BUILDING THE FUTURE:

CONSTRUCTION *in* SOUTHERN CALIFORNIA

▲ THE INDUSTRY, ITS JOBS AND ITS ECONOMIC CONTRIBUTION

LAEDC INSTITUTE FOR APPLIED ECONOMICS

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SOUTHERN CALIFORNIA INDUSTRY SERIES

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Executive Summary

What we learned in this study.

Thoughtfully designed buildings and infrastructure not only provide shelter and places to work and learn, they make modern life possible. A region's built environment can also enhance mobility, preserve and strengthen cultural experiences, and make our urban landscape beautiful and inviting. In this way, the construction industry affects both the economy and the quality of life in Southern California. The combination of technology and design that is inherent in many of Southern California's signature industries is also a hallmark of the construction industry – graceful skyscrapers built to withstand powerful earthquakes are one example; advanced materials that allow builders to shape glass, steel and concrete into structures that mimic ocean waves are yet another.

This report examines the construction industry in Southern California, its recent trends and its contribution to the regional economy. Our findings are summarized as follows:

The industry employed 313,700 direct payroll workers in Southern California in 2015.

The average annual wage earned by construction workers in 2015 was $58,986.

Recent Industry Activity

- The value of construction put in place nationwide over the past decade peaked in 2006 at $1.17 trillion before plunging to $789 billion in 2011, a decline of 32.5 percent. By 2015, the value of construction put in place reached $1.09 trillion, which was 6.5 percent shy of the 2006 peak level.
- Construction activity as a share of regional gross product has averaged 3.7 percent between 2004 and 2014 (latest data available) and stands at 2.9 percent.
- In 2015, residential construction permits in the region were 51 percent below the prerecession peak reached in 2004. Nonresidential permits, on the other hand, were very near to achieving new peak levels.
- As of 2015, the volume of regional construction lending had largely recovered but was still lower by 1.3 percent than in 2005.

Sizing Things Up

- The construction industry employed 313,700 workers in Southern California in 2015, below peak employment in 2006 by 23.7 percent, or almost 98,000 jobs.
- Of all wage and salary jobs in the region, construction employment comprised an average share of 4.6 percent from 2005 to 2015, peaking at 6.0 percent in 2006.
- Construction industry wages were on average $58,986 per year, slightly higher than the average wages for all other industries at $55,783.
- Wages were highest in the heavy and civil engineering sector at $84,872, followed by construction of buildings ($64,180) and specialty trade contractors ($53,171).

- Measured from 2005 through 2015, real wage growth in the construction industry outpaced the average wage growth of all other industries in the region, increasing by 8.4 percent on an average annual basis compared with 2.4 percent for all other industries.

Spreading the Wealth

- The construction industry spent more than $47 billion on goods and services for inputs into production, and paid $25 billion in wages and benefits in 2014 (latest data available).
- In addition to the 313,700 direct payroll jobs in the construction industry, an additional 189,600 jobs were supported in 2015 through indirect effects and 151,900 jobs were supported by induced effects.
- The industry contributed $56.1 billion in value-added output, accounting for 5.5 percent of the regional gross product, and generates $35.7 million in labor income (direct, indirect and induced).

The industry spent more than $47 billion on goods and services for inputs into production, and paid $25.0 billion in wages and benefits.

Work, Work, Work

- The occupational makeup of the workforce is concentrated in one major occupational group: construction and extraction workers, which accounted for 61 percent of the jobs in the industry. Although many jobs are skilled, approximately 67 percent of openings require a high school credential or less.
- Southern California is home to numerous educational institutions and apprenticeship programs that offer targeted programs and training for construction-related work.

Looking Ahead

- Near term trends include increased urban densification, improved energy-efficiency of buildings, continued adoption of technological enhancements such as 3D modeling and building information modeling.
- The construction industry continues to improve efficiency and capability through advances in technology, modeling and innovative processes.

Near term trends include increased urban density, energy-efficiency, and technological enhancement, yet some caution remains.

Introduction

Building our future.

After a long hiatus, Southern California is building again. The skyline of downtown Los Angeles is punctuated with construction cranes as new hotels, office towers and apartment buildings rise from their concrete foundations. In the Inland Empire, distribution facilities with warehouses as large as one million square feet connect the region's transportation corridors, receiving and distributing goods to wholesalers, retailers and consumers. Amusement parks are adding attractions to increase their appeal to local visitors and tourists. *The Wizarding World of Harry Potter* at Universal Studios Hollywood was completed in 2015, while ground was broken in April of this year on the much anticipated *Star Wars Land* at Disneyland. A new $2.5 billion, 70,000-seat football stadium is in development in Inglewood. When completed it will be the largest sports venue in the world. At the region's seaports and airports, large-scale infrastructure projects are underway or have recently been completed that will increase the capacity and speed at which goods and travelers flow into and out of Southern California as a new bridge rises above the main channel at the Port of Long Beach, airport terminals throughout the region are modernized and commuter rail lines expanded.

Southern California's built environment (homes, workplaces, public spaces and infrastructure) is the result of construction activities. Construction is the process of moving and assembling materials and equipment into a complete and functional structure.

While materials and equipment technology have evolved, the basic construction process of assembling a building piece by piece has in many ways remained unchanged for decades. Construction is not as conducive to standardization as other goods-producing industries may be. Each construction project brings with it a unique design and a different set of parameters. A harbor breakwater, an international air terminal, a desalinization plant, a neighborhood shopping center, flood control channels, solar farms and single-family homes are all construction projects, each requiring a diverse set of skills and technologies to move from concept to fully-formed structure.

About This Report

This report is the third in our Industry Cluster Series, which examines industry clusters in the larger Southern California region in detail. Industry *clusters* are distinct from more commonly recognized industry *sectors* as they are formed by firms that are in related industries, that sell related products, employ similar types of labor and have in common a geographic concentration of activity.

In this report, however, we depart from the industry cluster approach, narrowing our focus to describe the construction industry sector alone and in its three subsectors.

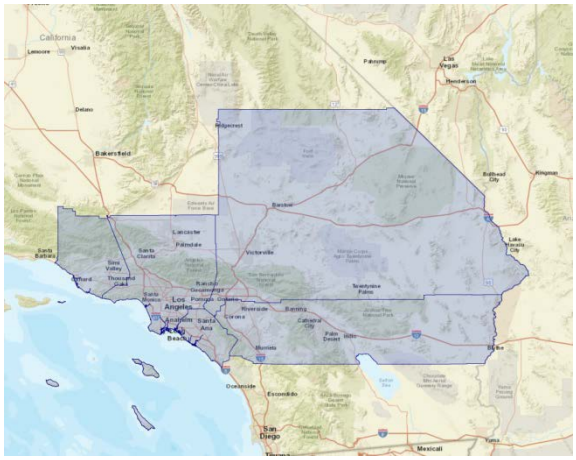
The first of these major subsectors is the construction of buildings, both residential and nonresidential. Residential construction includes single-family homes, townhomes,

condominiums and apartment buildings. On the nonresidential side, there are commercial buildings such as office buildings, shopping centers, hotels, industrial buildings and distribution facilities. The second division of the construction industry is the heavy civil sector, which encompasses major public works, including highways, airports, dams, water distribution and sewage facilities and other infrastructure. The final sector includes various specialty trade contractors such as firms specializing in foundations, finishing work, plumbers, carpenters and electricians.

