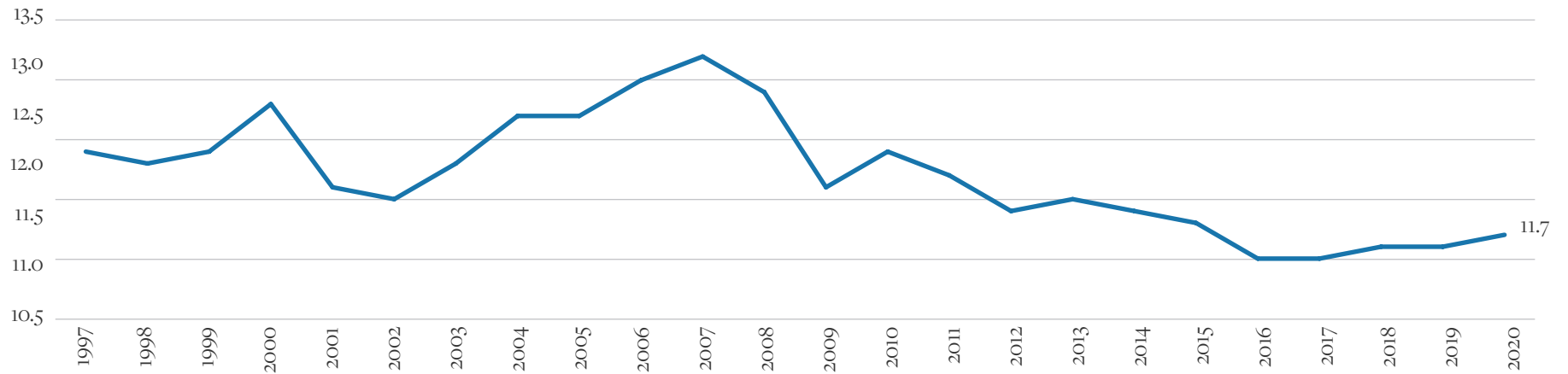
Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

2-3 U.S. Manufacturing Output Indexed Growth (1990=100)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

2-4 U.S. Manufacturing's Contribution to GDP (%)



Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

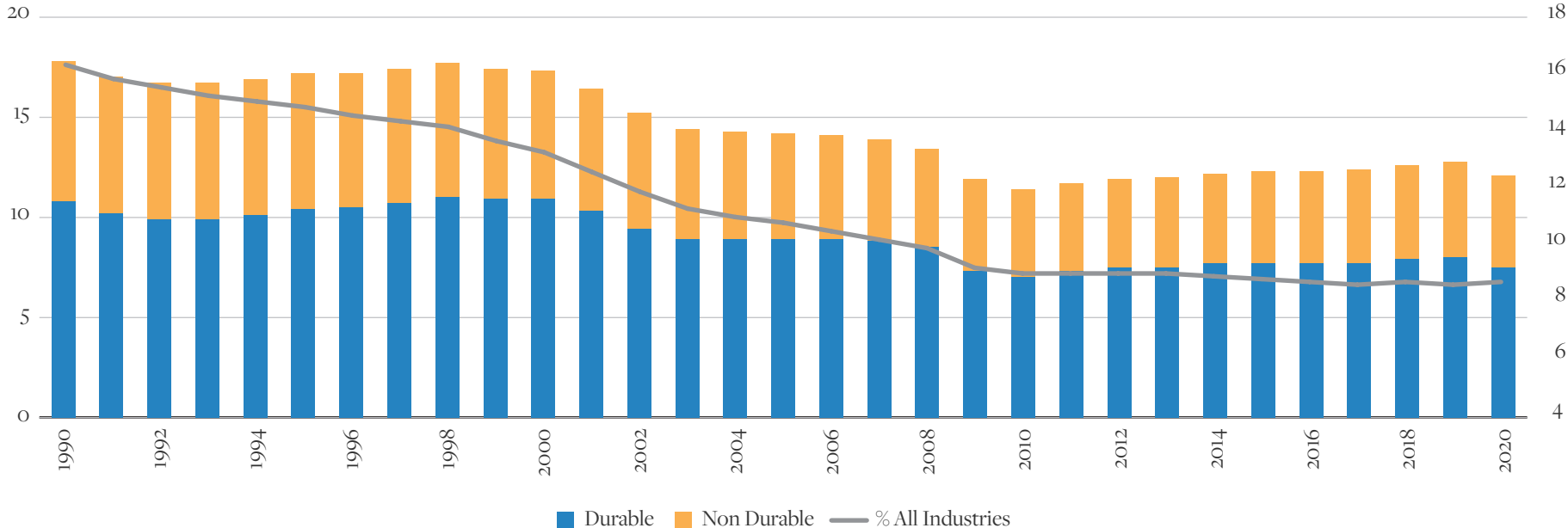
Manufacturing Employment

The Manufacturing sector has been, and still is, a large share of total U.S. employment. However, employment levels over time have been steadily declining. About 5.7 million Manufacturing jobs were lost between 1990 and 2020, reducing employment in the sector by nearly one-third. With this decline, the industry’s share of total employment fell from 16.4% in 1990 to 8.7% in 2020. This trend has occurred in both durable and nondurable Manufacturing industries.

However, more recently, and since the Great Recession, Manufacturing sector payrolls have grown modestly. In fact, over the last five years the Manufacturing sector has maintained its share of the national workforce, stemming over two decades of consistent declines.

While Manufacturing lost a significant number of jobs since 1990, other sectors have been adding jobs. Between 1990 and 2020, roughly 36 million jobs were added in non-Manufacturing industries, increasing employment by almost 39.9%, compared to the -32.1% loss of Manufacturing jobs.

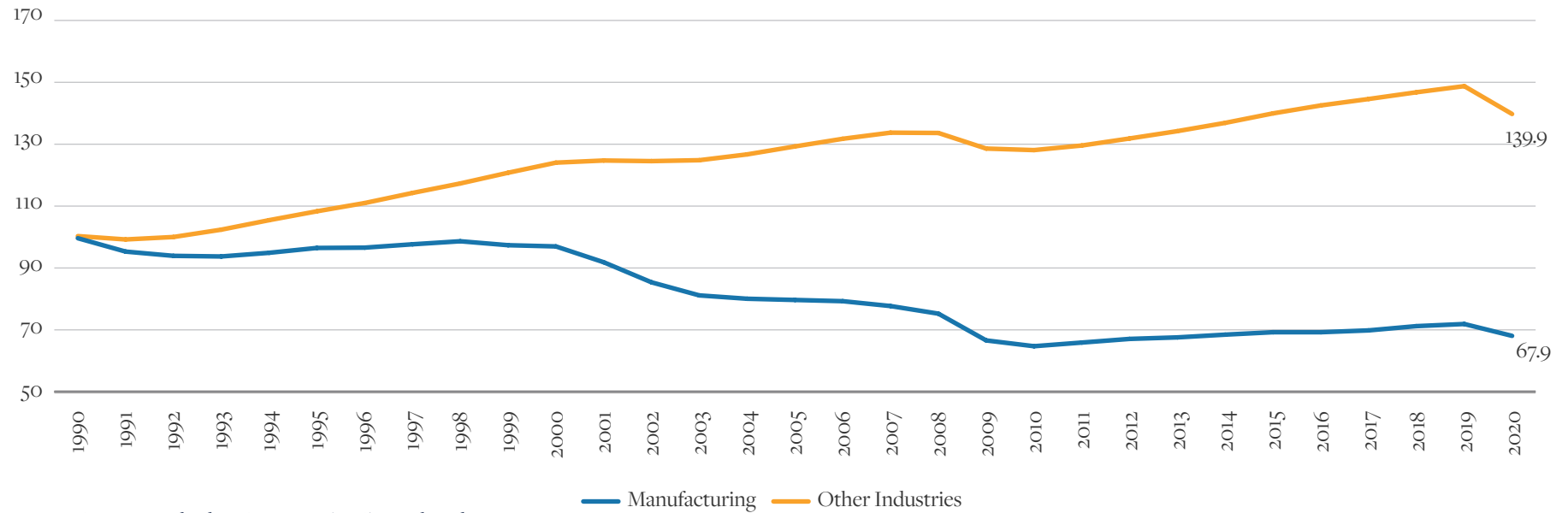
2-5 U.S. Manufacturing Employment (In millions)



Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

2-6 U.S Employment

Indexed Growth (1990=100)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Productivity of Labor and Capital

While Manufacturing employment has increased modestly over the last decade in the United States, it has been concentrated in medium-high and medium-low technology intensive firms. As a result, Manufacturing has not been able to sustain the rapid increases in productivity from 1990 to 2010.

Productivity gains from 1990 to 2010 were driven in part by improved skill levels of those employed, or through capital investment, so that each worker is able to produce more (with better equipment) in spite of not being more highly skilled — or a combination of both. However, labor productivity increases over the period were also driven by a domestic shift. Manufacturing operations requiring relatively low-skilled workers were the first to be susceptible to off-shoring. With low-skilled workers dropping out of the labor pool, the average labor productivity for Manufacturing would increase, with or without increases in labor productivity for the current workforce.

As these low-skilled jobs have been lost, employment in more technology-intensive Manufacturing operations will account for a larger share of Manufacturing employment. Workers remaining in these industries are those with higher skill levels and are consequently those earning higher average annual wages.

Labor productivity is a measure of real output per unit of labor input. In Manufacturing, labor productivity has been steadily increasing from 1990 to 2010 and largely stable over the last decade. Manufacturing labor produces more than twice the value of output it did in 1990 (in real terms).

Gains in labor productivity over the period were stronger in durable goods Manufacturing, where labor productivity grew 131% (an average annual growth rate of 4.1%). But even nondurable goods Manufacturing increased labor productivity by 63% over the period (an annual average growth rate of 3.3%).

Manufacturing productivity growth has been stronger compared to other sectors. Productivity growth across all private businesses was 82% since 1990, trailing Manufacturing's growth.

The combination of increased automation, the loss of low-skilled workers, and the emergence of more high-tech Manufacturing has increased the share of capital in Manufacturing. In 1990, labor accounted for 34% of value added, but this has fallen to 28% while returns to capital have increased from 19.7% in 1990 to 28.3% in 2020.

There is no doubt that increasing the capital intensity of Manufacturing has boosted labor productivity, but it's only one piece of the productivity picture. A more comprehensive measure is multi-factor productivity (MFP) which measures real output per combined set of inputs, including labor, capital and purchased intermediate inputs. Changes in MFP are not attributable to changes in individual inputs but to the joint effects of inputs working together, and hence to the efficient management of production factors, cost advantages (reaching economies of scale), managerial competency, innovation, and the incorporation of new products and processes made possible through research and development.

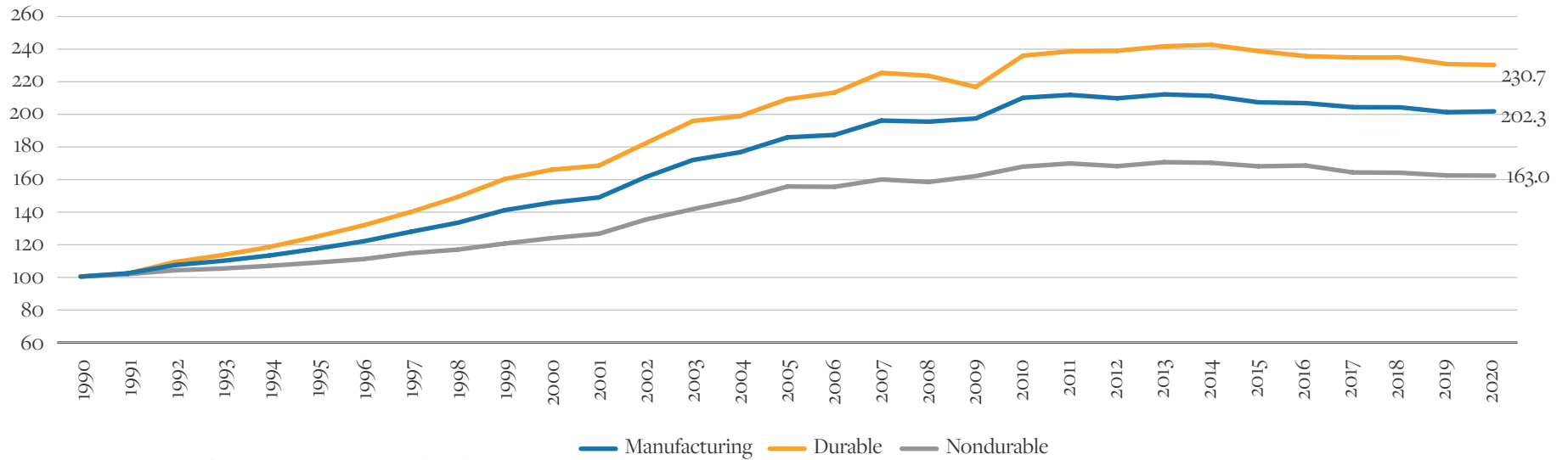
This index has also shown robust growth since 1990. Growth in MFP for Manufacturing was 23.9% from 1990 to 2019. However, MFP increased more across all private businesses, growing 29.7% from 1990 to 2019.

The overall value of total gross output in the Manufacturing sector totaled \$6.3 trillion in 2020. Gross output is a combination of value added (GDP) and the cost of intermediate inputs consumed in the production of goods in the sector. Value added includes operating surplus (profit or the returns to capital), compensation of employees (labor income), and taxes on production.

Interpreting the shares of gross output shows how total expenditures are allocated among the needs of production. Intermediate inputs (energy, materials and purchased services) accounted for 62.5% of total expenditures in Manufacturing in 2019, with materials being 50.5% of the total. Total value added was 37.5% of the total gross output in the sector. The allocation of expenditures show sensitivity that Manufacturing industries in aggregate may have to increases in costs in one or several of these components.

2-7 U.S. Manufacturing Labor Productivity

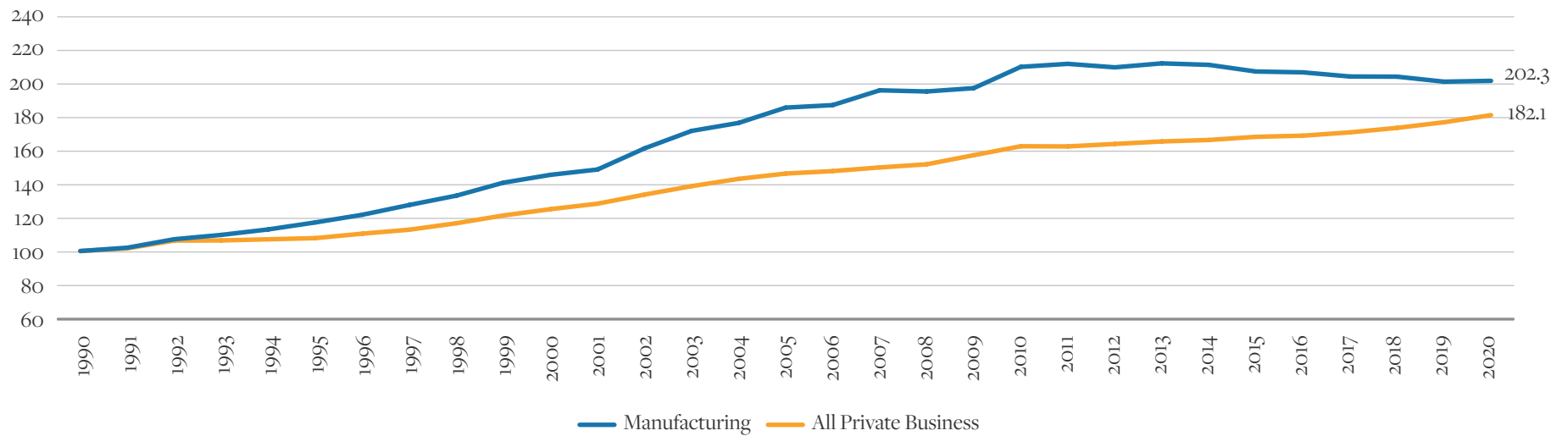
Output per Hour (1990 = 100)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

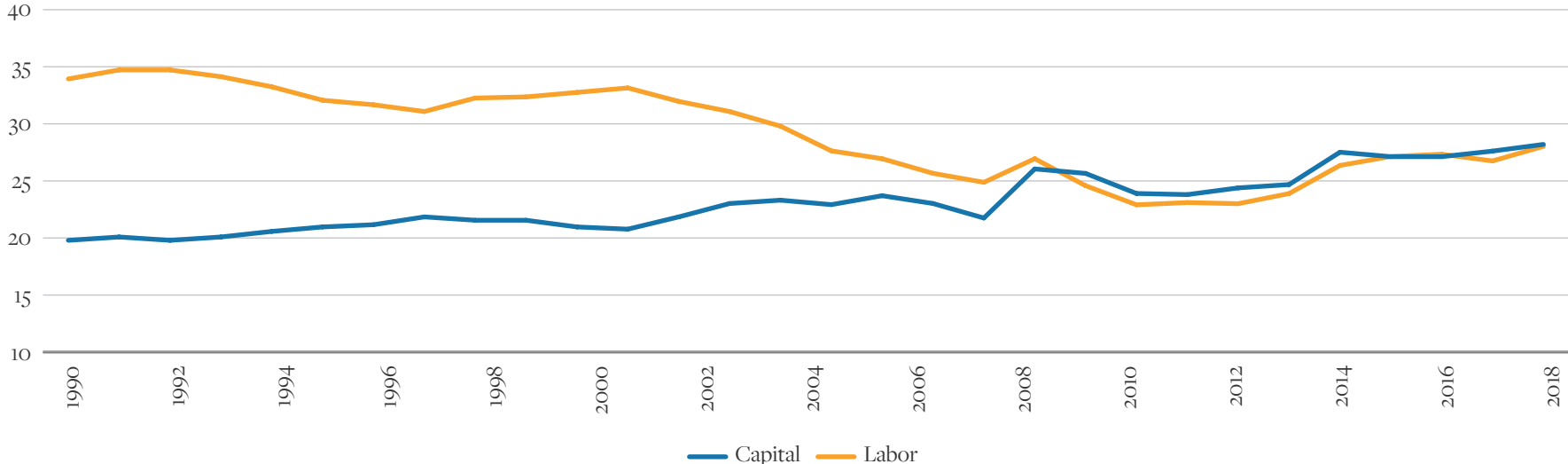
2-8 U.S. Labor Productivity

Output per Hour (1990 = 100)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

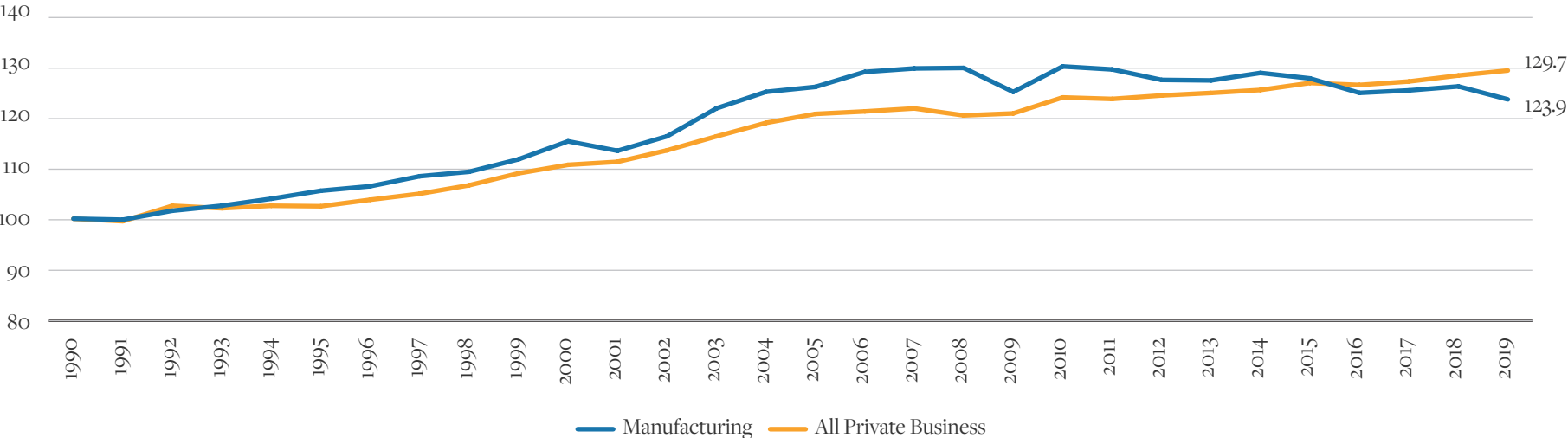
2-9 U.S. Manufacturing Factor Shares



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

2-10 U.S. Multifactor Productivity Index

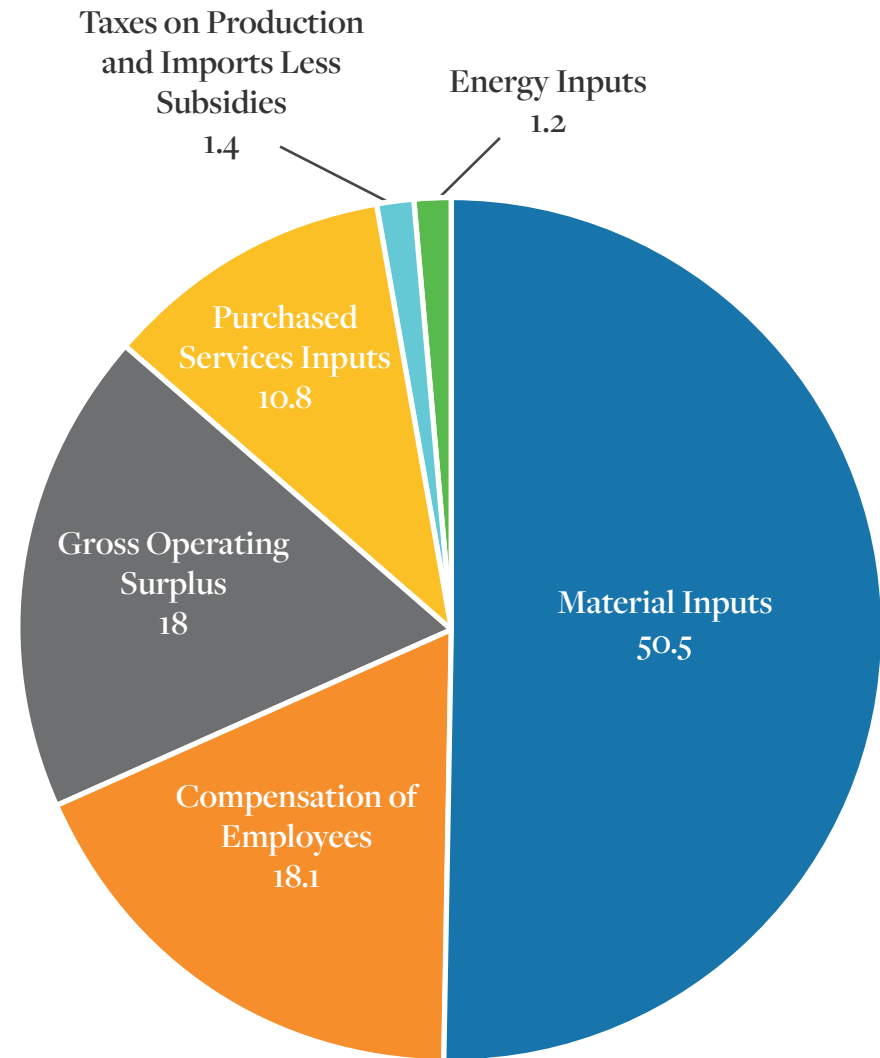
(1990 = 100)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics



2-11 Composition of Gross Output for \$6.3 Trillion of U.S. Manufacturing (2019)



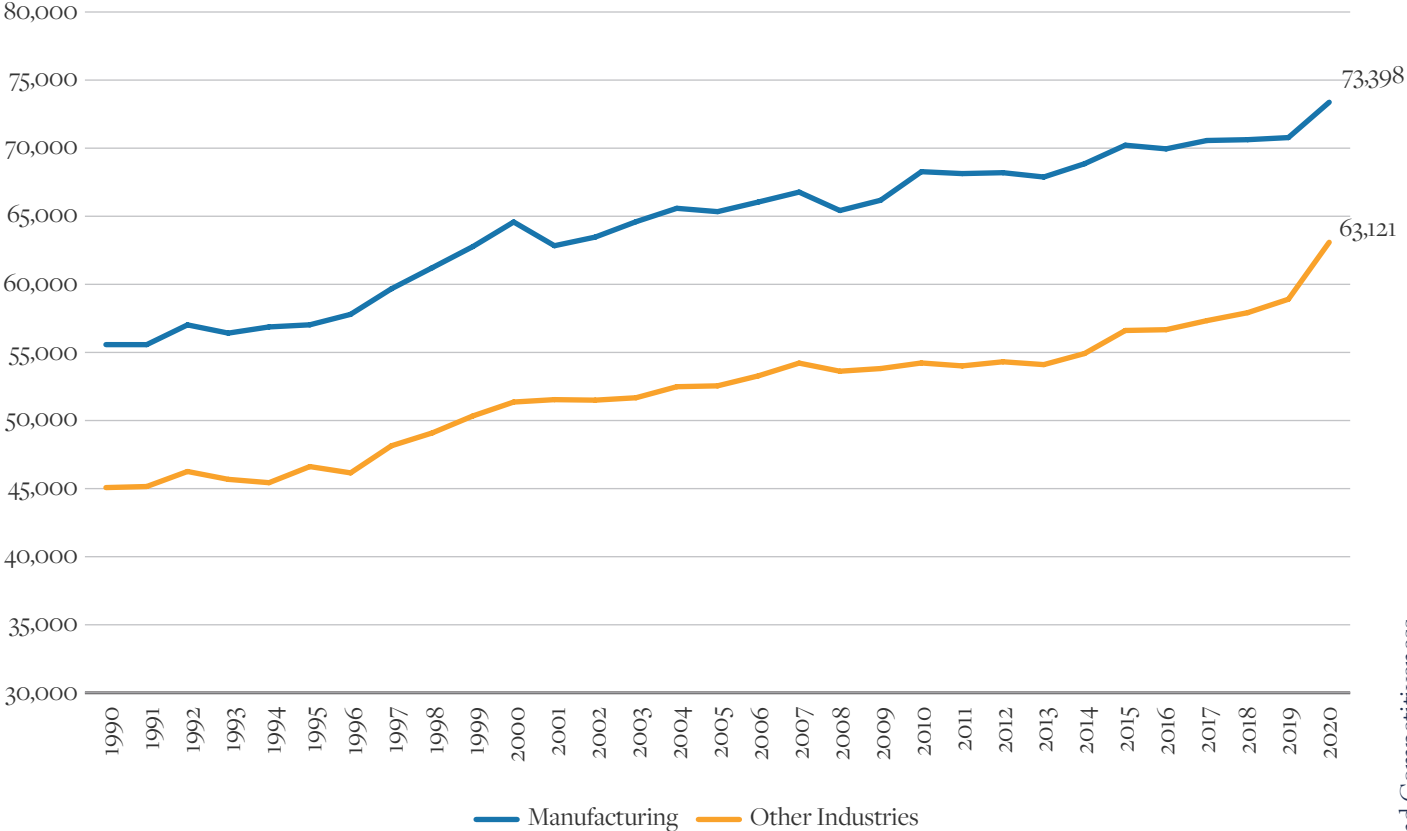
Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

Manufacturing Wages

Manufacturing continues to provide lower-skilled workers employment opportunities with higher-than-average annual wages and career ladders through on-the-job training that can lift wages over their working lives.

Indeed, Manufacturing wages are higher than wages in other industries. Interestingly, though, the increase in real average annual wages since 1990 was 32.2% compared to the increase in labor productivity of 102.3% percent — and compared to the increase in real wages in all other industries of 40.1%.

2-12 U.S. Real Average Annual Wages
(\$2020)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

California in Context

Manufacturing activity occurs in every state of the nation, but with more than 11% of all jobs in the nation, California's Manufacturing sector is also a major contributor to the national industry. California is the largest state contributor to national Manufacturing GDP, representing 14.5%, followed by Texas at 10.9%. Far behind are the contributions made by Ohio, Illinois, Indiana, North Carolina, Pennsylvania, and Michigan.

Manufacturing's value added in California has grown three-times the national rate, increasing almost 176% since 1997 compared to 51% growth for the nation. However, California's Manufacturing sector tumbled during the Great Recession and didn't fully recover until 2015, a quicker turnaround compared to the nation overall.

Manufacturing's contribution to GDP has hovered just above 11% for the last decade in California. In 2020, Manufacturing's contribution to GDP was 11.5% in the state, just below the 11.7% rate for the nation.

Indeed, Manufacturing accounts for a smaller share of overall GDP in California than many other states. Given California's diverse economic base, Manufacturing's 11.5% share of state product is far less than 27.8% in Indiana, 23.8% in Louisiana, 19.3% in Kentucky, 19% in Wisconsin, 18.7% in Michigan, and less than 11.5% in Alabama, North Carolina, Iowa, Mississippi, and Ohio, among others. While the Manufacturing sector is an important part of California's economy, the state does not depend solely on the contribution of Manufacturing.

Mirroring the national experience, the decline in Manufacturing employment in California has been dramatic, with 806,700 jobs lost between 1990 and 2020 (or -39%). The loss of durable Manufacturing jobs in the early 1990s was largely the result of reductions in national defense spending, which disproportionately impacted California's aerospace and defense industries. However, there were also declines for nondurable goods. From 1990 to 2020, Manufacturing employment in durable goods fell by -41%; for nondurable goods, employment fell by -35%.

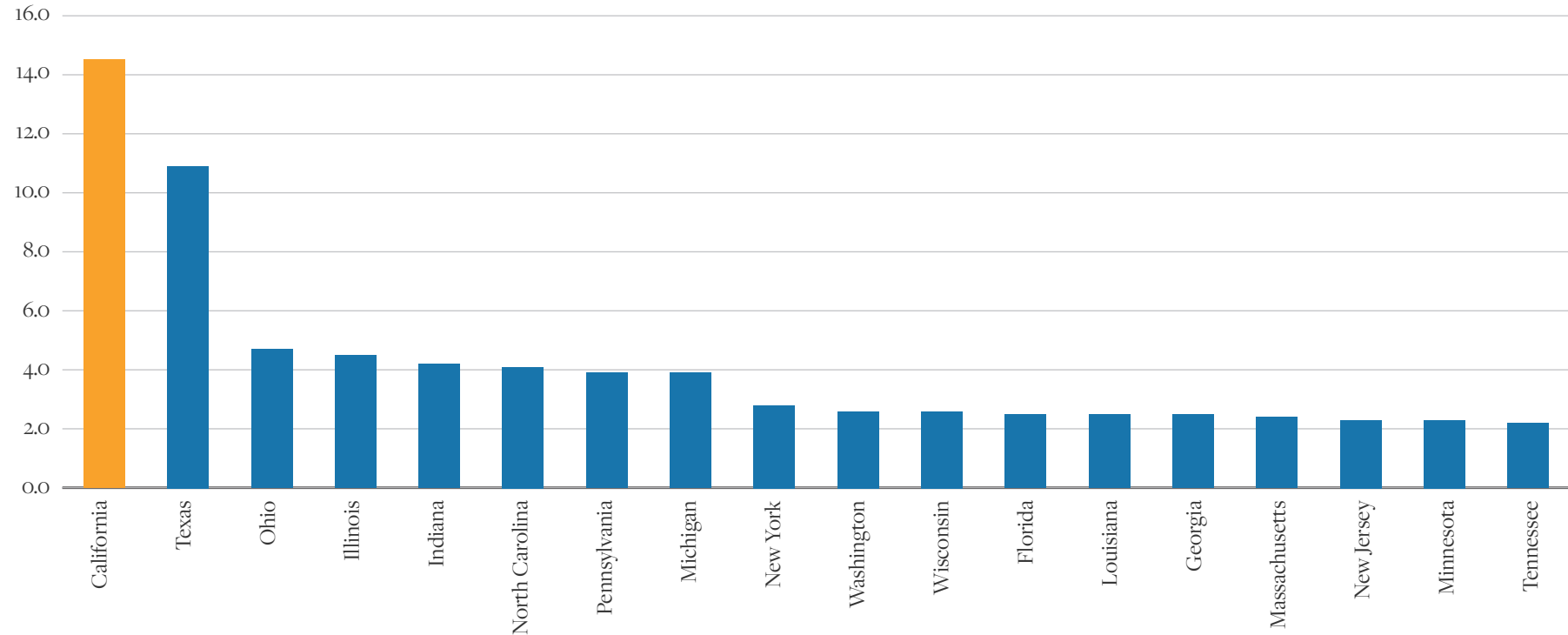
The overall declines since the turn of the century may be more related to transformational shifts or increased automation, consolidation, and off-shoring of low-skilled Manufacturing processes (industry changes versus a loss of demand for manufactured products).

As Manufacturing employment has declined faster in California than the nation, California's share of U.S. Manufacturing employment has also fallen from 15.6% in 1990 to 7.7% in 2020.

The decline in Manufacturing employment has been more than compensated by growth in employment in other industries. While Manufacturing declined by -39%, all other industries (including Government) grew 35% percent.

In 2020, goods-producing industries (Natural Resources, Mining, Construction and Manufacturing) accounted for 15.5% of all employment, while Services accounted for almost 69.8% (Government employment made up the remaining 14.7%). With such a large share of employment in Services and government sectors, the loss of Manufacturing jobs, while a cause for concern, has been offset by employment gains in other sectors.

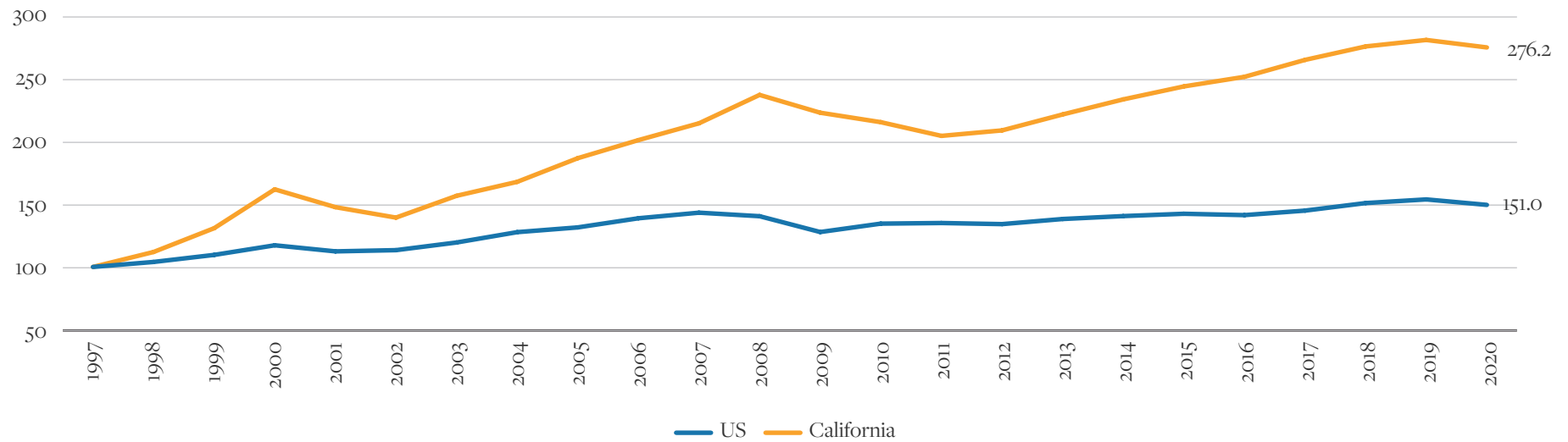
2-13 Contribution to National Manufacturing GDP (2020)



Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

2-14 Growth in Real Manufacturing GDP

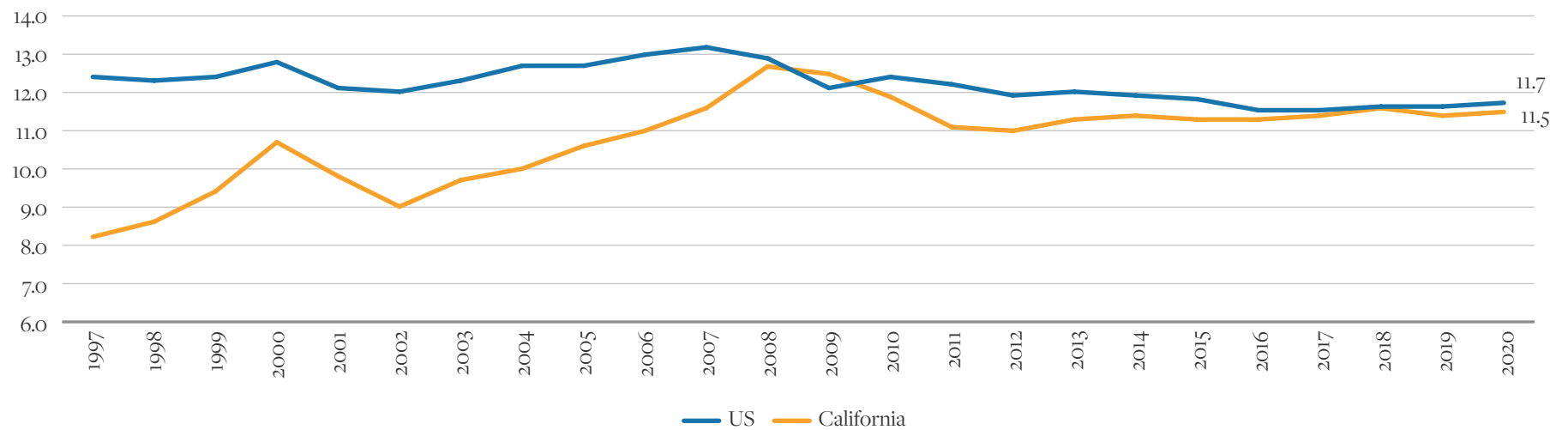
(1997 to 2020)



Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

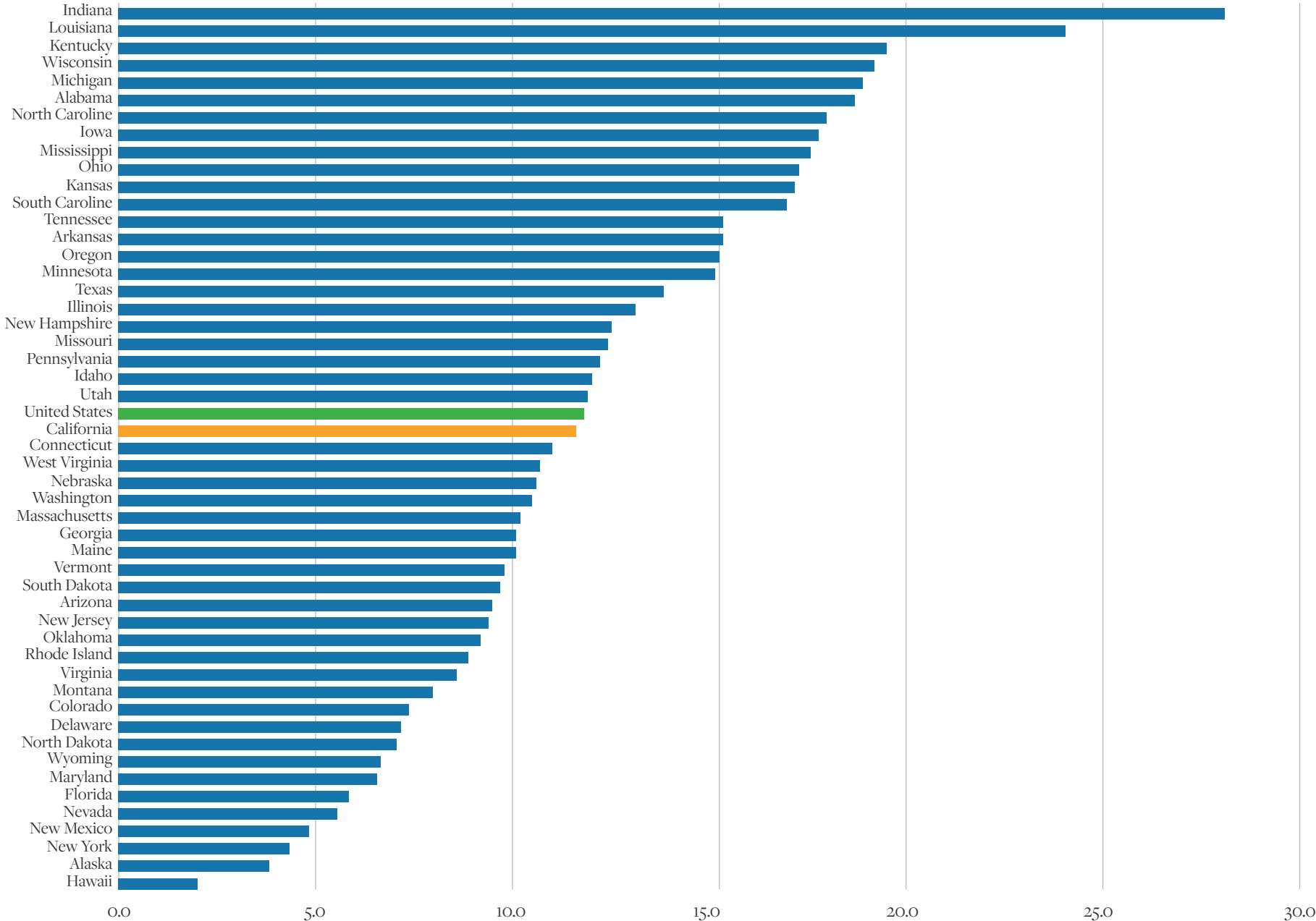
2-15 Manufacturing's Contribution to GDP

(1997 to 2020)



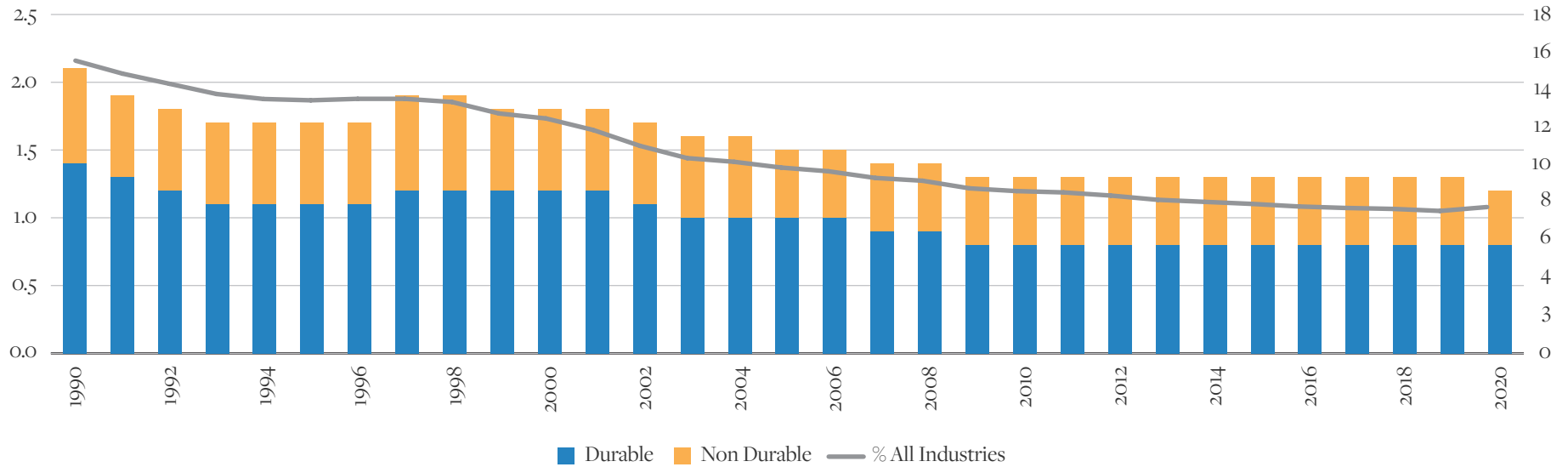
Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