By understanding the current and historic trends of our leading industries, we can come to understand the challenges and opportunities present in the various sectors of the local economy and, thus, tailor our economic development programs and policies to strengthen existing specialties and build them into flourishing, thriving and growing industries. We can ensure that we have a workforce ready and able to fill the jobs of the future in our strongest industries, and remain competitive in a fast-changing global economy.

We can focus our public policy and programmatic efforts on those industries most likely to provide the highest wages, which, in turn, produce the highest impacts on the local economy and the best return for our investment, and those that are at risk of moving elsewhere.

The purpose of this report is to describe the construction industry in the five-county region of Southern California, which includes Los Angeles, Orange, Riverside, San Bernardino and Ventura. Specifically, we review industry trends, employment and wages, workforce needs, and the contribution of the construction industry to the regional economy.



Our discussion proceeds in five parts.

First, we describe industry activity beginning with national trends in the value of new construction put in place and the industry's contribution to the gross product of the five-county region. We then examine future product coming through the local supply pipeline as measured by new construction permits before concluding with a discussion of the lending environment for new development projects.

Next, we focus on the metrics of the industry - its size in terms of employment and wages and how these have performed over the past 10 years.

Third, we examine the supply chain of the construction industry – what goes into the making of the industry's products? What recipe of goods and services is needed to provide the industry with its necessary inputs? With this quantified, we estimate the overall contribution of the construction industry to the regional economy through its multiplier impacts.

Fourth, we consider the supply of workers into the industry. Construction firms employ a full spectrum of workers, from new entrants to highly-specialized and experienced labor. The occupational makeup of the industry is examined and regional workforce development programs outlined. An occupational forecast is provided to project future workforce needs.

We conclude with a brief discussion of future trends and emerging technologies in the construction industry.

This comprehensive picture of an industry that forms the backbone of our economy is meant to inform policymakers and local stakeholders as we together develop regional strategies to bring jobs and prosperity to the Southern California economy.

Complete discussion and description of methodologies and data sources are provided in the Appendix, along with more detailed data tables that expand on the exhibits shown throughout the document.

Recent Industry Activity

Past performance.

The construction industry in the United States makes an important contribution to the nation's economic growth. In the national income accounts, business fixed investment spending accounts for about 16 percent of GDP on average between 2005 and 2015. Approximately 40 percent of that was attributable to construction activity (residential and nonresidential).

The Value of Construction Put in Place

The "value of construction put in place" is a measure of the value of construction installed or erected at a site in a given period. For an individual project this includes the cost of materials, labor and equipment rental, contractor's profit, architectural and engineering services, overhead and office costs, and interest and taxes paid.

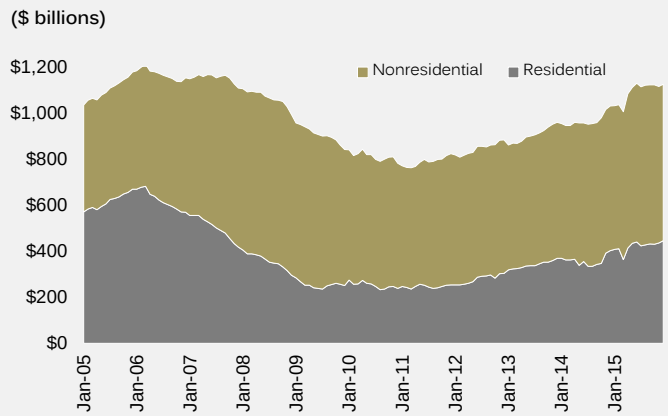
The value of construction put in place nationwide over the past decade, both private and public, peaked in 2006 at $1.17 trillion before plunging to $789 billion in 2011, a decline of 32.5 percent. Although the second quarter of 2009 marked the end of the recession, construction is a lagging indicator, which helps explain why the slowdown in activity persisted well into the early years of the recovery. By 2015, the value of construction put in place reached $1.09 trillion, which was 6.5 percent shy of the 2006 peak level.

The value of construction put in place in the U.S. reached $1.1 trillion in 2015, just shy of its peak in 2006.

While the value of residential and nonresidential construction put in place rose and fell in tandem during the recession and its aftermath, the residential component suffered a larger decline and has been slower to recover. After peaking at $622 billion in 2006, by 2011 the value of residential construction had plunged by 60.4 percent to $247 billion. In 2015, the value of residential construction put in place was still below its prerecession peak by 32.2 percent. In comparison, the value of nonresidential construction put in place declined by 23.4 percent from $708 billion in 2008 to $543 billion in 2011, but by 2015 had rebounded to within 5.1 percent of the value recorded in 2008.

The nonresidential component of this metric has several subcomponents that are worth looking at in more detail. Although its aggregate value was lower in 2015 than it was prior to the recession, a number of these subcomponents, mostly infrastructure-related, have reached new peak levels. Transportation was up by 13.2 percent in 2015 compared with 2008; the value of highway and street construction rose by 8.0 percent; and conservation and development (dams, breakwaters, dredging) increased by 18.8 percent. Manufacturing was the only non-infrastructure component to surpass its

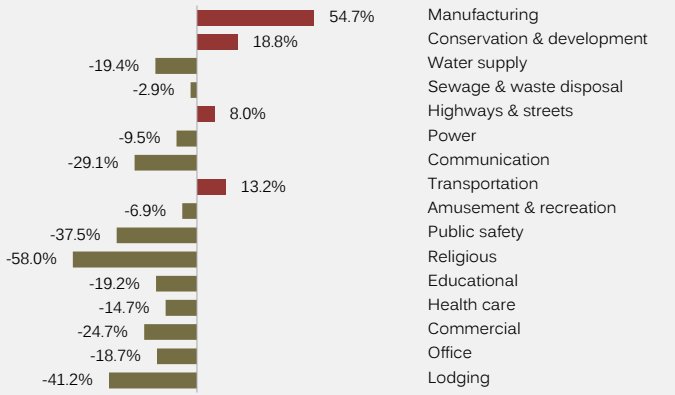
Value of U.S. Construction Put in Place



Source: U.S. Census Bureau

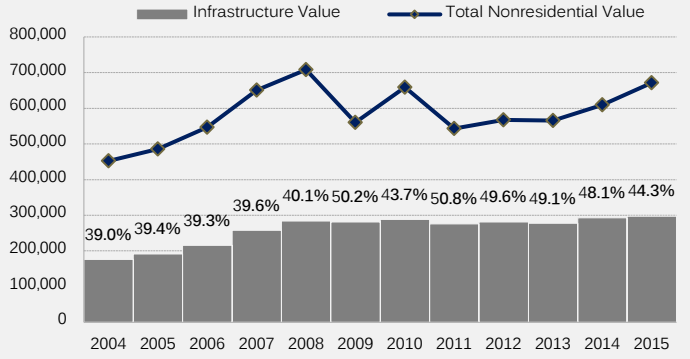
Value of Nonresidential Construction Put in Place by Subcomponent

Percent change from Prerecession Peak to 2015



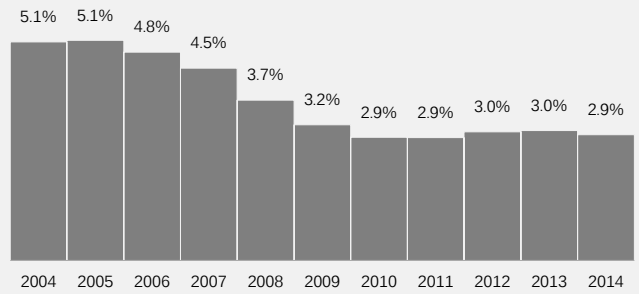
Source: U.S. Census Bureau

Value of Infrastructure as Percent of Nonresidential Construction Put in Place



Source: U.S. Census Bureau

Construction Vaue-Added as a Percentage of Regional Gross Product



Source: Bureau of Economic Analysis

prerecession peak, higher by 54.7 percent in 2015 compared with 2008.