2-16 Manufacturing GDP as Share of State GDP (2020)



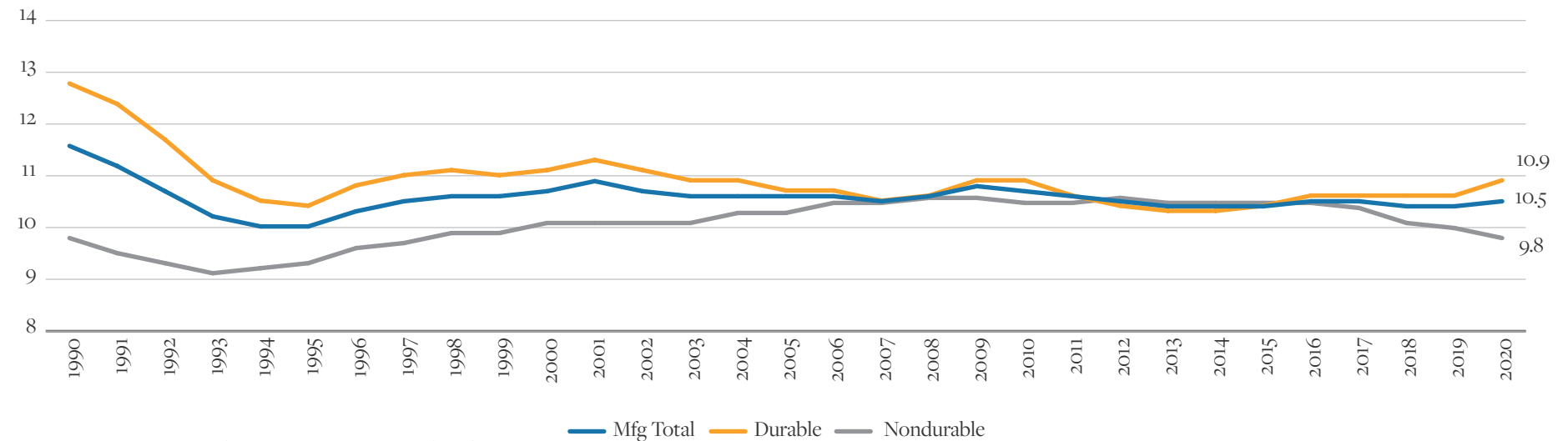
Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

2-17 California Manufacturing Employment (In millions)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

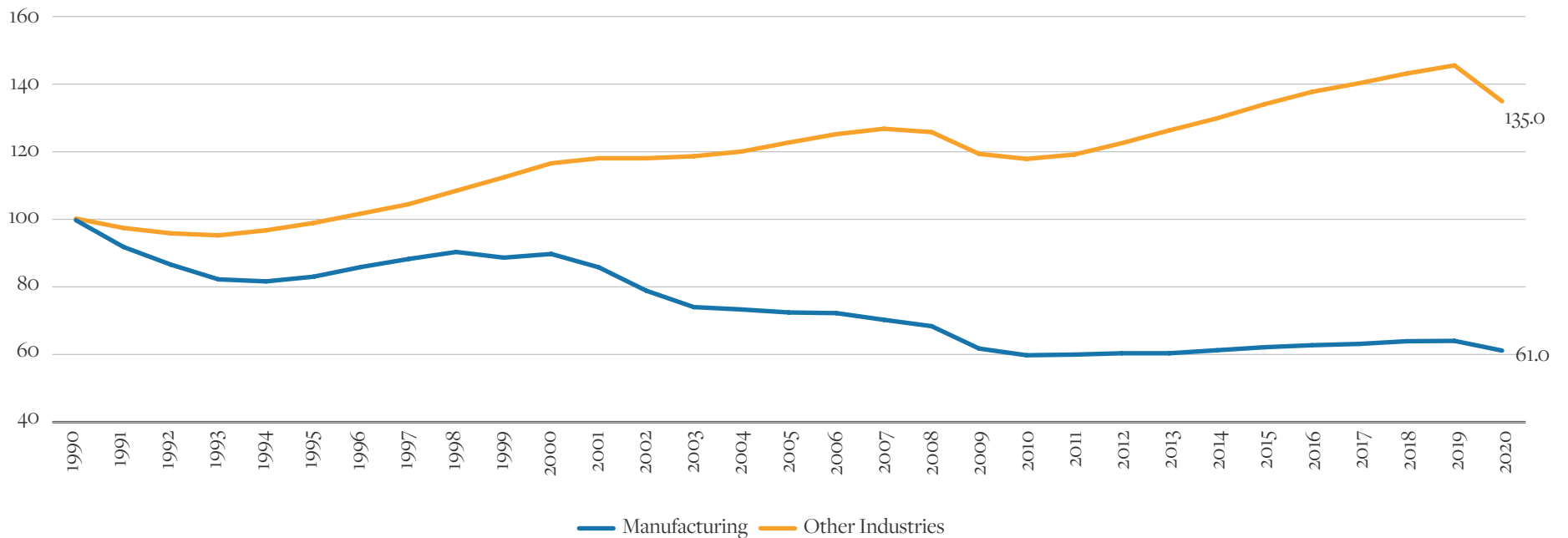
2-18 Manufacturing Employment California Share of US Manufacturing



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

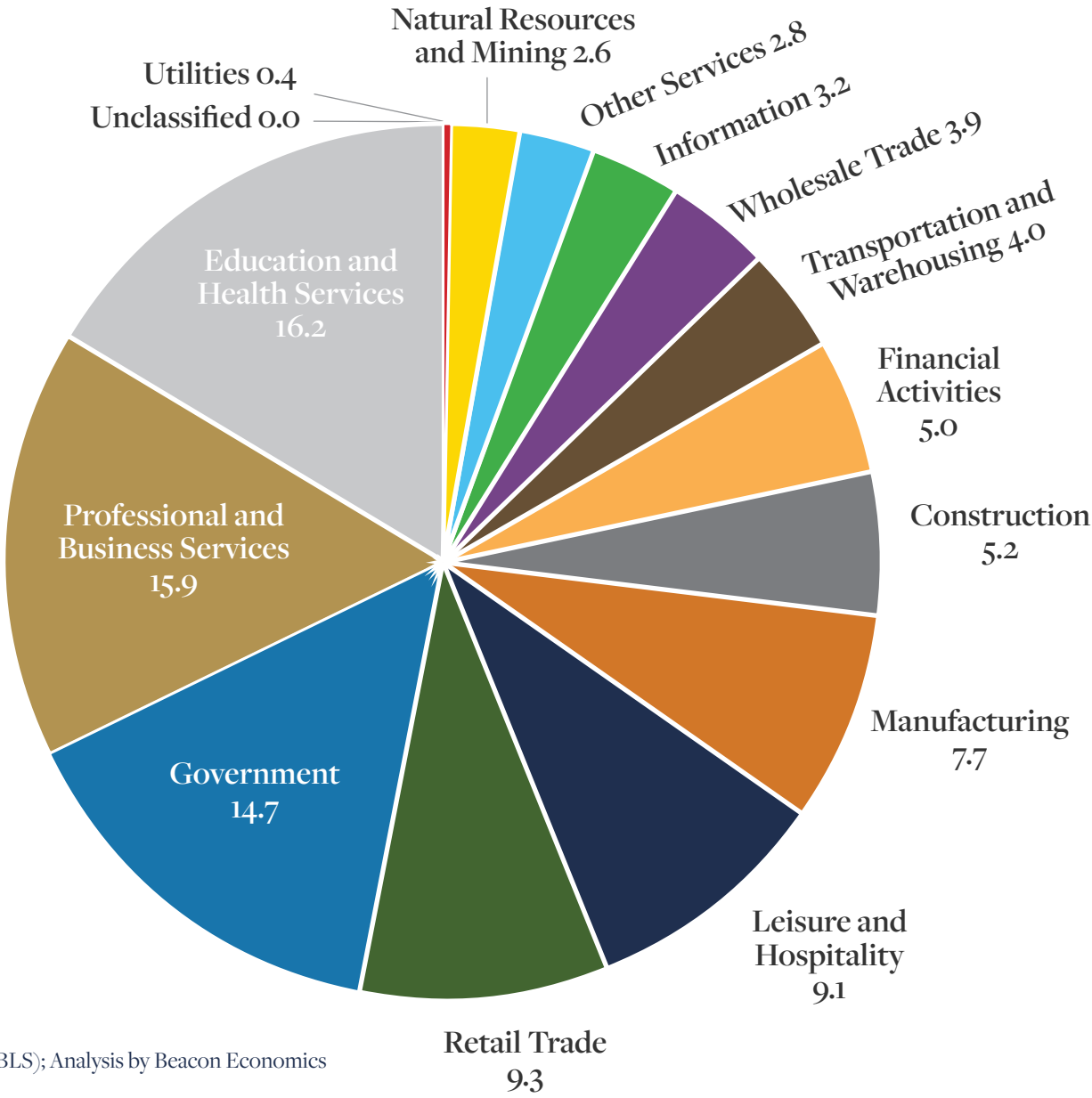


2-19 California Manufacturing Employment Indexed Growth (1990=100)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

2-20 CA Employment by Industry Sectors (2020)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Manufacturing Employment in California

Employment in Manufacturing is a measure of the number of jobs provided by businesses in the industry. Employment can be estimated at different levels of industry classifications and used to determine the current industry composition, long-run employment trends, track relative competitiveness, and observe Manufacturing workforce characteristics.

Manufacturing's Current Industry Composition in California

The first level of detail in Manufacturing employment is the three-digit industry subsector. There are 21 Manufacturing subsectors, with 10 non-durable and 11 durable-goods Manufacturing subsectors.

A mix of high-tech and low-tech industries (the three largest-emplying industry subsectors of computers and electronic product Manufacturing, food Manufacturing, and transportation) accounted for 44.6% of California's total Manufacturing employment in 2020.

Overall, the Manufacturing sector has average annual wages higher than average annual wages across all industries, but within Manufacturing there are wide disparities among subsectors. The industry subsector with the highest average annual wage (computer and electronic product Manufacturing) is four-times that of the subsector with the lowest (textile mills).



3-1 Manufacturing Employment by Industry Subsector California

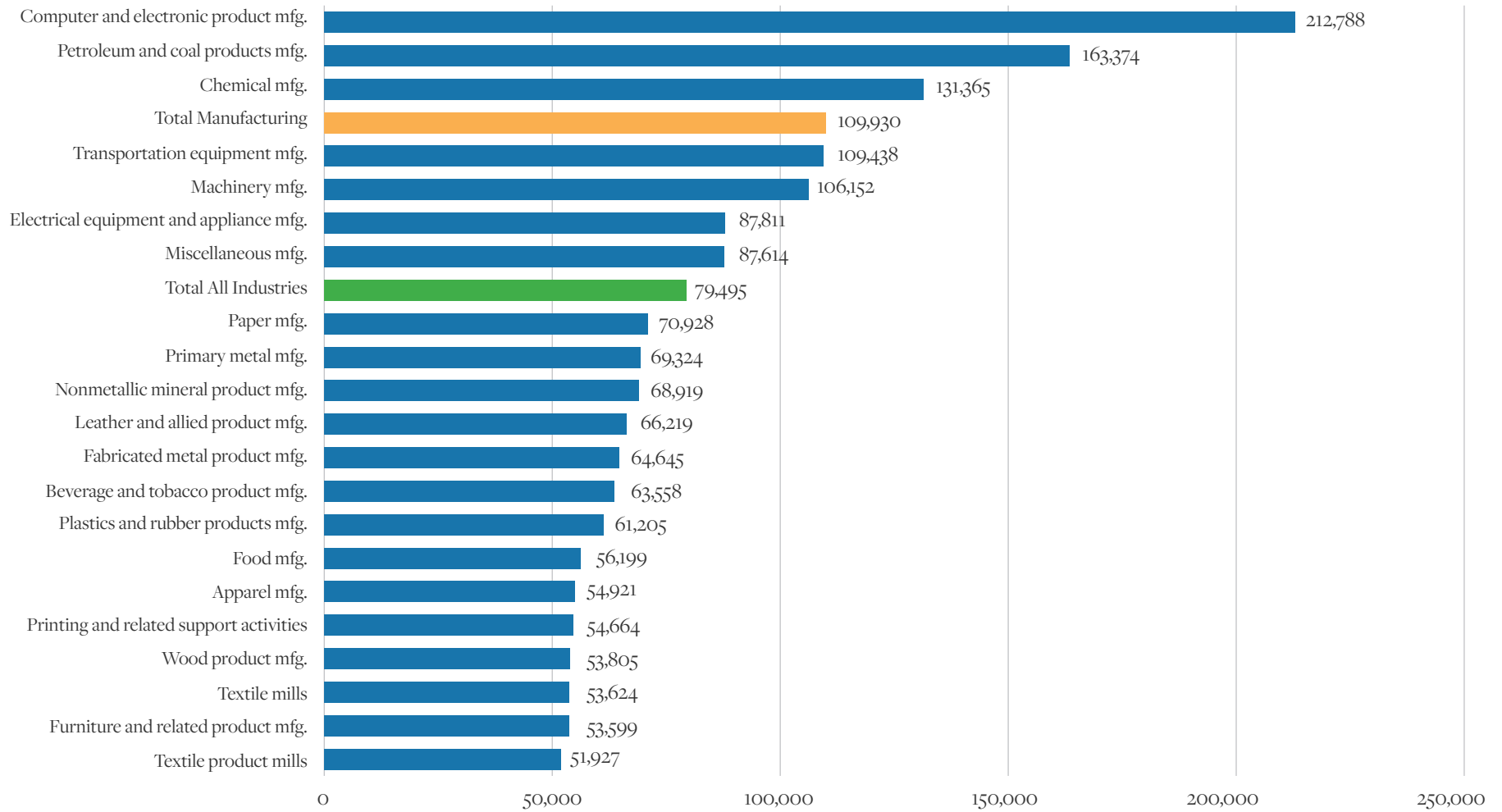
2020

NAICS	Industry Subsector	Jobs	Share of mfg. (%)
334	Computer and electronic product mfg.	282,409	22.4
311	Food mfg.	154,907	12.3
336	Transportation equipment mfg.	125,424	9.9
332	Fabricated metal product mfg.	124,062	9.8
339	Miscellaneous mfg.	81,973	6.5
325	Chemical mfg.	81,398	6.4
333	Machinery mfg.	74,225	5.9
312	Beverage and tobacco product mfg.	59,632	4.7
326	Plastics and rubber products mfg.	42,077	3.3
323	Printing and related support activities	32,165	2.5
327	Nonmetallic mineral product mfg.	30,676	2.4
337	Furniture and related product mfg.	30,000	2.4
335	Electrical equipment and appliance mfg.	28,348	2.2
315	Apparel mfg.	26,395	2.1
321	Wood product mfg.	25,545	2.0
322	Paper mfg.	20,060	1.6
331	Primary metal mfg.	15,853	1.3
324	Petroleum and coal products mfg.	12,414	1.0
314	Textile product mills	7,801	0.6
313	Textile mills	5,125	0.4
316	Leather and allied product mfg.	2,805	0.2
	TOTAL MANUFACTURING	1,263,294	100.0

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

3-2 Average Annual Wages in Manufacturing California

2020



Source: U.S. Bureau of Economic Analysis (BEA); Analysis by Beacon Economics

California's Largest Manufacturing Industries

Employment data at the industry group level provides a more detailed examination of Manufacturing sector performance. Larger industry subsectors are divided into their industry groups. For example, the computer and electronic product Manufacturing subsector includes: computer and peripheral equipment Manufacturing; communications equipment Manufacturing; audio and video equipment Manufacturing; semiconductor and other electronic component Manufacturing; navigational, measuring, electromedical, and control instruments Manufacturing; and Manufacturing and reproducing magnetic and optical media.

The 25 largest-employing Manufacturing industries across California in 2020 represented 24.7% of all Manufacturing employment in the state, accounting for over 312,000 jobs.

The largest industry group in terms of employment in California is electronic instrument Manufacturing, an industry group concentrated in Southern California that supplies highly technical satellite and radar systems to the aerospace industry group. With just over 93,000 jobs, this industry group accounted for 7.4% of all Manufacturing jobs in 2020. This industry group, along with the fourth-largest industry group of aerospace products and parts Manufacturing, accounted for more than 13.4% of all Manufacturing jobs in the state in 2020. The second largest industry group was semiconductor and electronic component, which is concentrated in Northern California.

3-3 Largest Manufacturing Industries by Employment California 2020

NAICS	Industry Subsector	Jobs	Share of mfg. (%)
3345	Electronic instrument mfg.	93,234	7.4
3344	Semiconductor and electronic component mfg.	81,411	6.5
3341	Computer and peripheral equipment mfg.	80,366	6.4
3364	Aerospace product and parts mfg.	75,955	6.0
3121	Beverage mfg.	59,503	4.7
3391	Medical equipment and supplies mfg.	54,196	4.3
3254	Pharmaceutical and medicine mfg.	46,440	3.7
3327	Machine shops and threaded product mfg.	40,427	3.2
3118	Bakeries and tortilla mfg.	38,241	3.0
3261	Plastics product mfg.	37,670	3.0
3119	Other food mfg.	34,767	2.8
3231	Printing and related support activities	32,165	2.5
3323	Architectural and structural metals mfg.	32,141	2.5
3399	Other miscellaneous mfg.	27,777	2.2
3114	Fruit and vegetable preserving and specialty	26,182	2.1
3152	Cut and sew apparel mfg.	24,179	1.9
3116	Animal slaughtering and processing	21,887	1.7
3332	Industrial machinery mfg.	20,360	1.6
3222	Converted paper product mfg.	18,940	1.5
3219	Other wood product mfg.	18,263	1.4
3371	Household and institutional furniture mfg.	17,687	1.4
3361	Motor vehicle mfg.	17,624	1.4
3115	Dairy product mfg.	16,921	1.3
3342	Communications equipment mfg.	16,878	1.3
3329	Other fabricated metal product mfg.	16,631	1.3
	<i>All other manufacturing industries</i>	321,178	24.7
	TOTAL MANUFACTURING	1,262,023	100.0

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Changes in Manufacturing Employment in California

Although the Manufacturing sector added jobs from 2010 to 2020, increases did not occur across all Manufacturing subsectors. Of the 21 Manufacturing subsectors, 11 subsectors gained jobs and 10 subsectors lost jobs during this period.

The largest number of jobs added from 2010 to 2020 was in transportation equipment Manufacturing; this subsector added 21,406 employees. Other subsectors adding a significant number of jobs over the period were beverage and tobacco product Manufacturing, computer and electronic product Manufacturing, food Manufacturing, and fabricated metal product Manufacturing.

The largest number of jobs lost from 2010 to 2020 was in apparel Manufacturing; this subsector shed 32,316 employees. Other subsectors losing a significant number of jobs over the period were printing and related support activities, textile mills, petroleum and coal product Manufacturing, and primary metal Manufacturing.

Variations in Manufacturing across California over the last decade can be examined in more detail by looking at changes across industry groups. In terms of largest number of jobs added, computer and peripheral equipment Manufacturing added 23,679 jobs from 2010 to 2020. Other industry groups adding a significant number of jobs over the period include beverage Manufacturing, motor vehicle Manufacturing, other food Manufacturing, and aerospace.