Hence, the share of infrastructure spending relative to all nonresidential construction has grown, from 39.0 percent in 2005 to 44.3 percent in 2015. The share of infrastructure construction put in place reached 50 percent in 2009 and stayed in that range during the early years of the recovery. This may have been due to the American Recovery and Reinvestment Act (2009), which provided funds for infrastructure projects to provide jobs at a time when private construction investment was pulling back.

Prior to the housing market crash and recession, residential spending constituted a higher share of total construction spending than nonresidential, averaging 54.6 percent in 2005 and 2006. That share declined sharply in 2007 and fell to a low of 27.9 percent in 2010. Although the residential share of construction spending has been rising since 2011, it stood at just 38 percent in 2015 versus 62 percent for nonresidential.

Gross Product of the Construction Industry in Southern California

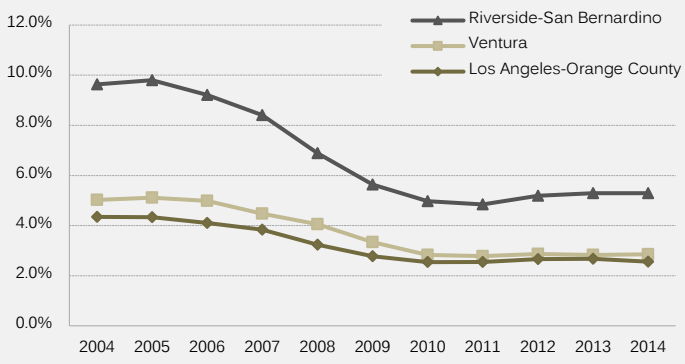
In 2014 (most current data available), the regional gross product of Southern California was $962.2 billion. Construction activity contributed $28.1 billion, or 2.9 percent of the total.

Over the past ten years, construction's contribution to the region's gross product fell from a high of 5.1 percent in 2004 and 2005. Beginning in 2009, as the economy shifted from recession to recovery, shares have been mostly flat, in the range of 2.9 to 3.2 percent

An examination of gross product figures by metro area (the smallest geography for which this data is available) shows that the relative contribution of the construction industry to gross product in each area is very different. The construction industry in the Los Angeles-Orange County MSA is the largest in Southern California in absolute terms, but it represented just 2.6 percent of the area's economy in 2014. This was down from 4.3 to 4.1 percent reached in the years 2004 through 2006 and corresponded with the region's residential construction boom. In the Ventura area, the construction industry's contribution to gross product was 2.9 percent in 2014, down from 5.1 to 5.0 percent during the years leading up to the housing crash.

Over the past decade, the construction industry has played a more prominent role in the economy of the Inland Empire. There, construction made up 5.3 percent of the economy in 2014 having attained shares of 9.6 to 9.2 percent in the years immediately preceding the recession.

Construction Value-Added as % of Regional Gross Product



Source: Bureau of Economic Analysis

Construction Permits

Construction permits issued by cities and counties are a forward indicator of new construction coming through the pipeline. They are divided into residential and nonresidential permits. Residential permits include permits for single-family homes (detached, semi-detached, row house and townhouse units) and multi-family structures (duplexes, three to four unit structures and apartment-type structures with five units or more). While residential permits are tracked by both construction value and number of units, the number of units permitted is the most commonly used metric when discussing trends in residential permits. A single-family home is one unit and one permit. Likewise, a planned complex of 100 apartments would be recorded as 100 permitted units.

Nonresidential construction permits include, among others, commercial structures (office, hotel, retail and other mercantile buildings), industrial structures and public works. Also tracked are building permits for educational, health care, religious and parking garage construction. Nonresidential permits are measured by construction value as there is no equivalent to "units." In addition to providing information on new construction, permits for renovations and remodels are also tracked (in total) for both residential and nonresidential structures.

Residential Construction Permits

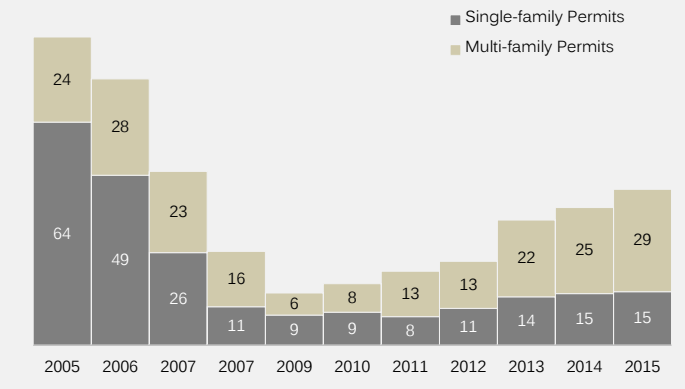
The boom in new home construction that took place in the early years of this century began to lose steam as early as 2005, well before the housing market collapse. New home building in Southern California peaked in 2004 at 91,556 units permitted before plummeting to 14,942 units in 2010. In spite of six years of year-over-year gains, new home construction remains 51 percent below its previous peak.

Since the housing market collapse, new home construction in the five-county region has been sharply divided between a surge in new multi-family units (primarily apartments) and a more gradual recovery in single-family homes.

Although the increased ratio of new multi-to single-family residences is clearly visible across most of the region, this trend is most prevalent in Los Angeles County. The slower recovery of single-family construction reflects weaker demand in the face of sluggish income growth and tighter mortgage lending standards. Constraints on land (rising costs, competition for developable land), labor and development lending may also be factors.

Residential Building Permits In SoCal

Number of Units Permitted (000's)



Source: California Home Building Foundation, Real Estate Research Council

Residential Permits by County

Single- and Multi-Family Share of Total Residential in 2005 and 2015

	2005		2015	
County	Single	Multi	Single	Multi
Los Angeles	46.4%	53.6%	18.7%	81.3%
Orange	56.3%	43.7%	30.8%	69.2%
Riverside	87.9%	12.1%	78.9%	21.1%
San Bernardino	91.7%	8.3%	68.9%	31.1%
Ventura	57.4%	42.6%	55.7%	44.3%

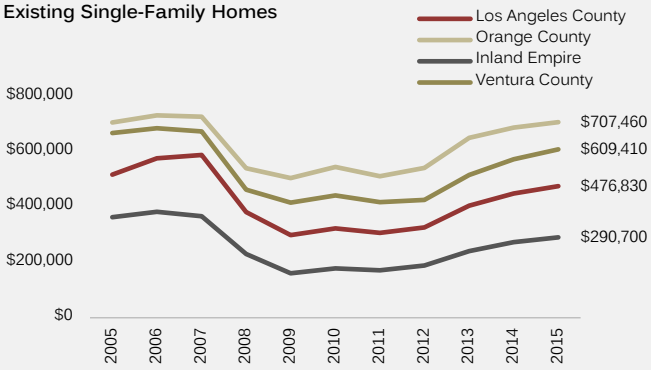
Over the 10 year period from 2005 to 2015, the ratio of single-family to multi-family homes built in the region has declined dramatically. In 2005, single-family homes accounted for 67 percent of new home construction, while multi-family accounted for 33 percent. As of 2015, that ratio was 35 percent single-family to 65 percent multi-family. In Los Angeles County, the single-family share fell from 46.4 percent in 2005 to 18.7 percent in 2015. In comparison, the Inland Empire, which still has large tracts of developable land, remains the region's stronghold for new single-family construction with a 78.9 percent share of new home permits in 2015 in Riverside County and 68.9 percent in San Bernardino County.

Median Home Prices and Rental Rates

Median home prices in Southern California have risen on a year-over-year basis for over four years and are closing in on pre-recession peaks. The primary driver behind the recent increase is a lack of inventory for sale, not a surge of buyers. Although the economy is growing and adding jobs, incomes have not kept pace with home price increases and mortgage lending standards are still relatively restrictive.

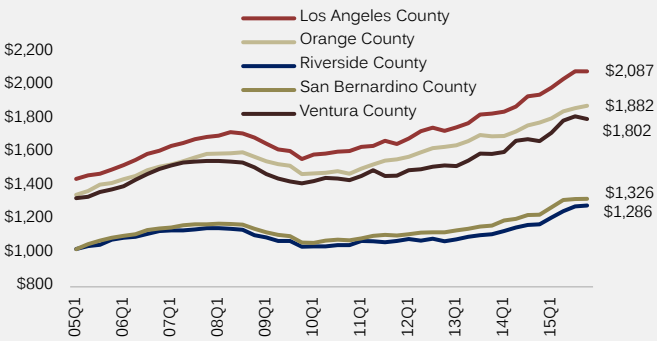
Median Home Prices

Existing Single-Family Homes



Source: California Association of Realtors

Monthly Apartment Rental Rates



For Apartments with more than 100 units
Source: Real Estate Research Council as provided by Real Facts

On the supply side, many existing homeowners who would like to sell cannot, either because they are still underwater on their mortgage (although these cases are declining in step with rising home prices), or because they cannot afford or qualify for a "move-up."

As for new homes, development is skewed towards more expensive homes as developers try to maintain profit margins in an environment of rising land values and higher impact fees. The result is very little inventory at the low end of the market, which makes it very difficult for first-time buyers to purchase a starter home.

After five years of escalating prices, affordability is once again a major issue, especially for first time buyers. California's nonpartisan Legislative Analyst's Office estimates that in addition to the 100,000 to 140,000 units that California is expected to build on an annual basis in the coming years, the state would likely need approximately 100,000 additional units annually (almost entirely in coastal communities) to mitigate problems with housing affordability caused by supply constraints.

Nonresidential Construction Permits

The recovery of nonresidential construction following the recession has been a rather uneven affair, advancing and retreating over the past seven years, but unlike new home building, nonresidential construction in Southern California is closer to achieving pre-recession peak levels.

The composition of current development projects has changed. Prior to the recession, commercial and industrial construction comprised approximately 40 percent of new building activity in the region. After falling to around 20 percent during the recession, commercial and industrial construction now garners a 30 percent share. Other types of construction such as public works, education, religious, amusements, etc. are more volatile, but currently make up 22 percent of new nonresidential permits in the region.

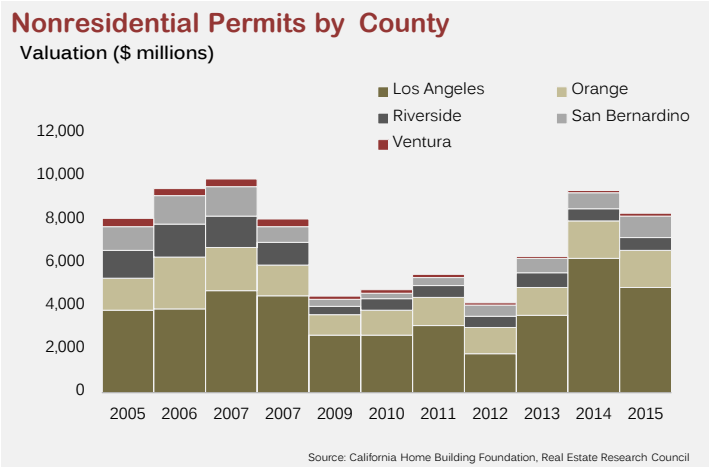
A notable development over the past 10 years has been the rise of permits for remodels and renovations to existing buildings. Averaging 35 percent of total construction permit activity prior to the recession, renovation projects now account for almost half of nonresidential permits.

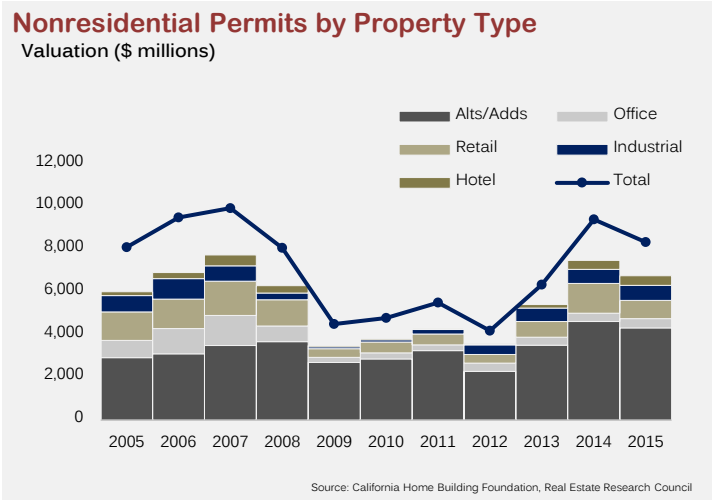
In Southern California, deliveries of new office, industrial and retail space peaked in this cycle in 2006 at 48.7 million square feet, fell to a low of 2.8 million square feet in 2010, but by 2015, had increased to 28.1 million square feet.

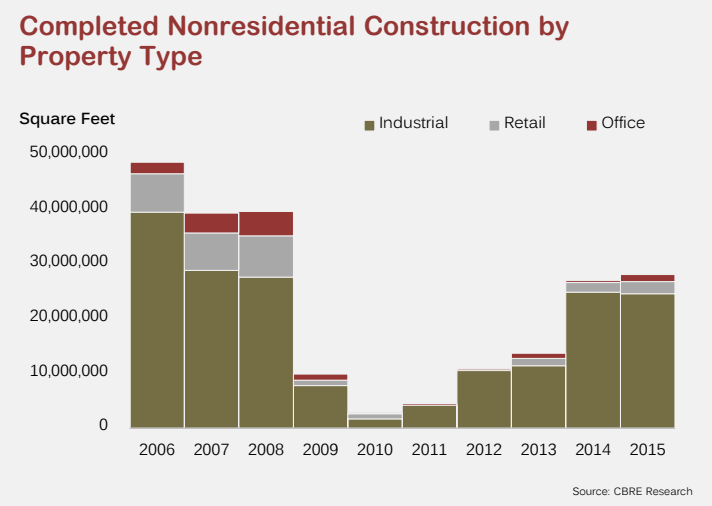
Office employment growth across Southern California is healthy and in some submarkets vacancy rates are approaching or have crossed their long-run average, an indication that new office construction may start to ramp up in the near future.