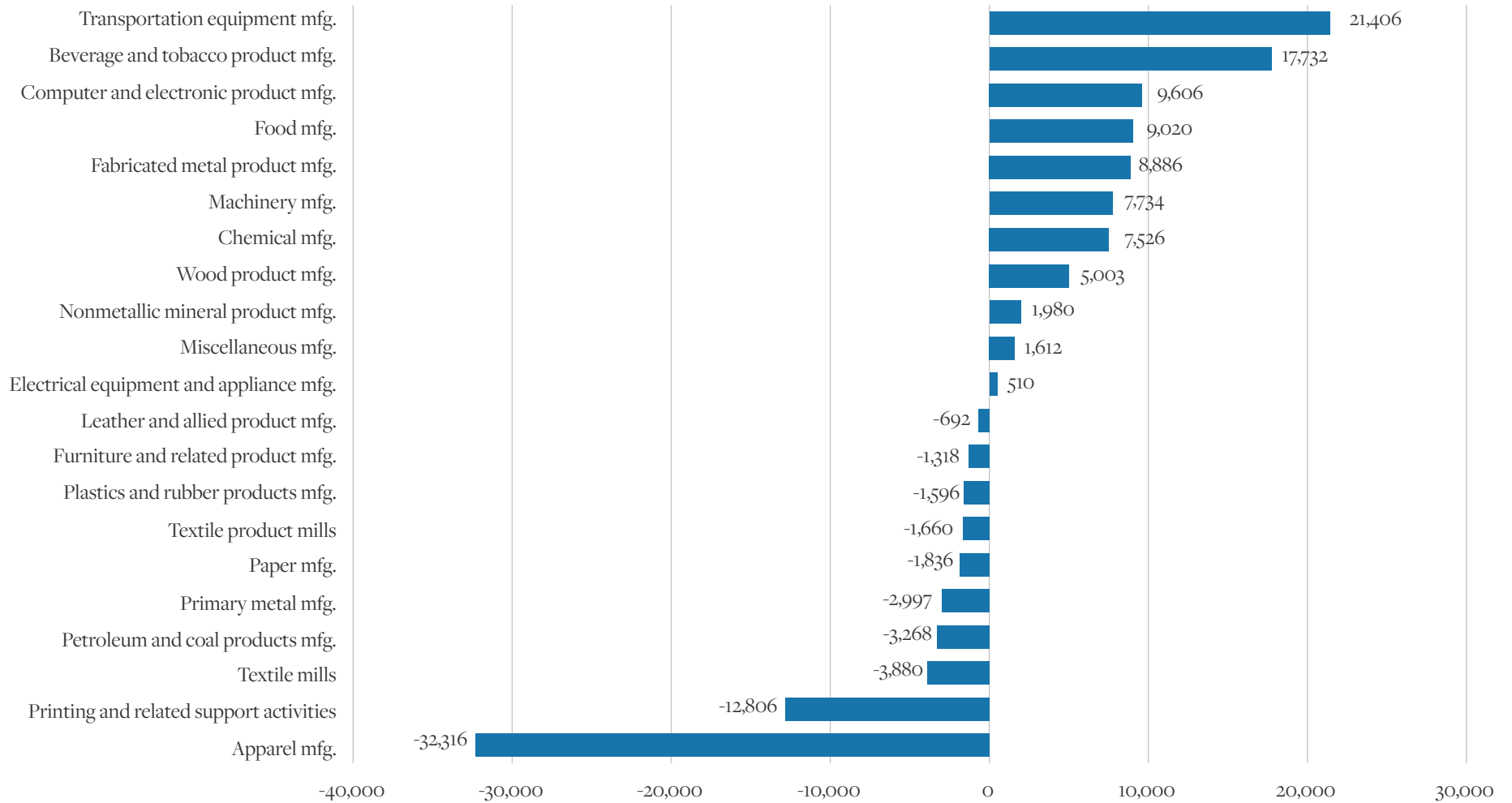
In terms of largest number of jobs lost, cut-and-sew apparel Manufacturing shed 29,845 positions from 2010 to 2020. Other industry groups losing a significant number of jobs over the period were printing and related support activities, communications equipment Manufacturing, semiconductor and electronic component Manufacturing, and fruit and vegetable preserving.

A handful of industry groups have seen their footprint in California grow significantly over the last decade. Motor vehicle Manufacturing and railroad rolling stock Manufacturing are now four-times the size they were in 2010. In addition, other food Manufacturing and industrial machinery have increased employment by over 50%. The increases have not been across the board, however. California's apparel industry continues to be in decline, with apparel knitting mills, cut-and-sew apparel Manufacturing, textile and finishing mills, fiber-yarn-thread mills, and fabric mills leading the declines in percentage terms.

For complete employment and wage data by industry subsector and industry group, see tables A-1 and A-2 in the Appendix.

3-4 Manufacturing Employment by Subsector

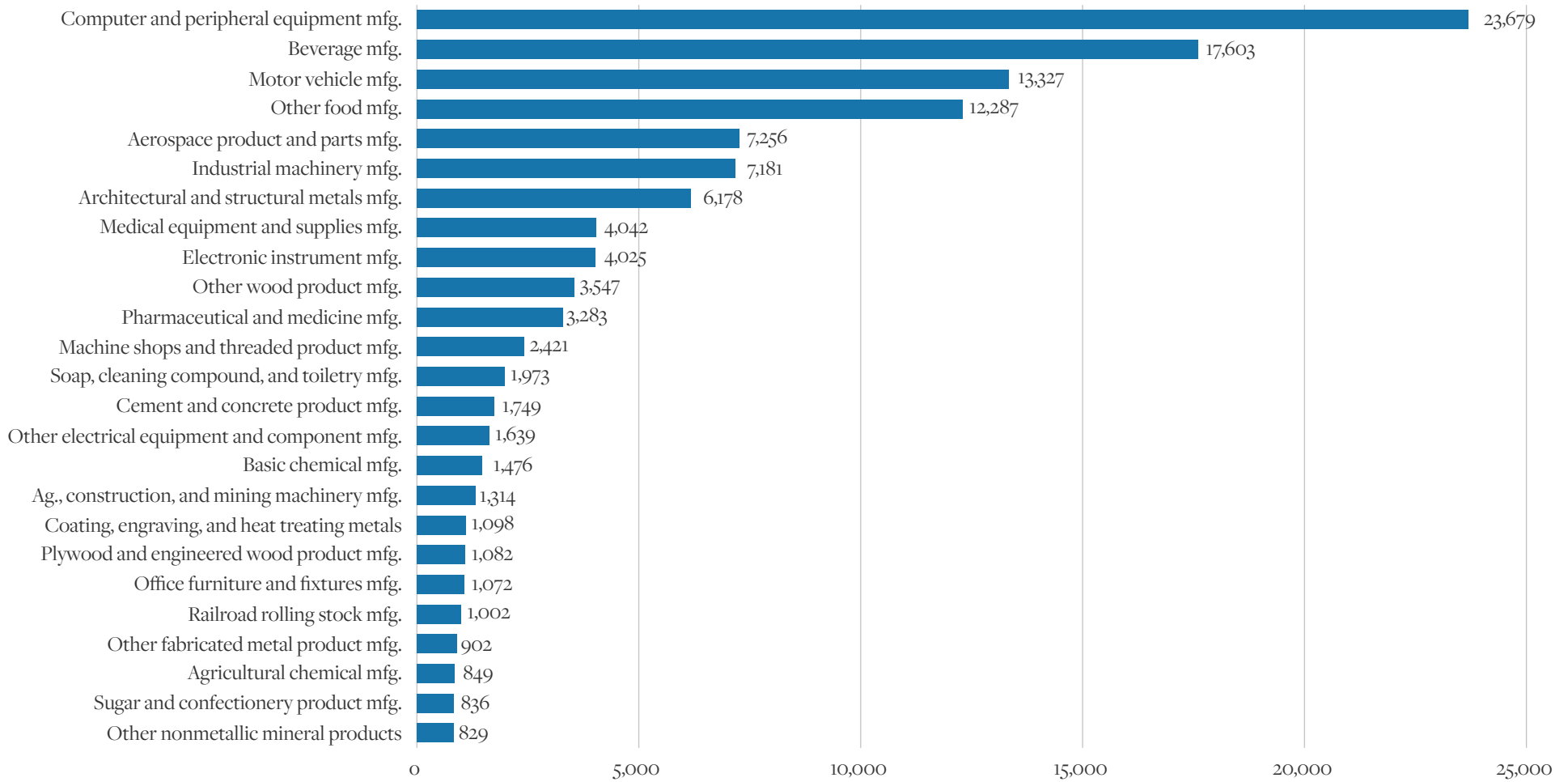
Change from 2010 to 2020



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

3-5 Manufacturing Industry Groups with Largest Employment Increases

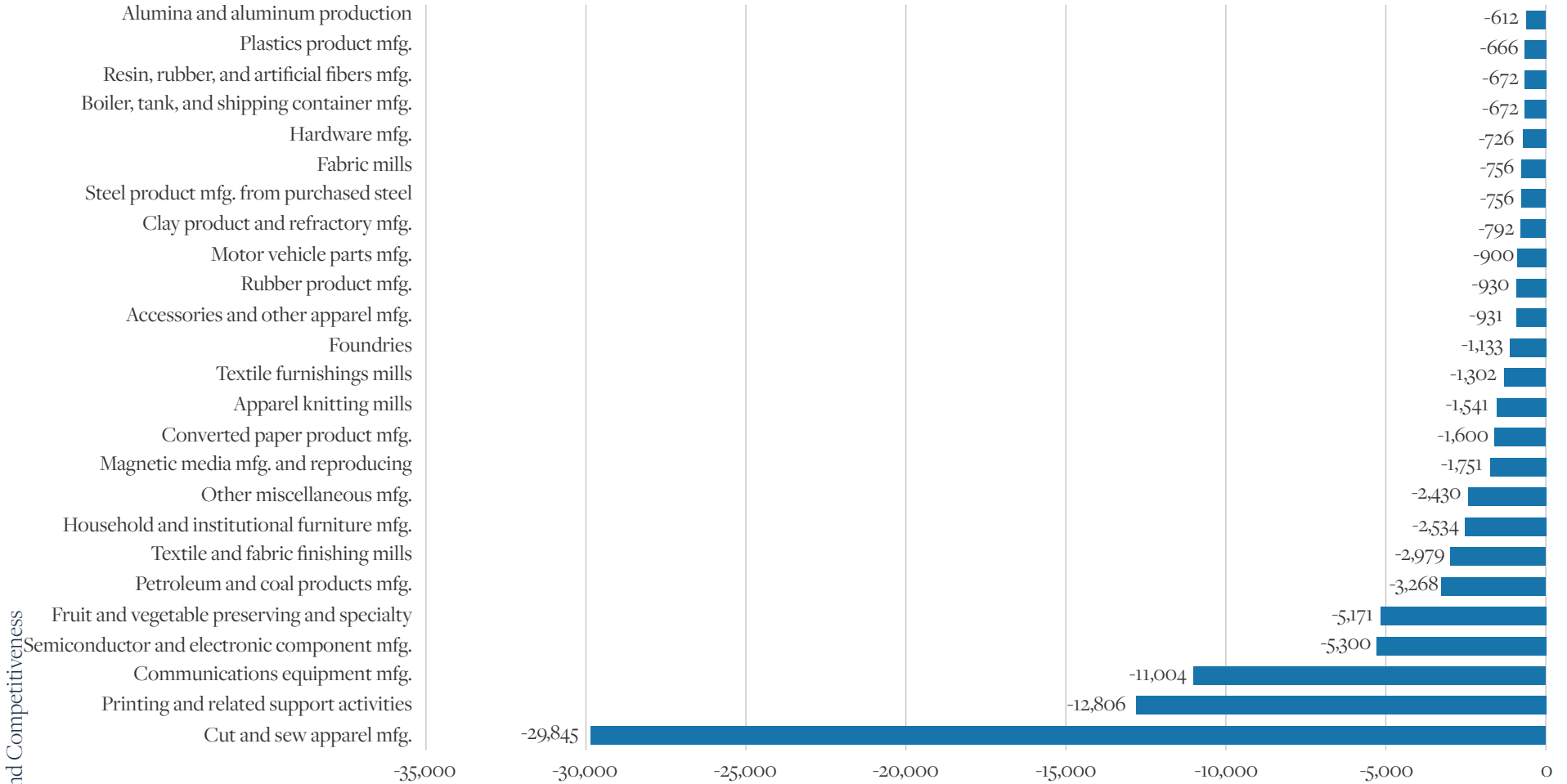
Change from 2010 to 2020



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

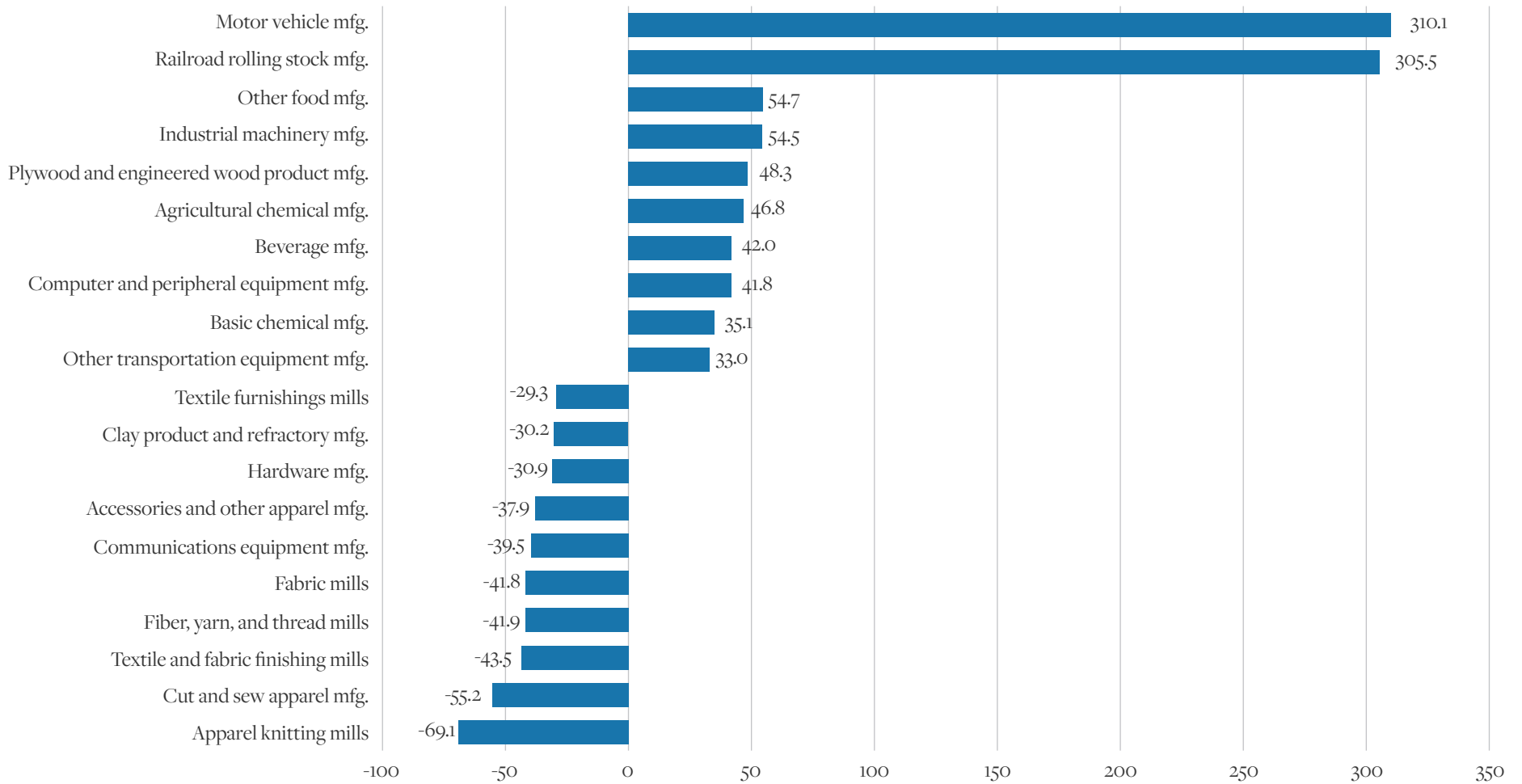
3-6 Manufacturing Industry Groups with Largest Employment Decreases

Change from 2010 to 2020



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

3-7 Industry Groups with the Largest Increases/Decreases by Percentage Change from 2010 to 2020



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

California's Manufacturing Workforce

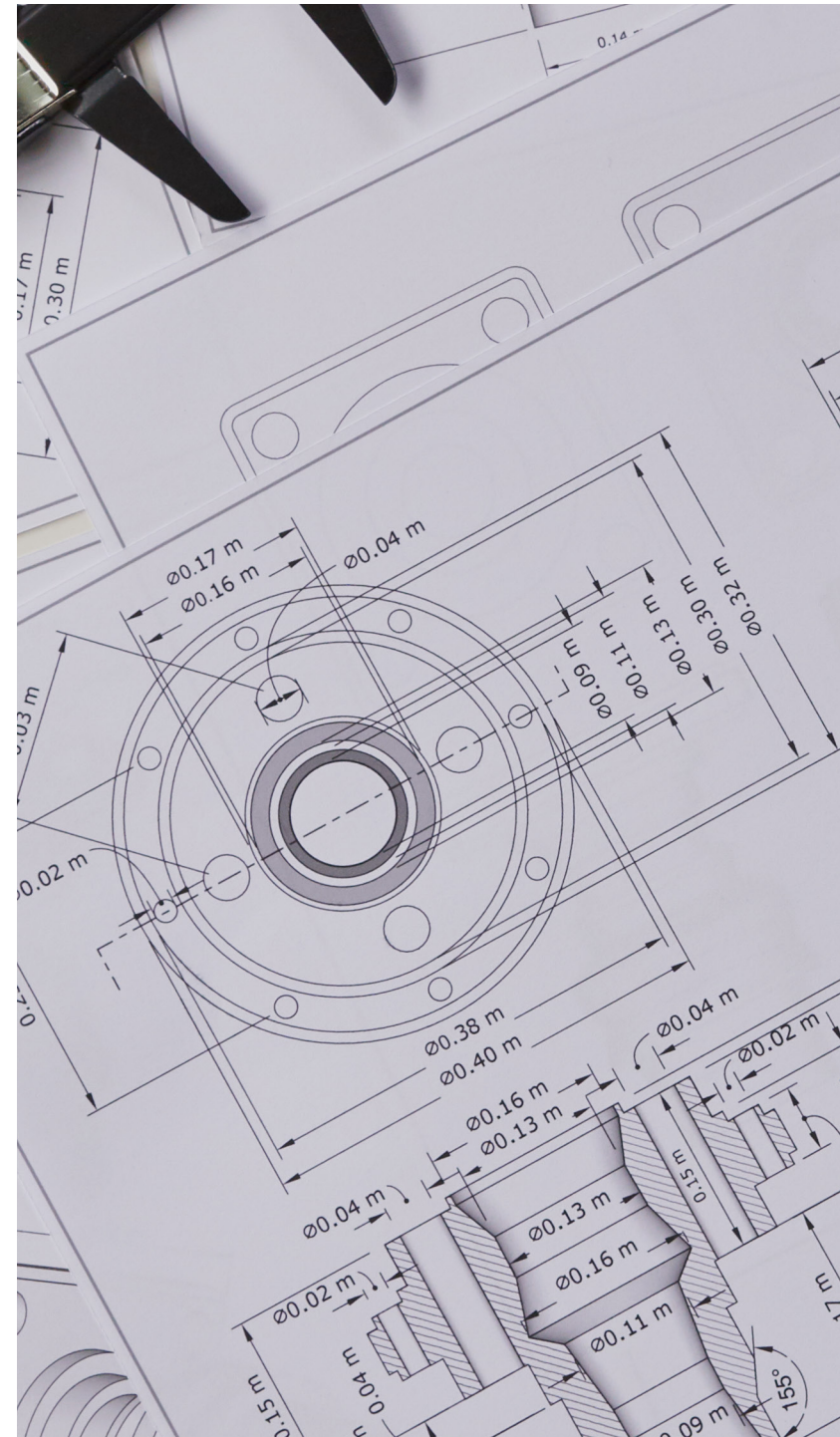
There are a variety of occupations in California's Manufacturing sector, with jobs on the production line, in accounting, sales, office and administrative services, engineering and computer sciences. More than 41% of the state's Manufacturing jobs are in production occupations. These include machinists, welders and cutters, team assemblers, machine operators, inspectors, testers, production helpers, and many others. Comparatively, more than 50% of U.S. Manufacturing workers are in production occupations, which suggests a higher degree of automation and technological intensity in California than the nation.

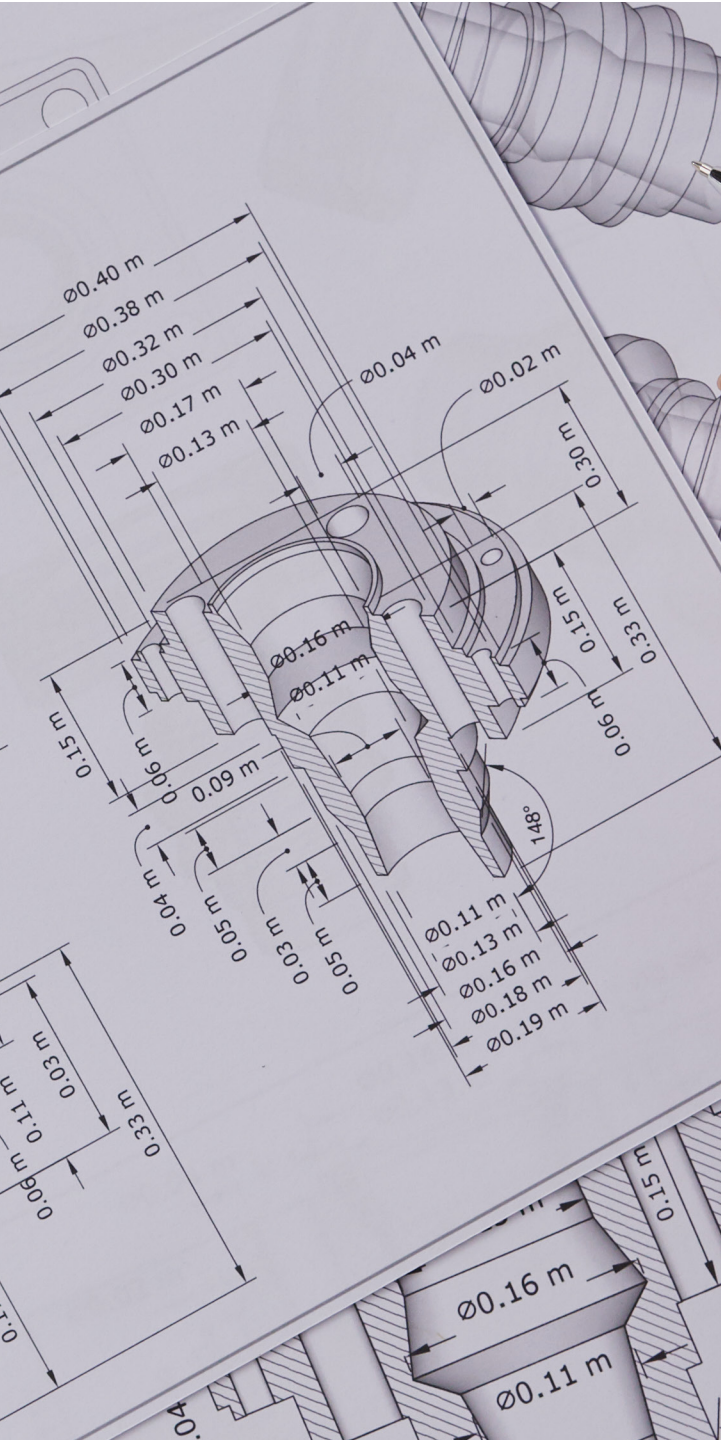
In California, office and administrative occupations account for 9% of all Manufacturing jobs; architectural and engineering occupations (mostly engineering) are 7.9%; and computer and mathematical occupations are 6.2%. At the national level, the share of workers in architectural and engineering occupations is less than 6.6%, and computer and mathematical occupations are 2.6%, further supporting the notion that Manufacturing is more technologically intensive in California than other areas.