As a major market for consumer goods, Southern California's industrial real estate markets have seen several years of steady improvement. The region is a hub for manufacturing, international trade and logistics, and entertainment, all of which are users of industrial space.

Currently, the primary concern for the region's industrial market is supply, rather than demand. The surge in tourism has resulted in a rush to bring new hotel product online after several years of almost no new hotel rooms delivered to the market. Theme parks and public transportation networks are also expanding and modernizing. A number of large infrastructure projects have broken ground over the past 10 years, including improvements to major freeway arteries, the expansion of the region's light rail system, and improvements to the region's seaports and airports.







Regional construction lending has almost entirely recovered its pre-recession peak, though lending standards remain tight.

The Lending Environment

The Federal Reserve conducts a quarterly Senior Loan Officer Opinion Survey (SLOOS) that addresses changes in the terms and standards of bank loans to businesses and households. Low interest rates and an influx of foreign investment into the U.S. and into Southern California in particular have resulted in the ready availability of financing for a wide variety of development projects.

That said, many lenders are approaching the underwriting of real estate debt more conservatively than they have in the recent past. Valuations have risen sharply and as concerns about the next recession factor into the decision-making process, lenders participating in the SLOOS reported a reduced appetite for risk and are tightening terms and standards. According to the Federal Reserve's most recent survey (released July 2016), an increasing share of banks are tightening their standards for commercial real estate (CRE) loans. The increase in the number of banks reporting stricter underwriting guidelines began in 2014 and rose sharply in the final quarter of 2015 through July of this year.

Southern California Construction Lending

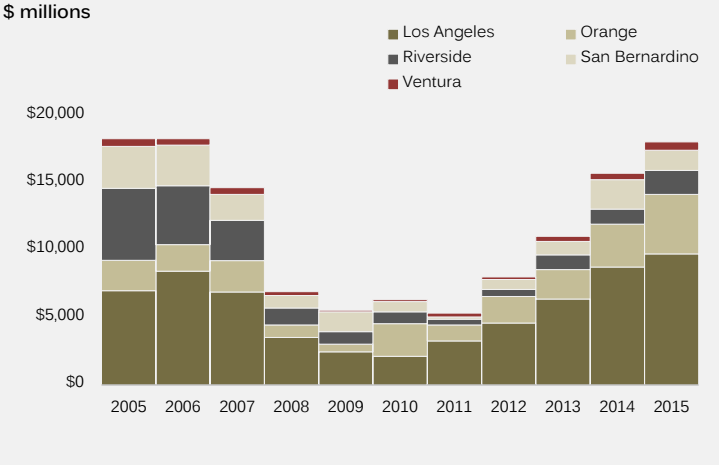
While the SLOOS data provide an overview of the national commercial real estate lending environment, we can also examine the volume of construction borrowing at the county level. These data utilize recorded construction trust deeds and are compiled by Dataquick Information Systems (via the Real Estate Research Council).

Construction borrowing across Southern California fell steeply during the recession. As of 2015, regional construction lending was still lower by 1.3 percent than it was in 2005. Because changes in construction borrowing over the past 10 years differs significantly by county, we can gain a more nuanced view of local lending activity by utilizing this data. In Los Angeles County, construction lending increased over the past decade by 39 percent, rising from just less than $7.0 billion in 2005 to $9.7 billion in 2015. In Orange County, the increase was 95 percent, reaching $4.4 billion in 2015 and in Ventura County, construction lending rose by 8.3 percent between 2005 and 2015.

Activity in the Inland Empire, however, continues to lag. Compared with 10 years ago, construction lending in Riverside County was lower in 2015 by 66.7 percent (totaling just $1.8 billion) and in San Bernardino by 51.7 percent ($1.5 billion in 2015). The Inland Empire was ground zero for the region's housing boom in the early to mid-2000s and suffered a more severe decline relative to other parts of Southern California when the housing market collapsed. Although industrial development (such as, for example, warehouses and distribution centers) has risen substantially in recent years, it has not been enough to offset the lack of new home building and other types of commercial development in the Inland Empire.

Construction Lending in Southern California

$ millions



Source: Real Estate Research Council as provided by Dataquick Information System

Sizing Things Up

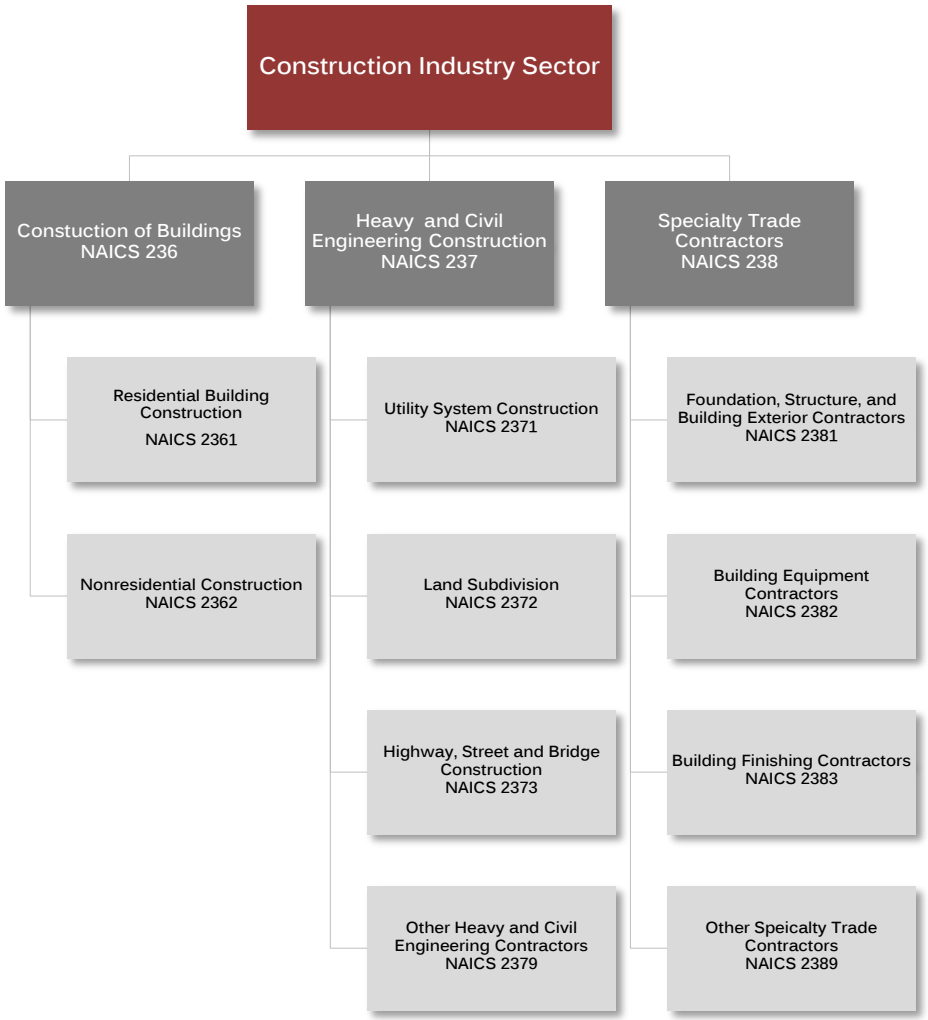
The industry defined.

Southern California is home to a large number of construction-related firms that run the gamut in size from a general contractor that may be engaged by a homeowner to remodel a kitchen to multinational corporations that manage the design and build process for multi-million dollar projects that employ thousands of workers. In this section, the industry will be quantified in terms of current and historical employment and wages by industry at the regional level for the five counties of Southern California.

Employment in the construction industry is organized into three subsectors. The first is the construction of buildings (NAICS 236). This subsector includes the construction of both residential and nonresidential structures.

Heavy and civil engineering construction (NAICS 237) includes workers engaged in the construction of utilities systems; land subdivision; the construction of highways, streets and bridges, and other heavy and civil engineering projects.

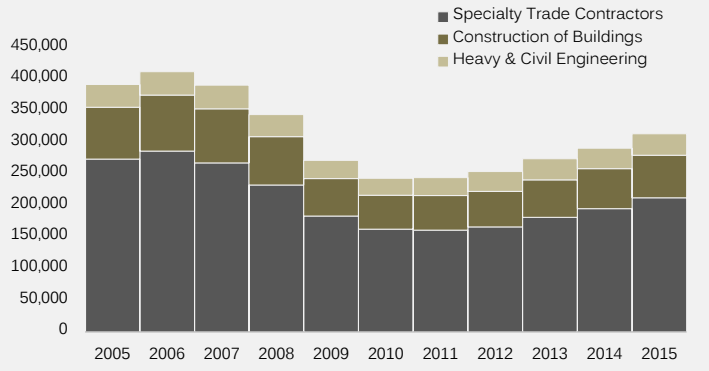
The third subsector of construction employment is specialty trade contractors (NAICS 238). This group includes contractors who specialize in foundations, structures and building exteriors, building equipment contractors, building finishing contractors and other specialty trade contractors. Detailed descriptions of the component industries of the construction industry are provided in the Appendix.



Industry Employment

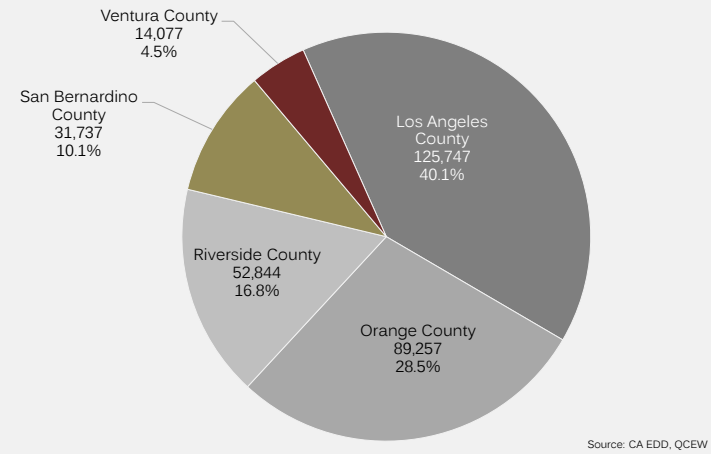
In the years leading up to the recession, fueled by the boom in new residential construction, the growth of wage and salary employment in the construction industry outpaced the average rate of job growth across all other industries in the five-county region. The flush times for

Construction Employment in SoCal



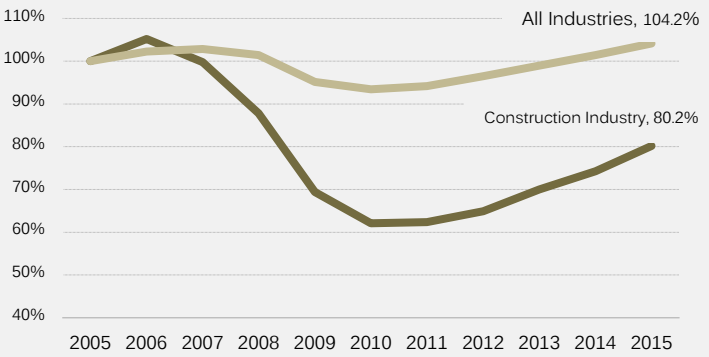
Source: CA EDD QCEW

Construction Payroll Employment by County 2015



Source: CA EDD, QCEW

Employment Growth in SoCal



Source: CA EDD, QCEW

construction workers came to an abrupt halt with the collapse of the housing market and the onset of the Great Recession. New building projects dwindled away and construction employment declined precipitously, falling faster and more steeply than overall employment during the downturn. Job growth returned to the region as the economy recovered, but the construction industry has yet to regain all the jobs lost during the recession. This stands in stark contrast with total employment in the region, which surpassed prerecession job counts in 2015.

In 2015, construction employment in the five-county region totaled 313,700 wage and salary workers. Construction employment in the region peaked at 411,500 workers in 2006 before falling to a low of 243,200 in 2011, a decline of 41 percent from peak to trough.

Los Angeles County has the highest number of jobs in the construction industry, with 125,750 jobs or 40.1 percent of all construction jobs in Southern California. Orange County had 89,360 construction jobs, or 28.5 percent of the Southern California total.

In spite of strong gains in more recent years, job counts in 2015 were still nearly 20 percent below that in 2005, while the growth of all employment in Southern California was 4.2 percent over the same period. Measured against the peak in 2006, the number of construction jobs in Southern California was down by 23.7 percent.

An examination of job trends by subsector reveals a great deal of variation in employment growth and contraction within the industry. Employment in the construction of buildings declined by 17.9 percent from 2005 to 2015, while heavy and civil engineering construction employment fell by 4.8 percent. Specialty trade contractors were hit the hardest with a 22.4 percent decline in job counts over the 10-year period. This subsector is also the largest subsector of the construction industry, accounting for more than two-thirds of all construction employment.

Measured as a share of total nonfarm employment in the region, the relative size of the construction industry has declined over time, from a peak share of 6.0 percent of total wage and salary employment in 2006 dropping to a low of 3.8 percent in 2010 and 2011. On average, construction employment comprised 4.6 percent of payroll employment during the 10-year period 2005 to 2015.

The counties that make up the region also experienced the rebound in construction employment differently. While Los Angeles County employs the largest number of construction workers, the other counties are expanding construction employment at a faster rate and in some cases, adding a larger number of workers.

Los Angeles County: In 2015, there were 125,700 construction jobs in Los Angeles County. On average, construction employment made up about 3.1 percent of total wage and salary employment in the county. Similar to the regional trend, construction employment declined by 15.4 percent (losing 22,810 jobs) over the past decade.

Orange County: The construction industry in Orange County employed 89,300 workers in 2015, which represented 5.9 percent of Orange County's wage and salary employment. Overall construction employment was lower by 5.9 percent compared with 2005, a loss of nearly 11,700 jobs.

Riverside County: In 2015, there were 52,800 workers employed in Riverside County's construction industry. Construction jobs averaged 8.6 percent of the county's wage and salary employment over the last 10 years (reaching 12.9 percent in 2005). Construction employment in 2015 was more than 32 percent below where it stood in 2005.

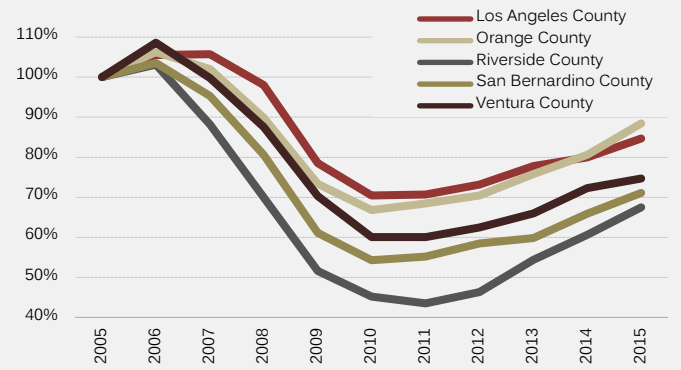
San Bernardino County: San Bernardino has also seen a resurgence in construction employment since the end of the recession, but in 2015 job counts were still below 2005 levels by 29 percent (a decline of 12,910 jobs).The share of construction jobs relative to total wage and salary employment in San Bernardino has averaged 5.1 percent since 2005, but currently stands 4.6 percent.