Median annual wages vary widely across these occupational groups, with the highest earning occupational group (management) garnering \$155,710 and the lowest earning occupational group (transportation and material moving) receiving \$36,190. Meanwhile, the median annual wage for Manufacturing in California is \$50,220, just above \$47,290 for all occupational groups in the state.

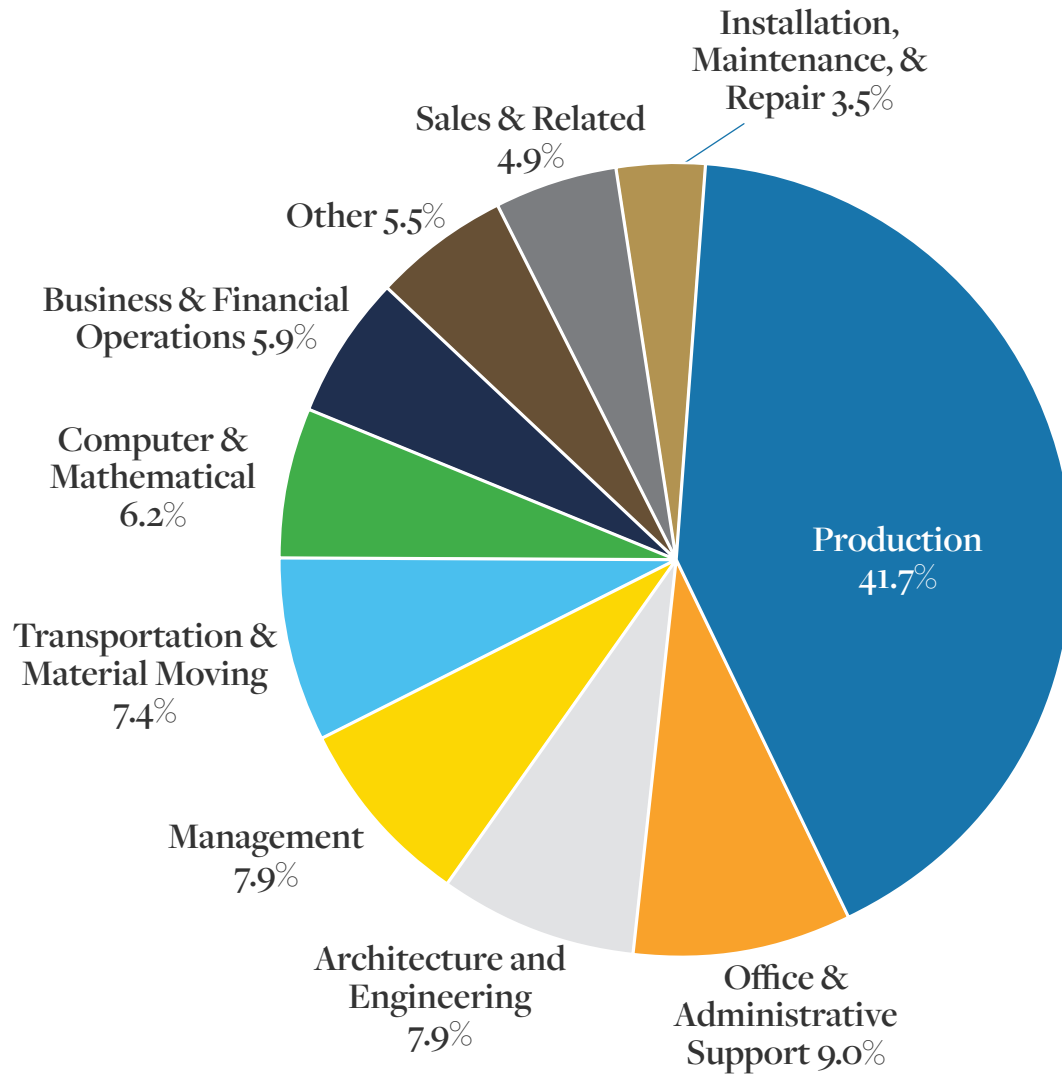
Given the wide range of occupations, it is expected a diversity of knowledge, skills and abilities would be needed. In fact, 63% of all jobs in Manufacturing require a high school diploma (or equivalency) only for an entry-level job, and 12.1% of positions are open to candidates without a high school diploma. Another 19% requires a bachelor's degree, and only 0.3% requires a post-graduate degree.

Work experience required for an entry-level position can often be used as a substitute for formal education or training. This would imply many job entrants gain on-the-job training and work experience to gain whatever competency is needed in their roles. This reinforces the notion that Manufacturing provides employment for workers at all skill levels and levels of education, providing well-paying job opportunities for those without a high school diploma and those with post-graduate degrees.



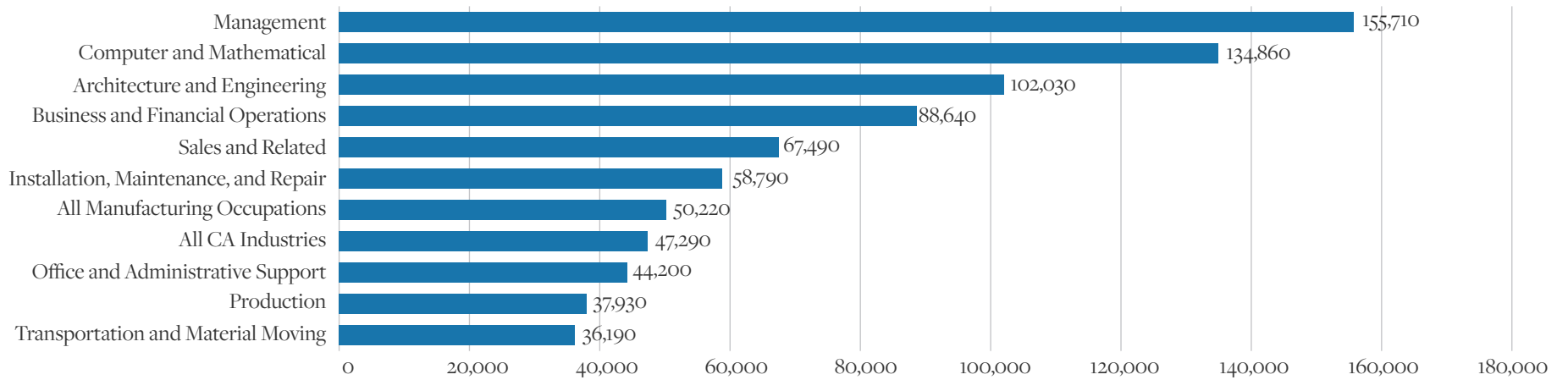


3-8 Occupational Distribution CA Manufacturing Sector By Major Occupation Group



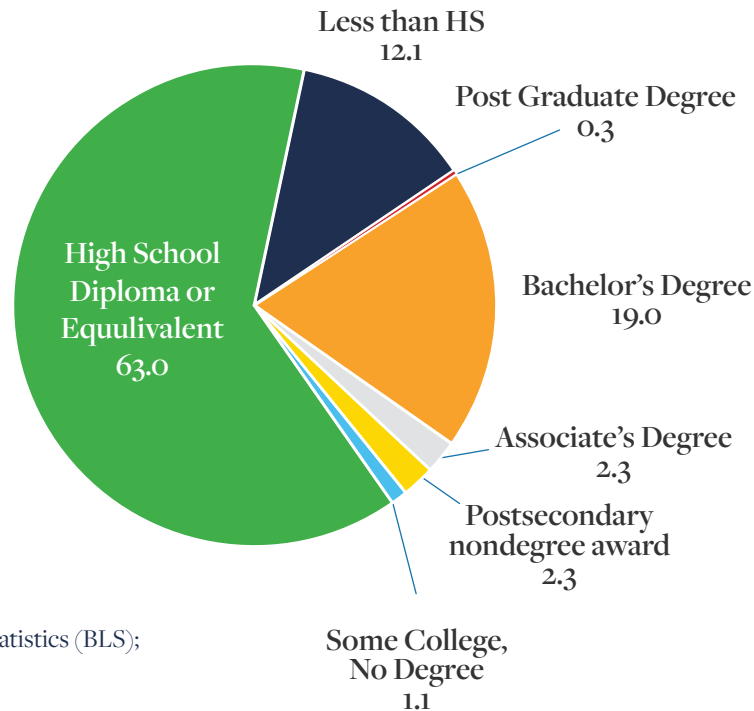
Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

3-9 Median Wages in the CA Manufacturing Sector By Major Occupation Group



Source: U.S. Bureau of Labor Statistics (BLS)

3-10 Entry Level Education Required



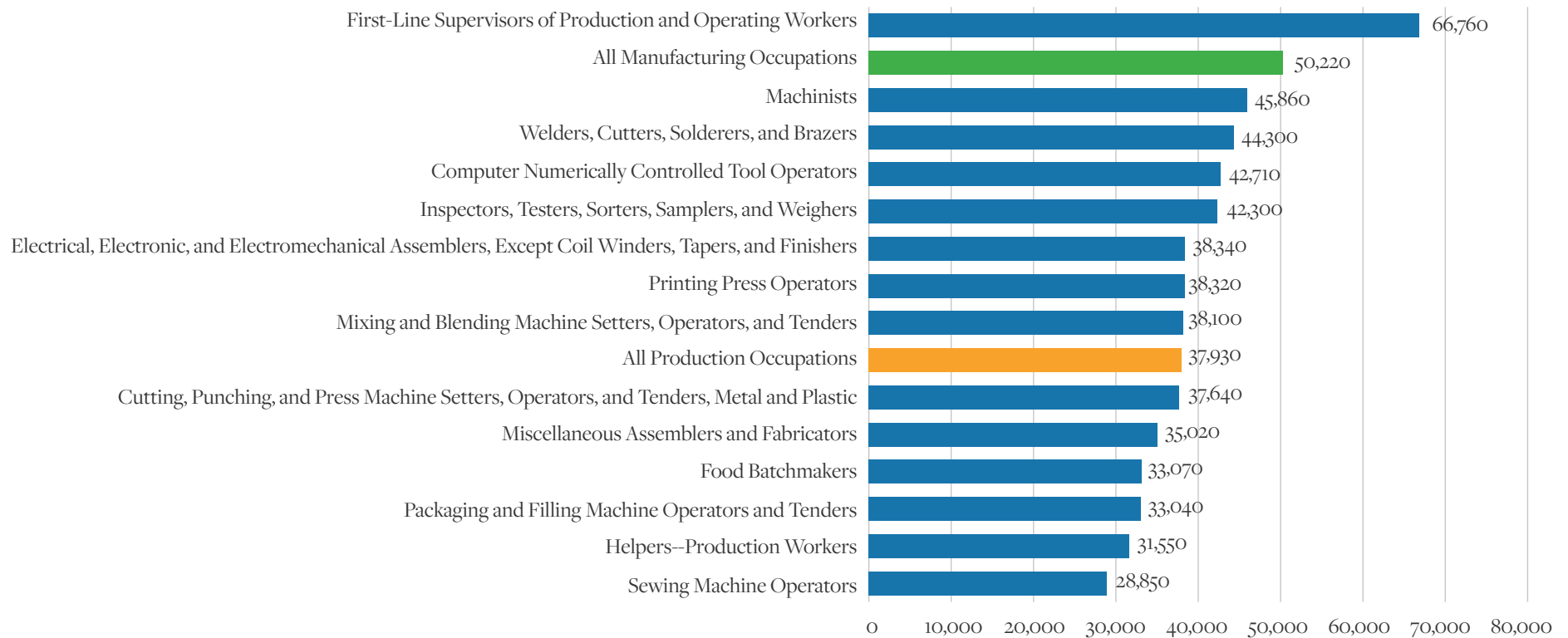
Source: U.S. Bureau of Labor Statistics (BLS);
Analysis by Beacon Economics

Production Workers in California

Workers directly involved in the production of goods, such as machinists, welders, assembly workers, first-line supervisors, layout specialists and machine setters, and operators and tenders are categorized in the major occupational group of production occupations. It is commonly thought these types of occupations are more accessible to lower-skilled workers and that many such occupations pay relatively high wages. These details may not be particularly evident in the data presented above relating to major occupational groups.

Despite the move toward higher-technology processes and tools in Manufacturing industries, production occupations are typically still the occupations with the lowest median wages. Production occupations in California, overall, earned \$37,930, roughly 75% of the Manufacturing median. Only first-line supervisors earned higher median wages.

3-11 Median Wages in the CA Manufacturing Sector For Production Occupations



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

California's Competitiveness in Manufacturing

Understanding the details of employment in California's Manufacturing industries and recent trends provides a clear picture of current conditions and a look-back to the recent past. However, these indicators do not give a clear picture of California's Manufacturing industries relative to other regions. Employment competitiveness is a function of many factors, including relative costs of inputs such as labor and energy and the productive capability of individual companies. There are two tools that may be helpful in assessing competitiveness using employment data. These are *employment concentration* and *technological intensity*.

Employment Concentration and Competitiveness

Location quotient, which is the ratio of the percentage of total employment in an industry in the region of interest compared to that same percentage nationally, provides a simple measure of employment concentration to compare the importance of an industry in a region with a larger region. For example, if 6.8% of employment in California is in apparel Manufacturing and only 2% across the nation, then the location quotient for fashion in California is 3.4. A location quotient of 1 would indicate the local industry concentration is identical to that of the nation in terms of employment concentration.

A higher location quotient is an indication the industry is relatively more concentrated regionally than the national average. This is evidence of clustering activity. One interpretation of such concentration is that existing conditions in the region are conducive to the success of that industry. Competitive advantage can be the result of well-developed supplier networks, a supply of skilled labor, proximity to transportation networks, adequate infrastructure, or access to natural resources.

Of 21 Manufacturing industry subsectors, four in California demonstrate a competitive edge in terms of their location quotient. These include apparel Manufacturing, computer and electronic products Manufacturing, beverage and tobacco product Manufacturing, and miscellaneous Manufacturing (which includes medical devices, sporting goods and musical instruments). Petroleum and coal products Manufacturing and leather and allied products Manufacturing have a location quotient of 1 and match the employment concentration in the nation overall.

At the bottom of the list are primary metal Manufacturing, textile mills, paper Manufacturing, plastics and rubber Manufacturing, and wood product Manufacturing. These industry subsectors are less concentrated in terms of employment than in the nation.

Given the size of California's economy, a lack of competitiveness does not mean these industries are not large sources of employment. However, even if industry employment in the state is significant in terms of employment levels, a location quotient of less than 1 means the industry is not as vital to the regional economy as it may be in other regions.

Since industry subsectors are aggregations of industry groups, it is possible California may have employment concentration in specific industry groups that are part of a larger subsector without high-employment concentration. There are 19 competitive Manufacturing industries in California based on location quotient. This includes a diverse set of industries related to fashion and apparel, high-tech industries involving computers and semiconductors, aerospace parts and instrumentation, medical and pharmaceutical Manufacturing, and food and beverage Manufacturing.

4-1 Competitiveness of Manufacturing Industry Subsectors California

2020

NAICS	Industry	LQ
315	Apparel mfg.	2.5
334	Computer and electronic product mfg.	2.3
312	Beverage and tobacco product mfg.	1.9
339	Miscellaneous mfg.	1.2
316	Leather and allied product mfg.	1.0
324	Petroleum and coal products mfg.	1.0
311	Food mfg.	0.8
325	Chemical mfg.	0.8
332	Fabricated metal product mfg.	0.8
323	Printing and related support activities	0.7
337	Furniture and related product mfg.	0.7
336	Transportation equipment mfg.	0.7
314	Textile product mills	0.7
327	Nonmetallic mineral product mfg.	0.7
335	Electrical equipment and appliance mfg.	0.6
333	Machinery mfg.	0.6
321	Wood product mfg.	0.5
326	Plastics and rubber products mfg.	0.5
322	Paper mfg.	0.5
313	Textile mills	0.5
331	Primary metal mfg.	0.4
TOTAL MANUFACTURING		0.9

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

4-2 Competitiveness of Manufacturing Industry Groups California

2020

NAICS	Industry	LQ
3341	Computer and peripheral equipment mfg.	4.3
3346	Magnetic media mfg. and reproducing	3.4
3152	Cut and sew apparel mfg.	2.9
3343	Audio and video equipment mfg.	2.7
3121	Beverage mfg.	1.9
3345	Electronic instrument mfg.	1.9
3344	Semiconductor and electronic component mfg.	1.9
3342	Communications equipment mfg.	1.7
3169	Other leather product mfg.	1.6
3332	Industrial machinery mfg.	1.5
3391	Medical equipment and supplies mfg.	1.5
3351	Electric lighting equipment mfg.	1.3
3114	Fruit and vegetable preserving and specialty	1.3
3119	Other food mfg.	1.3
3364	Aerospace product and parts mfg.	1.3
3133	Textile and fabric finishing mills	1.3
3254	Pharmaceutical and medicine mfg.	1.3
3159	Accessories and other apparel mfg.	1.2
3118	Bakeries and tortilla mfg.	1.1

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

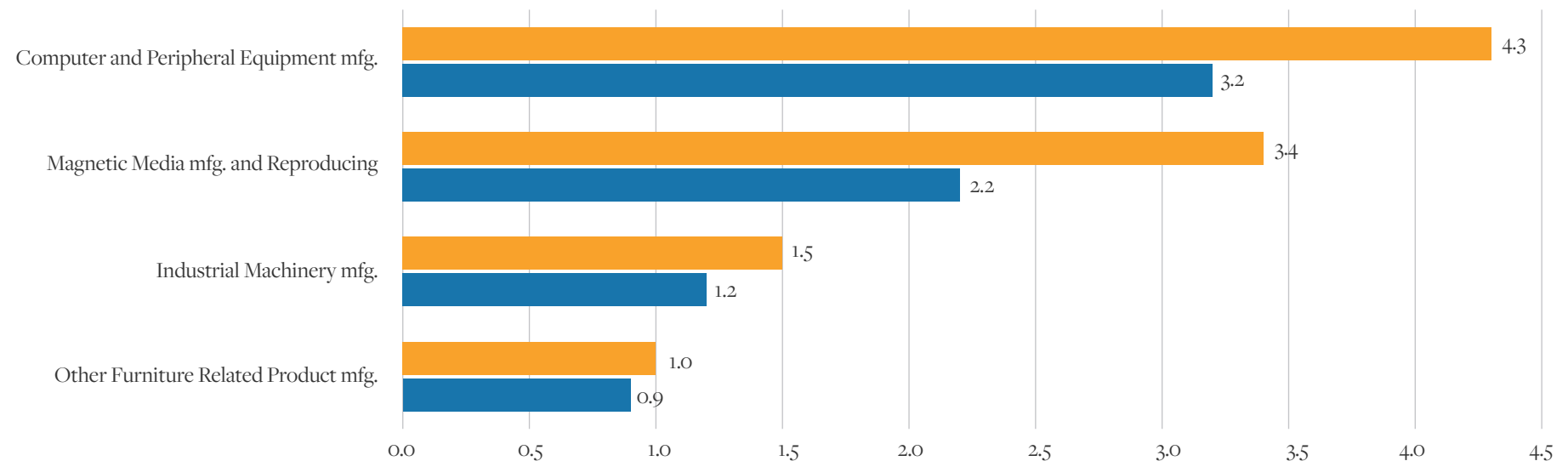
Performance of Competitive Industry Groups

Industries can become more or less concentrated over time. Increased relative concentration occurs when employment in the industry grows in the region faster than the nation, while decreased relative concentration occurs when employment is growing faster elsewhere than regionally. This can also mean other industries in the region are growing faster at the industry's expense. These are measured by changes in location quotients over time.

California has seen some competitive industries become stronger since 2010 in terms of location quotients. These include computer and peripheral Manufacturing, magnetic media Manufacturing, industrial Manufacturing, and other furniture-related product Manufacturing.

The state has also experienced some competitive industries losing strength since 2010. Nine industry groups have lost competitive strength since 2010, including cut-and-sew apparel Manufacturing, beverage Manufacturing, communications equipment Manufacturing, other leather product Manufacturing, and fruit and vegetable preserving.