Ventura County: The smallest county in the five-county region, Ventura construction employment experienced the steepest decline (in percentage terms) over the decade (2005-2015), falling by 25.3 percent or 4,762 jobs.

Wages in the Construction Industry

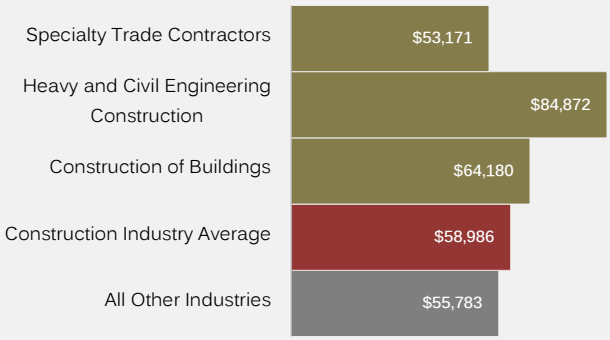
Workers in Southern California's construction industry earn a range of wages from highly compensated project managers and civil engineers earning more than $100,000, to skilled tradespersons and administrative workers to entry level helpers and material movers. Overall, the average annual wage earned by construction industry workers was $58,986 in 2015. By major subsector, heaving and civil engineering earned the highest average annual wage at $84,872, followed by construction of buildings

Construction Employment Growth by County



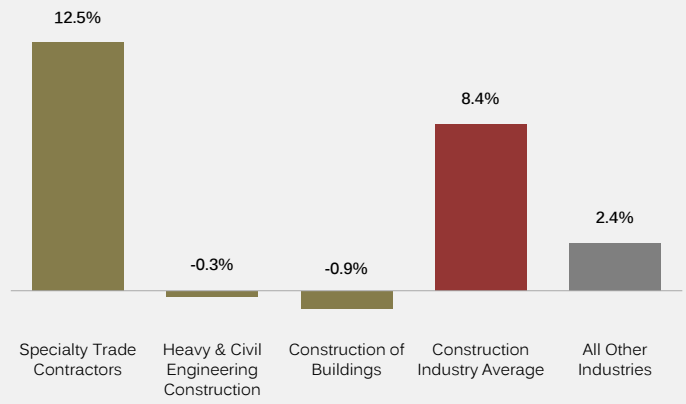
Source: CA EDD, QCEW

Average Annual Earnings in the Construction Industry by Subsector 2015



Source: CA EDD, QCEW

Real Wage Growth 2005-2015



Source: CA EDD, QCEW

($64,180) and specialty trade contractors ($53,171). The average annual wage earned by all other industries in the region was $55,783. (See Exhibit A-2 in the Appendix for additional information on average annual wage by detailed industry.)

In general, wage growth across many industry sectors has been tepid over the last 10 years. The recession was a major setback, with years of labor market slack stifling wage growth. In the construction industry, inflation-adjusted wages in the Southern California region increased by 8.4 percent – equivalent to an annual average growth rate of just 0.8 percent. Still, that was better than the 0.3 percent rate experienced by all other industries in the region over the same period.

Foundation, structure and building exterior contractors experienced the most rapid wage growth between 2005 and 2015 with an increase of 15.6 percent. On the other hand, there were four subsectors that experienced a decline in real wages over the past decade: residential building construction (declining by 0.9 percent); nonresidential building construction (falling by 9.4 percent); land subdivision (falling by 9.7 percent); and other heavy and civil engineering construction (falling by15.4 percent).

Nationally, there have been numerous reports in construction trade publications that finding enough skilled trades workers is a major concern for many construction firms. If that were the case, one would expect to see upward pressure on wages. While wages are growing slightly faster in the construction industry compared with the overall rate of wage growth, the data for Southern California does not necessarily indicate a general shortage of workers in the region. While many construction workers have left the industry, moved out of state or retired, it appears that at this time, the overall supply of labor is currently sufficient to meet demand, although it may be the case that some specific occupations are experiencing a shortage of skilled workers.

Spreading the Wealth

Impacts of the construction industry are felt across the economy.

The extent to which an industry's impact extends to other sectors of the economy and into the hands of households depends in great measure on the share of the industry's value (i.e., revenues) that is recirculated within the region. The total economic contribution of the construction industry to the Southern California economy multiplies through its supply chain and payroll spending throughout the region, the impacts of which are examined here.

The construction industry impacts a broad spectrum of industries through its supply chain.

Where the Industry Spends Its Revenues

Firms generate revenues through sales of their products and services, and use those funds to purchase the inputs needed to produce the product, to pay their workers, to pay taxes on production and profits, and to generate a return on capital in the form of profits. Industries can vary substantially in the shares claimed by each of these components.

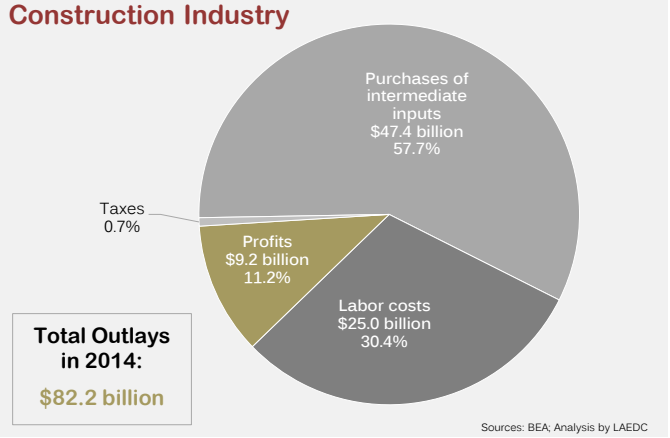
In 2014 (the most recent year for which this data is available), the construction industry spent $47.4 billion on intermediate inputs into production, accounting for 57.7 percent of all outlays. Labor payments reached $25.0 billion, accounting for 30.4 percent, and the industry distributed $11.2 billion in profits. Tax payments were a small share of all outlays.

The overall impact that an industry has on the broader regional economy depends upon the expenditures made within the economic region. In general, outlays for labor costs occur within the region, and households are supported by these earnings.

If most of the inputs used in production are purchased from local suppliers, those firms enjoy demand for their products and can increase their own hiring, supporting additional households in the region. If, on the other hand, most of the inputs are purchased elsewhere in the nation, then these purchases have no impact locally (other than perhaps in their transportation and storage) and the industry itself will generate fewer indirect effects.