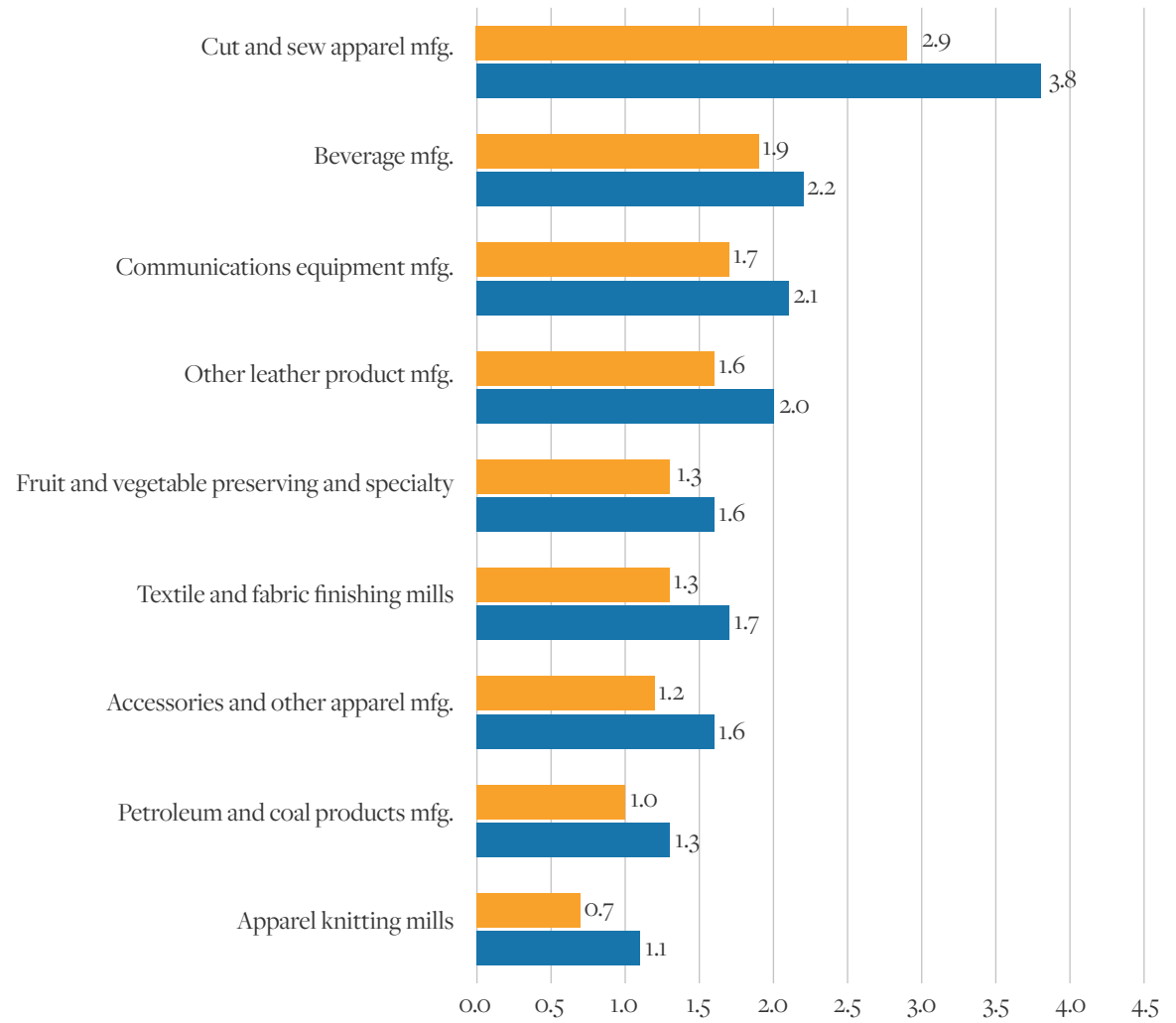
4.3 Competitive Mfg Industries That Grew Stronger



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics



4-4 Competitive Mfg Industries That Lost Strength



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Size, Competitiveness, and Performance

Because location quotients are calculated using relative employment shares of two separate geographies (California and the United States in our example), changes in location quotient can be the result of employment changes in either geography.

As a result, changes in the state's location quotient accompanied by little or no change in employment indicate a change in the industry's employment at the national level. Conversely, changes in state employment accompanied by little or no change in the location quotient indicate a concurrent change in industry concentration nationwide.

There are four combinations of changes in location quotient and employment: 1) those increasing in competitiveness and getting larger in terms of employment; 2) those increasing in competitiveness but getting smaller; 3) those losing competitiveness and getting larger; and 4) those losing competitiveness and getting smaller.

Simultaneous growth in employment and industry concentration is intuitive. Businesses in such industries have chosen to locate in California, are performing well enough to increase employment, and are growing faster than elsewhere, thus increasing their regional competitive strength. Industries in California that fit into this category include computer and peripheral equipment Manufacturing, other food Manufacturing, and industrial equipment Manufacturing.

A competitive industry that is growing in relative employment concentration while experiencing job losses implies industry employment across the nation as a whole is also declining, but at a faster rate. The only industry in this category is magnetic media Manufacturing and reproducing.

Simultaneous declines in employment and industry concentration imply businesses are choosing to leave the region or are encountering conditions causing them to contract in employment. In addition, industry employment is either increasing in other regions, or at least declining at a slower rate. Industries in California losing competitiveness since 2010 while also losing employment include cut-and-sew apparel Manufacturing, semiconductor and electronic component Manufacturing, audio and video equipment Manufacturing, and communication equipment Manufacturing.

A competitive industry declining in relative employment concentration while experiencing job gains implies the concentration of this industry in the nation as a whole is increasing faster than California. This implies the region is missing an opportunity to capitalize on existing strength and is losing its competitive edge to other regions. Industries in California losing competitiveness since 2010 while experiencing jobs gains include pharmaceutical and medicine Manufacturing, electric instrument Manufacturing, aerospace, and medical equipment and supplies Manufacturing.

For a complete list of location quotients for 2010 to 2020 for all industry subsectors and industry groups, see tables A-1 and A-2 in the Appendix.

4-5 Competitive Manufacturing Industries: Winners and Losers California

NAICS	Industry	Employment 2020	LQ 2020
<u>INDUSTRIES THAT ARE GROWING MORE CONCENTRATED AND ARE GETTING LARGER</u>			
3113	Sugar and confectionery product mfg.	6,954	0.8
3119	Other food mfg.	34,767	1.3
3256	Soap, cleaning compound, and toiletry mfg.	12,669	1.0
3332	Industrial machinery mfg.	20,360	1.5
3341	Computer and peripheral equipment mfg.	80,366	4.3
3379	Other furniture related product mfg.	3,908	1.0
<u>INDUSTRIES THAT ARE GROWING MORE CONCENTRATED BUT GETTING SMALLER</u>			
3346	Magnetic media mfg. and reproducing	4,427	3.4
<u>INDUSTRIES THAT HAVE LOST CONCENTRATION AND ARE GETTING SMALLER</u>			
3114	Fruit and vegetable preserving and specialty	26,182	1.3
3118	Bakeries and tortilla mfg.	38,241	1.1
3133	Textile and fabric finishing mills	3,870	1.3
3152	Cut and sew apparel mfg.	24,179	2.9
3159	Accessories and other apparel mfg.	1,528	1.2
3169	Other leather product mfg.	1,980	1.6
3241	Petroleum and coal products mfg.	12,414	1.0
3333	Commercial and service industry machinery	10,371	1.0
3342	Communications equipment mfg.	16,878	1.7
3343	Audio and video equipment mfg.	6,093	2.7
3344	Semiconductor and electronic component mfg.	81,411	1.9
3351	Electric lighting equipment mfg.	6,405	1.3
3399	Other miscellaneous mfg.	27,777	0.9

NAICS	Industry	Employment 2020	LQ 2020
<u>INDUSTRIES THAT HAVE LOST CONCENTRATION BUT ARE GETTING LARGER</u>			
3115	Dairy product mfg.	16,921	0.9
3121	Beverage mfg.	59,503	1.9
3254	Pharmaceutical and medicine mfg.	46,440	1.3
3327	Machine shops and threaded product mfg.	40,427	1.0
3328	Coating, engraving, and heat treating metals	15,489	1.0
3345	Electronic instrument mfg.	93,234	1.9
3364	Aerospace product and parts mfg.	75,955	1.3
3391	Medical equipment and supplies mfg.	54,196	1.5

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics



Technological Intensity of Manufacturing

For a regional economy, maintaining a competitive edge in a global economy requires an aggregation of competitive firms and industries. From a manufacturer's perspective, gaining an edge on the competition requires being more efficient, being more productive, innovating products and processes, and investing in new technology and high-skilled employees.

In 1997, the Organization for Economic Cooperation and Development (OECD) developed taxonomy for Manufacturing industries based on the level of technology used or produced. The thinking behind this initiative was that technology is a critical factor in productivity growth, and identifying technology-intensive industries is needed to analyze a region's overall competitiveness and performance outlook.

Since those early efforts, the taxonomy has been refined several times. Under the current methodology, technological intensity is measured by an industry's expenditures on research and development (R&D) as a share of the total value of production. An industry that invests more revenue back into research and development is likely to innovate and discover new products and processes, and be at the forefront of its competitiveness frontier.

The result is a categorization of Manufacturing industries into high technology, medium-high technology, medium-low technology and low technology groups.

Using this categorization, employment by technological intensity can be compared across regions. A region with relatively more of its Manufacturing employment in high technology and medium-high technology Manufacturing is more likely to be able to compete globally, win new markets, pay higher wages, and increase the wealth of its resident population.

Across the United States, 18.5% of Manufacturing employment is in high technology industries, 24.6% in medium-high technology, 24.4% in medium-low technology, and 32.5% in low technology.

California's employment is relatively more concentrated in high and medium-high technology industries, with 36.9% of Manufacturing employment in high technology, 14.5% in medium-high technology, 17.6% in medium-low technology, and 31.1% in low technology.

Increases in Manufacturing industry employment is being driven by California's higher technology industries. From 2010 to 2020, high technology industries increased employment by 5.4% and medium-high technology industries increased employment by 15.2%. In contrast, employment in low technology industries fell by -6%.

The differential rates of employment growth across technological intensities resulted in a slight change in the distribution of employment across categories within the Manufacturing sector over the period, such that high technology intensity Manufacturing and medium-high technology intensity Manufacturing increased its share of employment at the expense of low-technology intensive employment. Perhaps more importantly, California has improved its competitive position in both high technology industries and medium-high technology industries over the last decade.

Higher levels of R&D that are associated with high technological intensities are correlated with higher capital-to-labor ratios as well; thus, labor productivity is expected to be higher and workers are better compensated. In fact, employees in high technology Manufacturing earned a wage premium of \$66,800 on average over all other Manufacturing in 2020.

In addition, the change in real wages from 2010 to 2020 was greater in high technology industries, increasing 35% over the decade, compared to an increase of only 15.4% in low technology industries, 9.7% in medium-low technology, and 15.1% in medium-high technology.

4-6 Manufacturing Industries by Technological Intensity

HIGH TECHNOLOGY INDUSTRIES

- Aircraft and spacecraft
- Pharmaceuticals
- Office and computer and electronic products
- Radio, TV and communications equipment
- Medical, precision and optical instruments

MEDIUM-HIGH TECHNOLOGY INDUSTRIES

- Electrical machinery and apparatus
- Motor vehicles, trailers and semi-trailers
- Chemicals (excluding pharmaceuticals)
- Railroad equipment and transport equipment
- Machinery and equipment

MEDIUM-LOW TECHNOLOGY INDUSTRIES

- Building and repairing of ships and boats
- Rubber and plastics products
- Coke, refined petroleum products and nuclear fuel
- Other non-metallic mineral products
- Basic metals and fabricated metal products

LOW TECHNOLOGY INDUSTRIES

- Wood, pulp, paper, paper products, printing and publishing
- Food products, beverages and tobacco
- Textiles, textile products, leather and footwear
- Other manufacturing

Source: Organization for Economic Cooperation and Development (OECD); Analysis by Beacon Economics



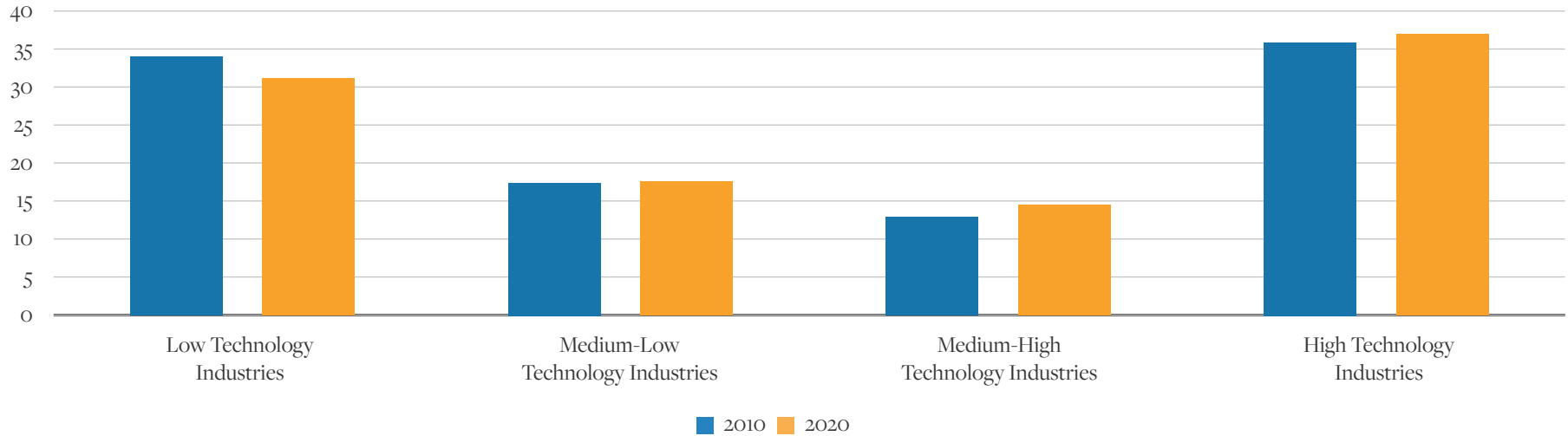
4-7 Manufacturing Employment by Technological Intensity United States and California 2020

	Employment 2020	% of all Manufacturing	2010-2020 Change (%)
UNITED STATES			
High Technology Industries	2,236,084	18.5	1.7
Medium-High Technology Industries	2,968,961	24.6	12.1
Medium-Low Technology Industries	2,948,097	24.4	7.1
Low Technology Industries	3,929,976	32.5	1.1
Total Manufacturing	12,083,118	100.0	5.2
CALIFORNIA			
High Technology Industries	465,405	36.9	5.4
Medium-High Technology Industries	182,788	14.5	15.2
Medium-Low Technology Industries	221,616	17.6	3.2
Low Technology Industries	392,214	31.1	-6.0
Total Manufacturing	1,262,023	100.0	2.4

Source: U.S. Bureau of Labor Statistics (BLS); Organization for Economic Cooperation and Development (OECD); Analysis by Beacon Economics

4-8 Manufacturing Employment by Tech Intensity

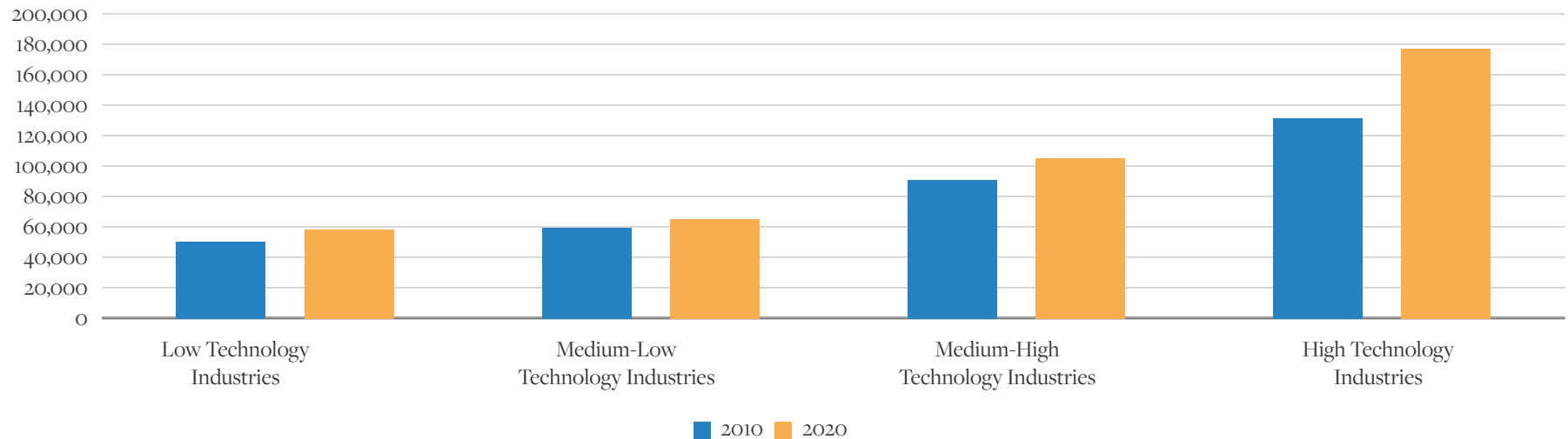
California 2010 to 2020



Source: U.S. Bureau of Labor Statistics; Organization for Economic Cooperation and Development (OECD); Analysis by Beacon Economics

4-9 Annual Wage in Manufacturing by Tech Intensity

California 2010 to 2020



Source: U.S. Bureau of Labor Statistics; Organization for Economic Cooperation and Development (OECD); Analysis by Beacon Economics

Key Manufacturing Industry Clusters in California

The Institute for Strategy and Competitiveness at Harvard Business School (supported by the Economic Development Administration of the U.S. Department of Commerce and Harvard University Professor Michael Porter's Cluster Mapping Project) has established a nationally-consistent grouping of industries into clusters based on several measures of relatedness, such as the use of labor and inputs, as well as geographic co-location patterns.

Industry clusters are known to be important for driving regional competitiveness, as firms in clusters can more easily learn from each other, share infrastructure, spur innovation and operate more efficiently — all factors which can lower costs, improve product and service quality, and increase the industry's ability to gain market share, leading to expansion and job creation.

The Cluster Mapping Project identifies 51 traded industry clusters, which are industries likely to sell their products and services to other regions and nations, and 16 local industry clusters, which primarily serve the local market.



In reality, the industry clusters strongest in California, in terms of employment concentration and therefore also competitiveness, are Agricultural inputs, Services, and the Entertainment industry cluster. The first is resource-based with broad concentration in the Central Valley, the most productive agricultural region in the nation. The Entertainment industry cluster is largely in Southern California given its historic roots, but has deep connection to the software and visual effects industries in Silicon Valley. Other competitive-traded clusters include information technology and analytical instruments (concentrated in Silicon Valley) and communication equipment and services (much of which is in San Diego and Orange County).

In this section, the top 12 Manufacturing industry clusters (by employment) are described and their competitive position analyzed.

5-1 Competitive Industry Clusters in California 2020

Cluster Name	Employment	LQ
Agricultural Inputs and Services	216,819	4.9
Video Production and Distribution	103,881	4.1
Apparel	28,400	2.2
Information Technology and Analytical Instruments	347,571	2.1
Music and Sound Recording	2,880	2.1
Performing Arts	48,584	1.8
Communications Equipment and Services	38,021	1.7
Marketing, Design, and Publishing	268,976	1.6
Aerospace Vehicles and Defense	104,308	1.4
Biomedical	97,438	1.3
Food Processing and Manufacturing	164,162	1.2

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

5-2 Key Manufacturing Industry Clusters in California

- Aerospace Vehicles and Defense
- Apparel
- Biomedical (Biopharmaceuticals and Medical Devices)
- Downstream Metal Products
- Food Processing and Manufacturing
- Furniture
- Information Technology and Analytical Instruments
- Metalworking Technology
- Plastics
- Printing Services
- Production Technology and Heavy Machinery

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Aerospace Vehicles and Defense

Once one of the strongest industry clusters in California, establishments in the aerospace vehicles and defense industry cluster manufacture aircraft, space vehicles, guided missiles, and related parts. This cluster also contains firms that manufacture the necessary search and navigation equipment used by these products.

The loss of defense spending in the 1990s led to significant employment declines in these industries across the state, exacerbated by the relocation of Manufacturing to other states and nations. The more recent trend toward commercialization has renewed opportunities for growth, but the industry remains dependent on government contracts.

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The loss of defense spending in the 1990s led to significant employment declines in these industries across the state, exacerbated by the relocation of Manufacturing to other states and nations. The more recent trend toward commercialization has renewed opportunities for growth, but the industry remains dependent on government contracts.

The -4.9% decline in employment over the last decade came in conjunction with a decline in the employment competitiveness. Despite the losses in employment and competitiveness, the cluster saw establishments grow by 7.1% over the decade. Still, the cluster employed more than 100,000 highly-paid workers in 2020, accounting for 16.2% of all aerospace jobs in the nation, with the majority of these workers employed in Southern California.

With companies such as SpaceX increasing their presence over the last decade, aerospace and aviation continue to be significant drivers of innovation through their unique needs for increased efficiencies and ability to invest in ever-newer materials and processes.

5-3 Aerospace Vehicles and Defense Industry Cluster California (2010 to 2020)

	2010	2020	Change (%)
Establishments	778	833	7.1
Employment	109,663	104,308	-4.9
% of CA Total Employment	0.9	0.7	-18.0
% of U.S. Cluster Employment	17.6	16.2	-7.8
Average Annual Wages (\$ 2020)	116,178	119,505	2.9
Employment LQ	1.6	1.4	-11.7

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Apparel

Establishments in the apparel cluster are focused on manufacturing clothing and fabric accessories (hats, gloves, and neckties) for men, women, and children.

The apparel cluster continues shedding jobs as the low value added of apparel Manufacturing migrates to lower-cost nations of Southeast Asia — as well as lower-cost regions of the United States. Industries in this cluster have suffered among the largest job losses (by percentage) of all Manufacturing industries, losing more than -20% of all establishments and over half of all employment from 2010 to 2020. The remaining concentration of employment in California allows the state to maintain its competitive advantage, but the outlook is dismal for this industry cluster. Employment in the apparel cluster continues to be primarily concentrated in Southern California.

While employment levels in the apparel cluster have fallen considerably, the average annual wage for workers in the cluster has increased 29.3% over the last decade, reaching an average annual wage of \$53,987.

5-4 Apparel Industry Cluster California (2010 to 2020)

	2010	2020	Change (%)
Establishments	3,407	2,687	-21.1
Employment	58,600	28,400	-51.5
% of CA Total Employment	0.5	0.2	-58.2
% of U.S. Cluster Employment	34.5	26.2	-24.1
Average Annual Wages (\$ 2020)	41,764	53,987	29.3
Employment LQ	3.0	2.2	-27.3

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics



Biomedical

A combination of biopharmaceuticals and medical device establishments in the biomedical cluster produce complex chemical and biological substances used in medications, vaccines, diagnostic tests, and similar medical applications. Establishments in this cluster also manufacture surgical, medical, dental, optical, ophthalmic, and veterinary instruments and supplies.

Consolidation of the industry over the past 10 years is evidenced by the decline in establishments accompanied by an increase in employment. While still relatively small, the cluster has increased in competitiveness and is expected to continue growing in strength amid continued investment and the regional presence of industry leaders.

California currently employs almost 16% of all workers in this industry cluster across the nation, with the majority in Southern California.

Continued advances in bioengineering, nanotechnology and the miniaturization of medical devices will continue, bringing new products and technologies to market. Supplemented and strengthened by cutting-edge research conducted at numerous research universities in California, this industry is poised for growth and the state is well-positioned to remain competitive in this industry cluster despite a modest decrease in competitiveness over the last decade.

5-5 Biomedical Industry Cluster California

(2010 to 2020)

	2010	2020	Change (%)
Establishments	3,407	2,687	-21.1
Employment	89,415	97,438	9.0
% of CA Total Employment	0.7	0.7	-6.0
% of U.S. Cluster Employment	16.0	16.0	-0.3
Average Annual Wages (\$ 2020)	114,153	136,578	19.6
Employment LQ	1.4	1.3	-4.5

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Downstream Metal Products

The downstream metal products cluster contains establishments that manufacture metal containers, pre-fabricated metal structures, and end-user metal products. These end-user products include ammunition, kitchenware, hardware, metal bathroom fixtures, and similar metal products for home finishing such as doors, windows and ornamentation.

The heavy industrial regions of Southern California account for the majority of the state's employment in this industry cluster. Growth in establishments outpaced the growth in employment over the past 10 years, suggesting an increase in small businesses in this industry cluster.

The state does not have a competitive edge overall in these industries. Individual counties do, however, given the geographic concentration of the cluster in the southern end of the state. However, California's overall competitive edge has fallen over the last decade.

5-6 Downstream Metal Products Industry Cluster California

(2010 to 2020)

	2010	2020	Change (%)
Establishments	1,417	1,491	5.3
Employment	27,221	28,351	4.1
% of CA Total Employment	0.2	0.2	-10.2
% of U.S. Cluster Employment	6.9	6.5	-6.0
Average Annual Wages (\$ 2020)	62,682	67,302	7.4
Employment LQ	0.6	0.5	-10.0

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics



Food Processing and Manufacturing

The food processing and Manufacturing cluster includes firms involved in the processing of raw food materials and the manufacturing of downstream food products for end users. This includes millers and refineries of rice, flour, corn, sugar, and oilseeds. These upstream products contribute in part to producing specialty foods, animal foods, baked goods, candies, teas, coffees, beers, wines, other beverages, meats, packaged fruits and vegetables, and processed dairy products.

The growth in establishments outpaced the growth in employment over the past 10 years, suggesting an increase in small businesses in this industry cluster. Continued growth over the last 10 years also suggests that much of this manufacturing is less exposed to automation and capital substitution or outsourcing. The explosion of micro-breweries and wineries has made beverage Manufacturing one of the fastest growing industries in the state. However, while growing, industry wages reflect the lower value of these manufactured goods, as the average wage in this cluster falls below the state average wage across all industries.

Food processing is often responsive to the size of the population. For example, beverage Manufacturing and bottling will almost always occur near the final consumer to minimize transportation costs to local markets. Other foods, however, are sold on the world market. Despite a modest decrease over the last year, California continues to retain competitiveness in this industry cluster.

5-7 Food Processing and Manufacturing Industry Cluster California (2010 to 2020)

	2010	2020	Change (%)
Establishments	3,133	5,356	70.9
Employment	137,496	163,324	18.8
% of CA Total Employment	1.1	1.2	2.5
% of U.S. Cluster Employment	15.1	14.7	-2.7
Average Annual Wages (\$ 2020)	57,009	62,707	10.0
Employment LQ	1.3	1.2	-6.8

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Furniture

The furniture cluster contains establishments that manufacture furniture, cabinets, and shelving for residential homes and offices. It also includes establishments that produce manufactured homes. The products in this cluster can be made of wood, metal, plastic, and/or textiles.

Manufacturing industries in this cluster have lost employment over the last decade while establishments have grown, suggesting an increase in the number of small businesses in the cluster. Employment in the industry cluster fell by -4.9% percent over the last decade, and in 2020 it paid an average annual wage exceeding \$119,000.

The state continues to have a competitive edge in this cluster, with the majority of employment located in areas of Southern California.

5-8 Furniture Industry Cluster California (2010 to 2020)

	2010	2020	Change (%)
Establishments	778	833	7.1
Employment	109,663	104,308	-4.9
% of CA Total Employment	0.9	0.7	-18.0
% of U.S. Cluster Employment	17.6	16.2	-7.8
Average Annual Wages (\$ 2020)	116,178	119,505	2.9
Employment LQ	1.6	1.4	-11.7

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Information Technology and Analytical Instruments

The information technology and analytical instruments cluster consists of information technology and analytical products such as computers, software, audio visual equipment, laboratory instruments, and medical equipment. The cluster also includes the standard and precision electronics used by these products (circuit boards and semiconductor devices).

Manufacturing industries in this cluster have gained establishments and jobs over the last decade, and California has increased its competitive edge. More than 243,600 highly-paid workers were employed here in 2020, accounting for more than 28% of all jobs in this industry cluster across the nation. The majority of these jobs are located in Northern California.

This is another high technology industry cluster continually in transition. While advances occur in one area, such as development of more advanced electronics and the explosion of cloud computing and social media, destruction occurs elsewhere, such as the adoption of digital delivery and virtual elimination of media reproduction. This industry cluster is the epitome of transformative processes.

5-9 Information Technology and Analytical Instruments Industry Cluster California (2010 to 2020)

	2010	2020	Change (%)
Establishments	3,379	3,986	18.0
Employment	206,594	243,634	17.9
% of CA Total Employment	1.7	1.7	1.7
% of U.S. Cluster Employment	24.1	28.1	16.6
Average Annual Wages (\$ 2020)	150,313	228,919	52.3
Employment LQ	2.1	2.4	11.7

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Metalworking Technology

Establishments in the metalworking technology cluster manufacture machine tools and process metal for use in metal-working. The cluster also contains the downstream manufacture of metal fasteners and hand tools.

The heavy industrial regions of Southern California account for the majority of the state's employment in this industry cluster. Although the number of firms fell, employment expanded, implying a consolidation of operations in larger companies.

The state does not have a competitive edge overall in these industries. Individual counties do, however, given the geographic concentration of the cluster in the southern end of the state. However, California's overall competitive edge has fallen over the last decade.

5-10 Metal-working Technology Industry Cluster California (2010 to 2020)

	2010	2020	Change (%)
Establishments	2,085	2,032	-2.5
Employment	39,182	41,053	4.8
% of CA Total Employment	0.3	0.3	-9.6
% of U.S. Cluster Employment	9.4	9.3	-0.6
Average Annual Wages (\$ 2020)	57,203	62,113	8.6
Employment LQ	0.8	0.8	-4.8

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics



Plastics

Establishments in the plastics cluster manufacture plastic materials, components, and products. The plastics and foams are manufactured for packaging, pipes, floor coverings, and related plastic products. The cluster also includes the upstream manufacturing of plastic materials and resins, as well as the industrial machines used to manufacture plastics.

This is another Manufacturing industry cluster experiencing job losses over the last decade, where the rate of job losses exceeded job losses in this industry cluster elsewhere in the nation, resulting in a -7.2% decline in California's share of national cluster employment.

Although the state does not appear to be competitive in this industry cluster, its products are vitally important for several other industries, including automobile and aerospace parts, medical devices, and beverage manufacturing. This industry is also at the forefront of incorporating advanced materials such as composites into products. Investments that yield improvements in process assessment and compression will improve the state's competitiveness.

5-11 Plastics Industry Cluster California (2010 to 2020)

	2010	2020	Change (%)
Establishments	1,227	1,235	0.7
Employment	40,873	40,431	-1.1
% of CA Total Employment	0.3	0.3	-14.7
% of U.S. Cluster Employment	7.3	6.4	-12.2
Average Annual Wages (\$ 2020)	55,298	62,572	13.2
Employment LQ	0.6	0.5	-15.9

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Printing Services

Establishments in the printing services cluster are primarily engaged in commercial printing, digital printing, and binding. The cluster includes upstream products and services necessary for printing (ink and prepress services). It also includes end-products such as books, greeting cards, business forms, and related goods.

This industry cluster has not been particularly strong competitively in California and has experienced declines in establishments and employment over the last decade. With more companies shifting to digital mediums for distribution, demand for traditional print media has fallen over the last decade, with employment in the cluster falling by -29.3% over the last decade.

The majority of employment is located in the industrial areas of Southern California. Jobs at all skill levels are represented in these industries, with relatively low average wages.

5-12 Printing Services Industry Cluster California

(2010 to 2020)

	2010	2020	Change (%)
Establishments	3,643	3,299	-9.5
Employment	45,660	32,732	-28.3
% of CA Total Employment	0.4	0.2	-38.2
% of U.S. Cluster Employment	9.2	8.6	-7.2
Average Annual Wages (\$ 2020)	51,490	54,961	6.7
Employment LQ	0.8	0.7	-11.1

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Production Technology and Heavy Machinery

Firms in the production technology and heavy machinery industry cluster primarily manufacture machines designed to produce parts and devices used in the production of downstream products. This cluster also includes end-use heavy machinery such as air and material handling equipment. The machines are used for industrial, agricultural, construction, commercial industry, and related purposes.

This industry cluster has not been particularly strong competitively in California and has experienced job gains over the last decade, although at a slower rate than all other Manufacturing industries.

The majority of the employment is located in the industrial areas of Southern California. Jobs at all skill levels are represented in these industries, with relatively high average wages.

5-13 Production Technology and Heavy Machinery Industry Cluster California

(2010 to 2020)

	2010	2020	Change (%)
Establishments	1,873	2,123	13.3
Employment	48,650	51,069	5.0
% of CA Total Employment	0.4	0.4	-9.5
% of U.S. Cluster Employment	5.7	5.8	1.9
Average Annual Wages (\$ 2020)	76,714	83,737	9.2
Employment LQ	05	0.5	-2.4

Source: Cluster Mapping Project; U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

Southern California Sub-Region

- With roughly 62% of the state's Manufacturing jobs, Southern California employs more than 777,000 manufacturing workers, accounting for 7.6% of all employment.
- Manufacturing in Southern California is very diverse, with a combination of low technology Manufacturing industries in fashion and food, and high technology manufacturing in aerospace parts and instrumentation, computer and electronic components, and medical devices.
- The region's overall Manufacturing competitiveness has fallen since 2010, with many of its most competitive industries experiencing declines in competitiveness over the decade.

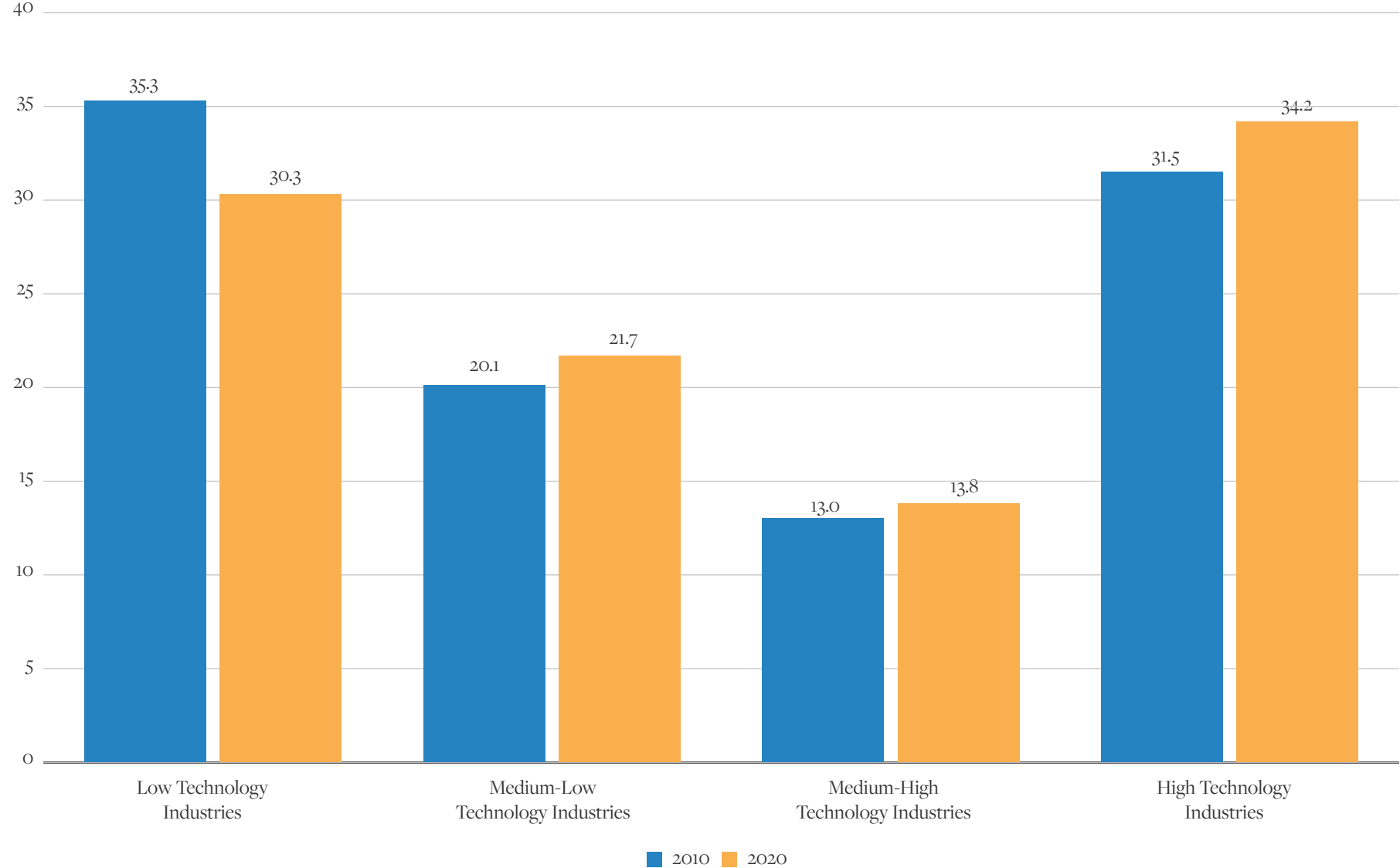
6-5 Manufacturing Employment by Subsector Southern California Sub-Region (2020)

NAICS	Industry Subsector	Employment	Establishments
311	Food mfg.	95,163	2,654
312	Beverage and tobacco product mfg.	22,827	1,111
313	Textile mills	4,406	264
314	Textile product mills	6,565	454
315	Apparel mfg.	24,888	2,271
316	Leather and allied product mfg.	2,143	145
321	Wood product mfg.	12,061	653
322	Paper mfg.	14,875	353
323	Printing and related support activities	23,526	2,297
324	Petroleum and coal products mfg.	6,621	135
325	Chemical mfg.	49,376	1,539
326	Plastics and rubber products mfg.	33,562	940
327	Nonmetallic mineral product mfg.	18,942	795
331	Primary metal mfg.	12,229	374
332	Fabricated metal product mfg.	91,362	4,459
333	Machinery mfg.	44,259	1,990
334	Computer and electronic product mfg.	118,234	2,279
335	Electrical equipment and appliance mfg.	19,067	764
336	Transportation equipment mfg.	94,619	1,356
337	Furniture and related product mfg.	22,616	1,333
339	Miscellaneous mfg.	60,630	2,685
	TOTAL MANUFACTURING	777,971	28,851
	<i>Percent of Sub-Region Total</i>	7.6	2.7
	<i>Percent of CA Manufacturing</i>	61.6	65.0

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

6-6 Manufacturing Employment by Tech Intensity Southern California

Southern California 2010 to 2020



Source: U.S. Bureau of Labor Statistics; Organization for Economic Cooperation and Development (OECD); Analysis by Beacon Economics

6-7 Competitive Manufacturing Industry Groups by Location Quotient

Southern California Sub-Region (2020)

NAICS	Industry Group	LQ	Change Since 2010
3152	Cut and sew apparel mfg.	4.4	Decrease
3343	Audio and video equipment mfg.	2.3	Decrease
3169	Other leather product mfg.	2.0	Decrease
3345	Electronic instrument mfg.	2.0	Decrease
3364	Aerospace product and parts mfg.	1.8	Increase
3133	Textile and fabric finishing mills	1.8	Decrease
3391	Medical equipment and supplies mfg.	1.7	Decrease
3342	Communications equipment mfg.	1.6	Increase
3351	Electric lighting equipment mfg.	1.5	Decrease
3159	Accessories and other apparel mfg.	1.5	Decrease
3119	Other food mfg.	1.3	Increase
3379	Other furniture related product mfg.	1.3	Increase
3256	Soap, cleaning compound, and toiletry mfg.	1.3	Increase
3328	Coating, engraving, and heat treating metals	1.3	Decrease
3327	Machine shops and threaded product mfg.	1.2	Decrease
3118	Bakeries and tortilla mfg.	1.2	Decrease
3344	Semiconductor and electronic component mfg.	1.2	Decrease
3399	Other miscellaneous mfg.	1.1	Decrease
3151	Apparel knitting mills	1.1	Increase
3333	Commercial and service industry machinery	1.1	Decrease
3114	Fruit and vegetable preserving and specialty	1.0	Decrease
TOTAL MANUFACTURING		0.8	Decrease

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

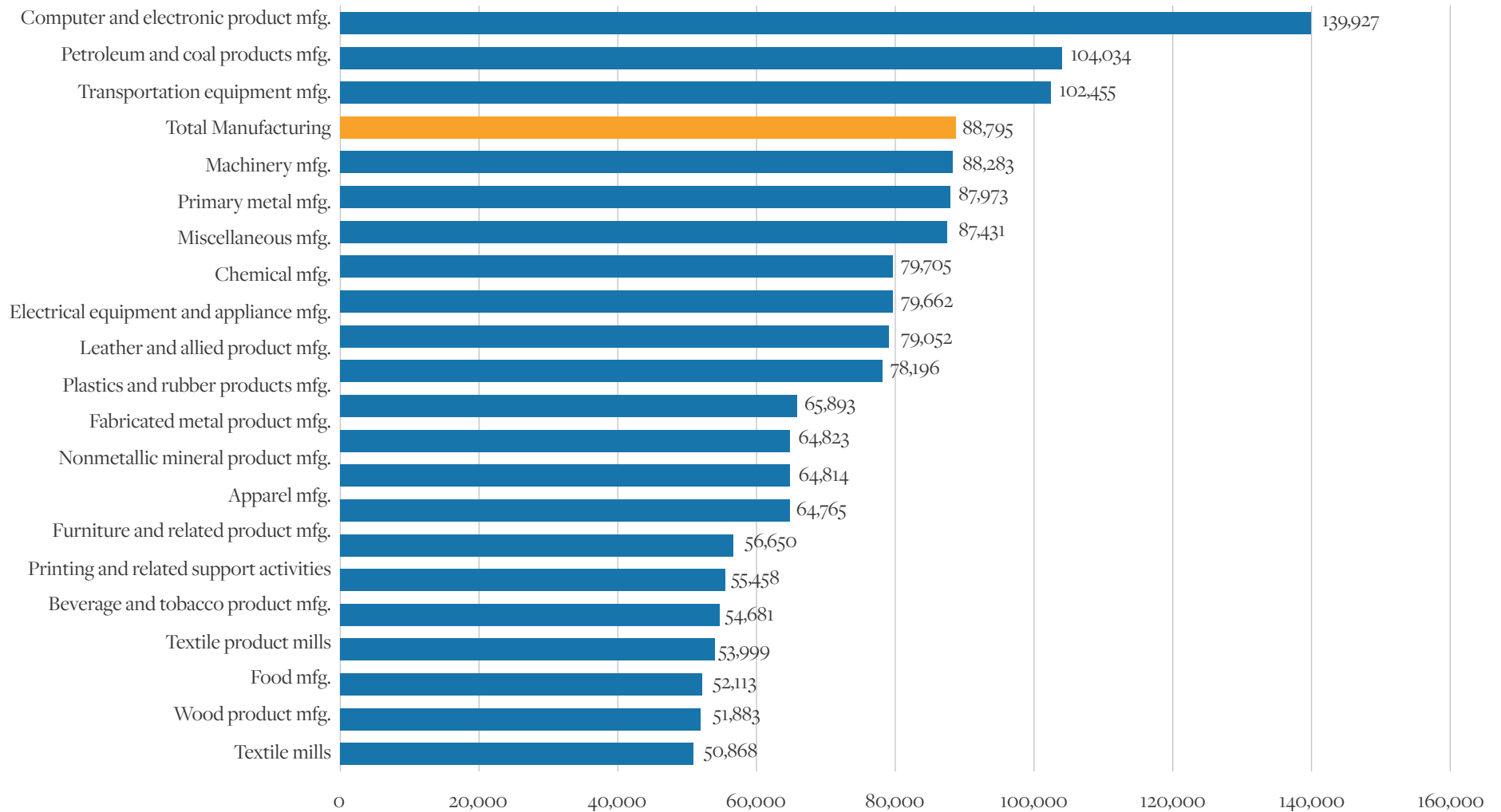


Orange County

- Manufacturing employment in Orange County averaged 148,600 in 2020, accounting for 9.9% of county employment and 11.8% of all Manufacturing employment in the state.
- More than 2,100 Manufacturing jobs were lost between 2010 and 2020, a decrease of -1.4% over the decade.
- Manufacturing wages in Orange County averaged \$88,795 in 2020, well below the state's average Manufacturing wage.
- Orange County is highly competitive in medical equipment, audio and video equipment, apparel Manufacturing, and electrical components.
- Manufacturing in Orange County is balanced between low and highly technologically-intensive industries, resulting in wages that are above the statewide average across all industries.

6-15 Average Annual Wages in Manufacturing

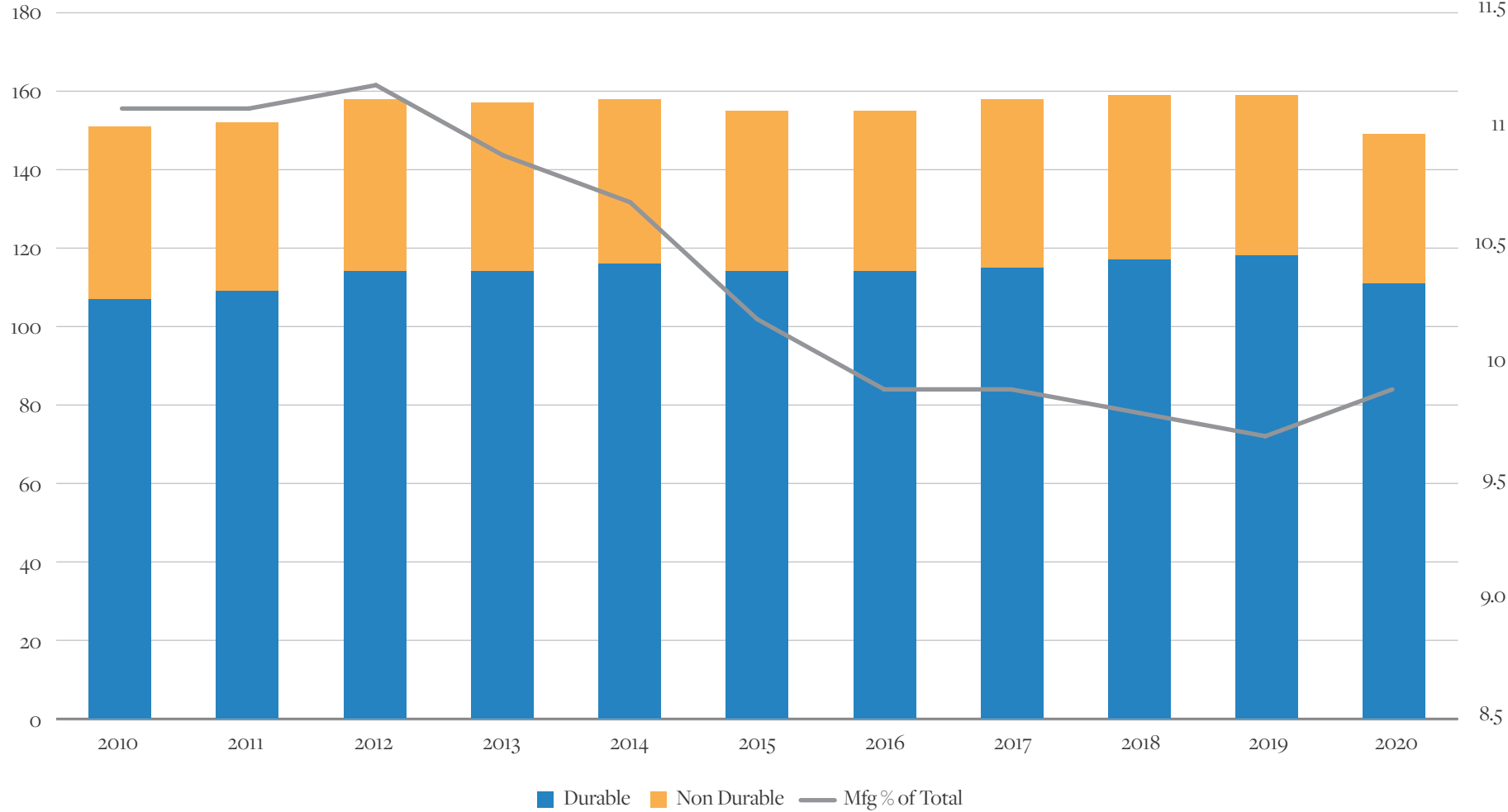
Orange County 2020



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

6-16 Manufacturing Employment

Orange County (In Thousands)



Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

6-17 Manufacturing Employment by Subsector

Orange County (2020)

NAICS	Industry Subsector	Employment	Establishments
311	Food mfg.	6,314	327
312	Beverage and tobacco product mfg.	2,050	92
313	Textile mills	548	24
314	Textile product mills	1,292	83
315	Apparel mfg.	3,516	220
316	Leather and allied product mfg.	153	16
321	Wood product mfg.	1,311	95
322	Paper mfg.	1,782	63
323	Printing and related support activities	6,471	501
324	Petroleum and coal products mfg.	174	18
325	Chemical mfg.	8,375	295
326	Plastics and rubber products mfg.	6,918	187
327	Nonmetallic mineral product mfg.	1,244	104
331	Primary metal mfg.	989	47
332	Fabricated metal product mfg.	20,588	919
333	Machinery mfg.	7,995	394
334	Computer and electronic product mfg.	33,063	632
335	Electrical equipment and appliance mfg.	4,824	176
336	Transportation equipment mfg.	13,614	239
337	Furniture and related product mfg.	4,301	201
339	Miscellaneous mfg.	23,030	631
	TOTAL MANUFACTURING	148,552	5,264
	<i>Percent of County Total</i>	<i>10</i>	<i>4</i>
	<i>Percent of CA Manufacturing</i>	<i>12</i>	<i>12</i>

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

6-18 Largest Manufacturing Industry Groups by Employment

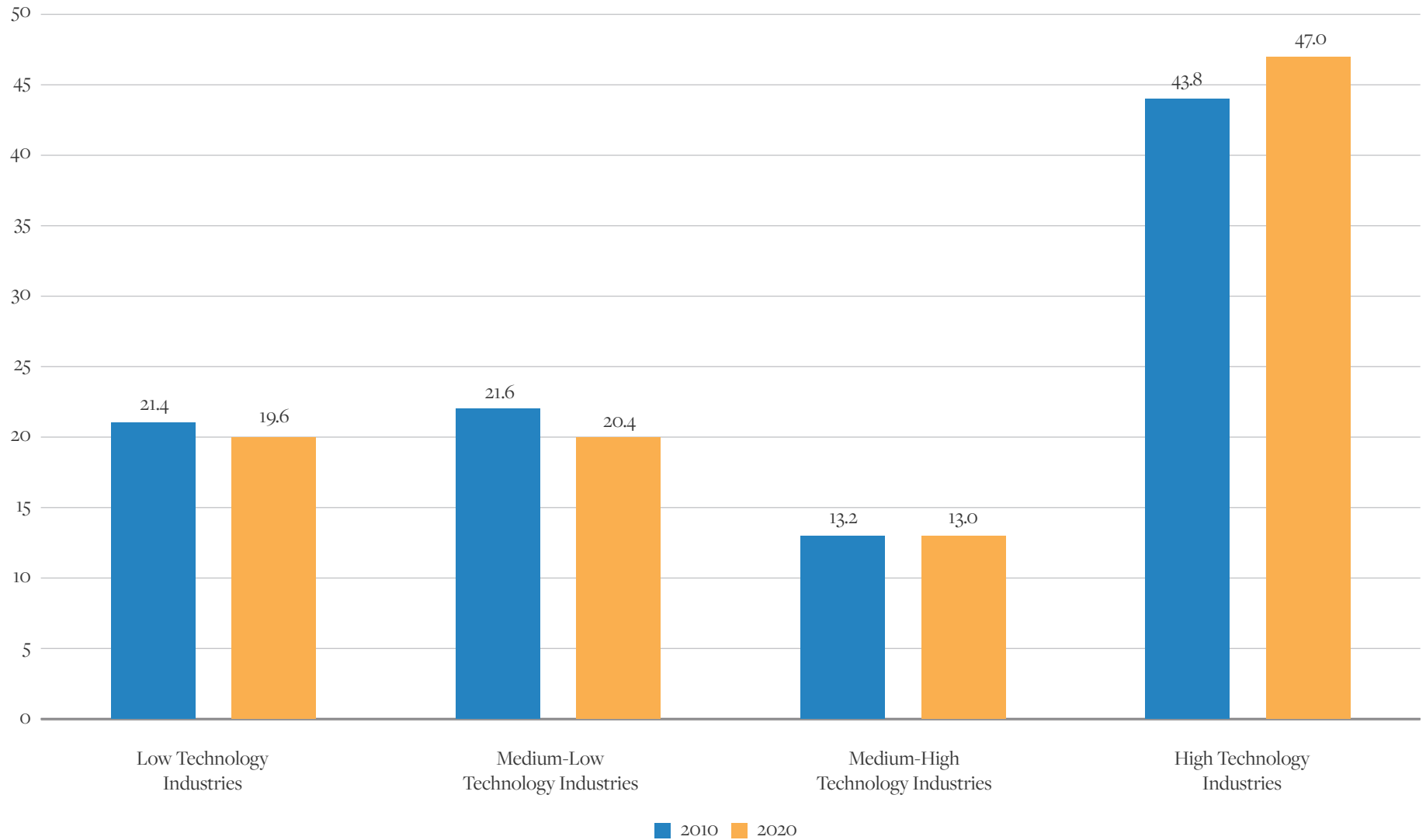
Orange County (2020)

NAICS	Industry Subsector	Employment	Share of Manufacturing (%)
3391	Medical equipment and supplies mfg.	19,096	12.9
3344	Semiconductor and electronic component mfg.	12,969	8.7
3345	Electronic instrument mfg.	12,808	8.6
3364	Aerospace product and parts mfg.	10,511	7.1
3327	Machine shops and threaded product mfg.	8,268	5.6
3231	Printing and related support activities	6,471	4.4
3261	Plastics product mfg.	5,606	3.8
3341	Computer and peripheral equipment mfg.	4,641	3.1
3254	Pharmaceutical and medicine mfg.	4,107	2.8
3399	Other miscellaneous mfg.	3,934	2.6
3329	Other fabricated metal product mfg.	3,364	2.3
3328	Coating, engraving, and heat treating metals	3,311	2.2
3323	Architectural and structural metals mfg.	3,274	2.2
3152	Cut and sew apparel mfg.	2,957	2.0
3118	Bakeries and tortilla mfg.	2,844	1.9
3339	Other general purpose machinery mfg.	2,577	1.7
3371	Household and institutional furniture mfg.	2,386	1.6
3256	Soap, cleaning compound, and toiletry mfg.	2,029	1.4
3335	Metalworking machinery mfg.	1,924	1.3
3119	Other food mfg.	1,827	1.2
3353	Electrical equipment mfg.	1,765	1.2
3359	Other electrical equipment and component mfg.	1,731	1.2
3372	Office furniture and fixtures mfg.	1,724	1.2
3333	Commercial and service industry machinery	1,672	1.1
3363	Motor vehicle parts mfg.	1,654	1.1
	<i>All other manufacturing industries</i>	25,100	16.9
	TOTAL MANUFACTURING	148,550	100.0

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

6-19 Manufacturing Employment by Tech Intensity

Orange County 2010 to 2020



Source: U.S. Bureau of Labor Statistics; Organization for Economic Cooperation and Development (OECD); Analysis by Beacon Economics

6-20 Competitive Manufacturing Industries by Location Quotient

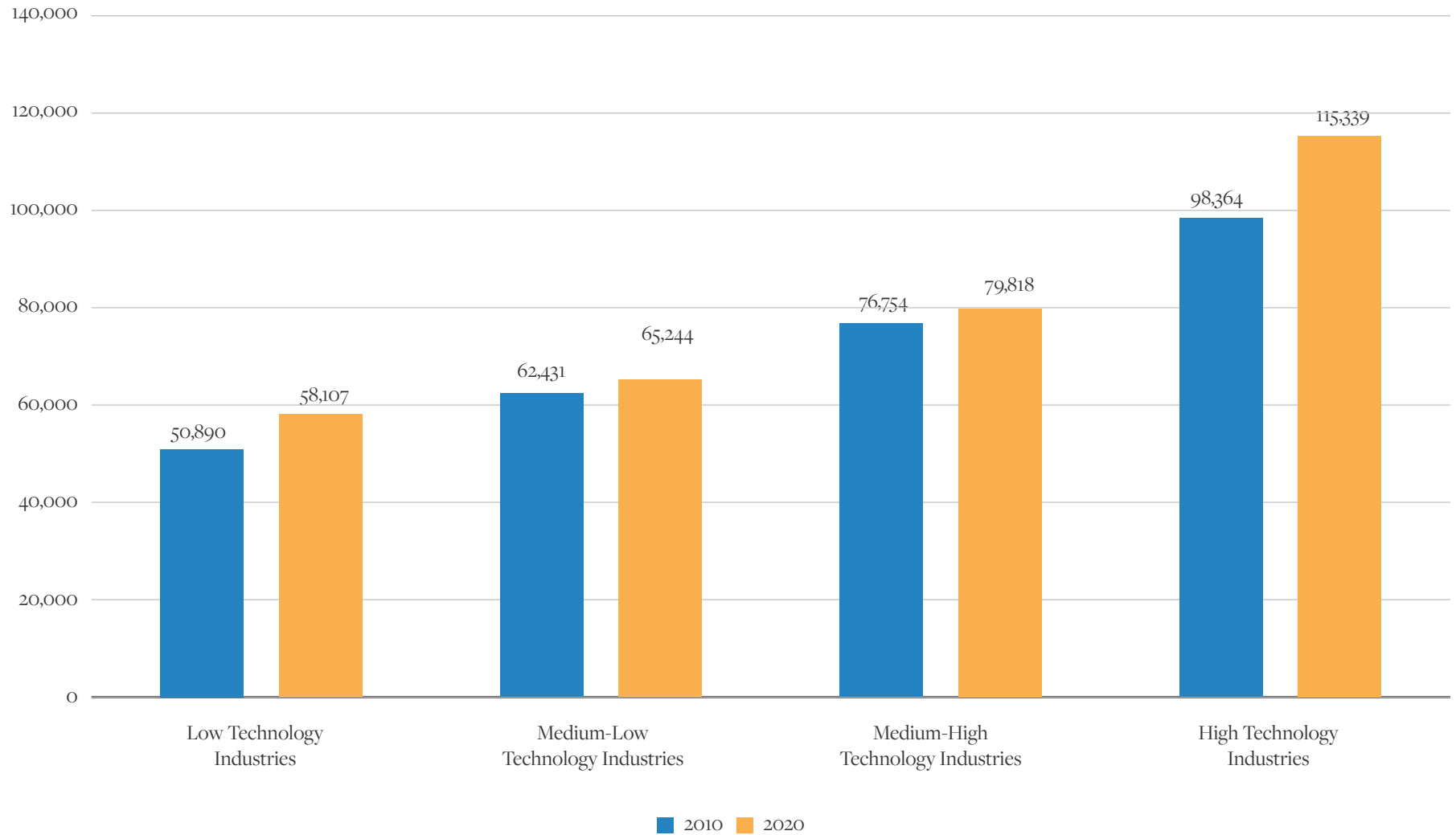
Orange County (2020)

NAICS	Industry Group	LQ	Change Since 2010
3391	Medical equipment and supplies mfg.	5.6	Increase
3343	Audio and video equipment mfg.	5.0	Increase
3151	Apparel knitting mills	4.8	Increase
3152	Cut and sew apparel mfg.	3.9	Increase
3346	Magnetic media mfg. and reproducing	3.4	Increase
3344	Semiconductor and electronic component mfg.	3.3	Increase
3345	Electronic instrument mfg.	2.8	Decrease
3351	Electric lighting equipment mfg.	2.7	Increase
3341	Computer and peripheral equipment mfg.	2.7	Decrease
3369	Other transportation equipment mfg.	2.6	Increase
3328	Coating, engraving, and heat treating metals	2.4	Increase
3327	Machine shops and threaded product mfg.	2.3	Decrease
3364	Aerospace product and parts mfg.	1.9	Decrease
3333	Commercial and service industry machinery	1.8	Decrease
3256	Soap, cleaning compound, and toiletry mfg.	1.7	Increase
3231	Printing and related support activities	1.6	Decrease
3372	Office furniture and fixtures mfg.	1.6	Increase
3149	Other textile product mills	1.5	Decrease
3133	Textile and fabric finishing mills	1.4	Increase
3399	Other miscellaneous mfg.	1.4	Decrease
3342	Communications equipment mfg.	1.3	Decrease
3321	Forging and stamping	1.3	Decrease
3159	Accessories and other apparel mfg.	1.2	Increase
3254	Pharmaceutical and medicine mfg.	1.2	Decrease
3329	Other fabricated metal product mfg.	1.2	Decrease
3353	Electrical equipment mfg.	1.2	Decrease
3359	Other electrical equipment and component mfg.	1.1	Increase
3335	Metalworking machinery mfg.	1.1	Decrease
	TOTAL MANUFACTURING	1.1	Decrease

Source: U.S. Bureau of Labor Statistics (BLS); Analysis by Beacon Economics

6-21 Annual Wage in Manufacturing by Tech Intensity

Orange County 2010 to 2020



Source: U.S. Bureau of Labor Statistics; Organization for Economic Cooperation and Development (OECD); Analysis by Beacon Economics

Recommendations for California's Manufacturing Industries

Events over the past two years have exposed the fragility of global supply chains. The intricate web of suppliers that combine to create final manufactured products span multiple nations and continents. These networks have been vulnerable to a patchwork of different government responses to the pandemic. As different parts of supply chains have shut down at different times, in response to the pandemic, this has created shortages across supply chains, and delays in the production of final products, most notably semiconductors and automobiles. Such vulnerabilities represent opportunities for California. As firms seek to reduce their reliance on key suppliers, California can benefit from such diversification. Most of the design of the world's leading technological hardware occurs in California, and the pandemic has created clear opportunities to bring production closer to design. There is a prospect of firms regionalizing supply networks, given the vulnerabilities exposed by the pandemic.

Yet California does not compete for manufacturing activity based on cost. Statewide efforts to lower housing prices would help ease worker shortages. In recent years, the state's population growth has plateaued as many workers, including those in the manufacturing sector, are priced out of the state. There are currently 53,000 jobs openings in the manufacturing sector in the state. If the state's governments cannot get a grip on the housing crisis, mid-value added parts of the industry will continue to leave the state. At the same time, California will not be as cheap as developing economies and most other parts of the US. While company departures to low cost places like Texas make for great headlines; these headlines mask the fact that growth in California's manufacturing output has exceeded the national rate by 83% since the late 1990s. While, contrary to popular perceptions, California's share of manufacturing jobs in the US has ticked up slightly since the year 2000.

Given its inability to compete on cost, California's key source of competitive advantage will be both to retain and ensure it remains home to workers with cutting-edge skills in the sector. California's manufacturers require a skilled workforce, with particular skills required to work with more advanced technologies. This will lead to an increase in productivity and competitiveness. Below we highlight six primary ways in which California's manufacturing industries can adapt to these changes.

- First, the ability of the state to supply, attract, and retain a skilled workforce is a key factor in supporting new manufacturing businesses. Without a skilled workforce, prospective manufacturers will look to other regions to build new manufacturing businesses or expand their current footprint. California's manufacturers should work with local educational institutions to develop skill standards that meet the needs of the manufacturing industry now and in the future. As more technology makes its way into production, the need to include skills training for manufacturing workers in community and technical college degree programs has become more evident. California manufacturers can establish skill standards by offering to serve on community and technical colleges' career programs advisory boards and communicating their current and future skill needs.
- Second, and as part of worker retention efforts, there should be more defined career pathways for incumbent workers. Career pathways enable worker engagement and motivation and allow workforce development organizations to better target training. These pathways also allow workers, many of whom may not have a four-year degree, to move from entry-level and lower-wage positions to upper-level/high-wage positions over the course of their careers. A clear wage and skill progression for workers would make careers in manufacturing more desirable, thereby increasing the supply of workers for manufacturers in California.
- Third, the state should commission a study to look for opportunities presented by the current supply chain crisis. This would require examining vulnerabilities in supply chain networks to identify areas that could be targeted for onshoring opportunities.
- Fourth, advanced technologies – automation, robotics, 3D printing, wearable technology, artificial intelligence, machine learning, and the internet of things – have transformed and will continue to transform the manufacturing sector in the state. Technology adoption will be crucial to California manufacturers retaining a competitive edge, and will be critical given the state's long-standing labor shortage. The creation of a technology transfer initiative in the state is long overdue and will be critical to facilitating the adoption of new technologies by small and medium manufacturers.
- Fifth, while California manufacturing cannot exclusively compete on cost, cost is still a critical factor in being globally and domestically competitive. It is important that California's manufacturers are as productive as possible. Emphasis should be placed on providing affordable solutions to improve production processes, product quality, and technology integration to maximize productivity and reduce manufacturing costs.
- Sixth, as California manufacturers increase their productivity, the opportunity to support profitable growth becomes more of a reality. Providing manufacturers with the expertise to develop new products and enter new markets will bolster their ability to grow. Affordable resources that will add capability and capacity needs to be broadly available to provide assistance with market understanding, product design, sales and marketing. These resources will translate an increase in productivity to profitable growth.