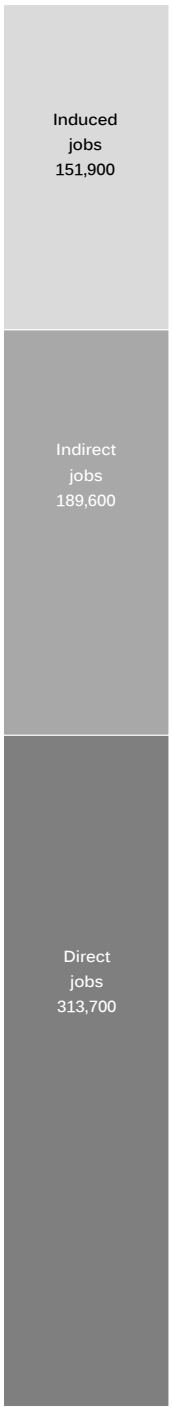
Determining the source of inputs can be done through detailed surveys but this is usually estimated using econometric techniques that take into account the region's ability to provide the needed inputs, regional price differences and the cost of transporting goods. Together, labor costs and regional purchases of intermediate inputs determine the spillover, or multiplier, impacts of the industry.

Composition of Total Outlays of Construction Industry



Economic Contribution of Construction Industry

655,200 total jobs



The concept of economic contribution answers the question, "What contribution does this industry make to the regional economy?" and measures not only the direct activity but also indirect and induced activity. This contribution is dependent on the payments made to suppliers of intermediate goods and services in the region and payments made to workers, who usually live locally and spend most of their incomes on household purchases from local suppliers.

In addition to the 313,700 direct payroll jobs in the construction industry, an additional 189,600 jobs were supported in 2015 through indirect effects of supply chain purchases that are not made within the industry itself, and 151,900 jobs that were supported through the household spending of employees in the industry cluster as well as its supply chain.

Labor income (which includes wages and benefits) earned by all construction-supported employment in Southern California reached $35.7 billion, accounting for approximately 8.6% of all labor income paid in the Southern California region in 2015.

Together, construction industry output totaled $114 billion of which, $56.1 billion was value-added, which accounted for 5.8 percent of the Southern California region's gross state product of $962.2 billion.

The overall impacts are widely distributed across many sectors of the economy through indirect and induced effects, including manufacturing, real estate rental and leasing, wholesale trade, professional and technical services, and administrative support and waste services. (See Exhibit A-3 in the Appendix for a complete and detailed contribution by industry sector).

The total fiscal impact of the economic activity in 2015 attributable to the construction industry, including direct, indirect and induced activity exceeded $13.5 billion. This includes, for example, property taxes paid by firms and households, sales taxes on consumption purchases, personal and corporate income, and payroll taxes paid for and by employees.

Total Economic Contribution of the Construction Industry (2015)

	Direct	Indirect	Induced	Total
Output ($ millions)	$ 58,520	$ 32,067	$ 23,432	$ 114,019
Employment (jobs)	313,700	189,600	151,900	655,200
Labor Income ($ millions)	$ 17,371	$ 10,454	$ 7,943	$ 35,668
Value-Added ($ millions)	$ 24,348	$ 17,756	$ 13,998	$ 56,102

Source: Estimates by LAEDC

Total Fiscal Impacts by Type

	$ millions
By Type of Tax:	
Personal income taxes	$ 4,166
Social insurance	3,719
Sales and excise taxes	2,049
Property taxes	1,437
Corporate profits taxes	1,444
Other taxes	776
Total	**$ 13,591**
By Type of Government:	
Federal	$ 8,503
State	2,928
Counties	1,501
Cities	659
Total	**$ 13,591**

Source: Estimates by LAEDC

Supply Chain Analysis

The intermediate purchases of the construction industry comprise an important part of the overall economic contribution of the industry. It was shown above that these accounted for 57.7 percent of the industry outlays, or $47.4 billion in 2014.

Gross inputs are a combination of goods and services. In this industry, approximately 48 percent of intermediate goods are manufactured products, such as petroleum products, concrete, plastic products, asphalt products, and fabricated metal products (see left panel in exhibit below). Trade, transportation and utilities accounted for 26 percent of intermediate inputs. These include wholesale trade services, retail purchases and truck transportation. Professional and business services accounted for 7.8 percent of intermediate inputs, including such services as architecture and engineering, legal services and waste management. The remaining 5.3 percent of inputs were provided by other industries, including financial services, hospitality and natural resources. A complete list of gross and regional input purchases by industry sector is provided in Exhibit A-4.

The overall impact of the construction industry is largely due to its regional purchases.

Regional Purchase Gap

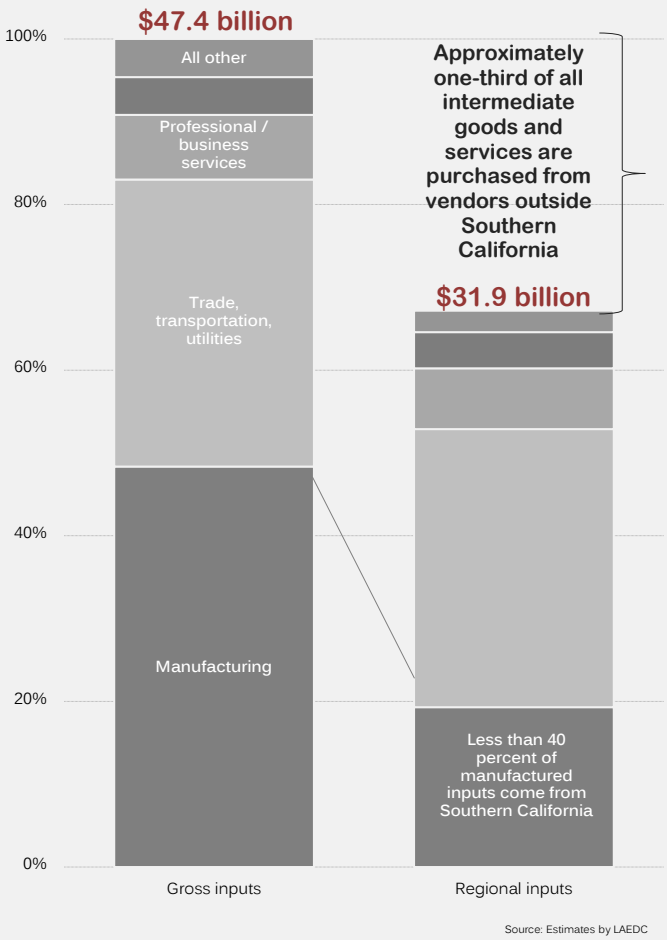
The ability of a region to fill the demands of its industries speaks to the richness and diversity of the regional economy. Not all regions can effectively compete, or wish to compete, with suppliers of specific goods and services based elsewhere. Industries making purchases of goods elsewhere are clearly benefiting from lower costs, better quality or other advantages to importing intermediate goods rather than purchasing from local firms.

From an economic development perspective, it may be preferable, however, to develop deep and broad local supply chains in order to capture a larger share of industry purchases, especially those that can be economically supported within the region.

The percent of all inputs purchased regionally are shown in the right panel of the exhibit. In general, trade, transportation and utilities are purchased from regional suppliers. Firms in the construction industry purchase almost 97 percent of these services from region suppliers. Similarly, the region is able to supply the industry with more than 94 percent of its needs for professional and business services.

In contrast, less than 40 percent of the industry's purchases of manufactured goods occur in the Southern California region. Because this represents a significant share of the industry's intermediate inputs, the impact on the overall regional supply pipeline is fairly significant in the magnitude of this lost opportunity. In terms of value, the industry spends $15.6 billion with firms outside the Southern California region.

Construction Industry
Regional Provision of Intermediate Inputs



Source: Estimates by LAEDC

Work, Work, Work

About the kinds of jobs that make this industry successful.

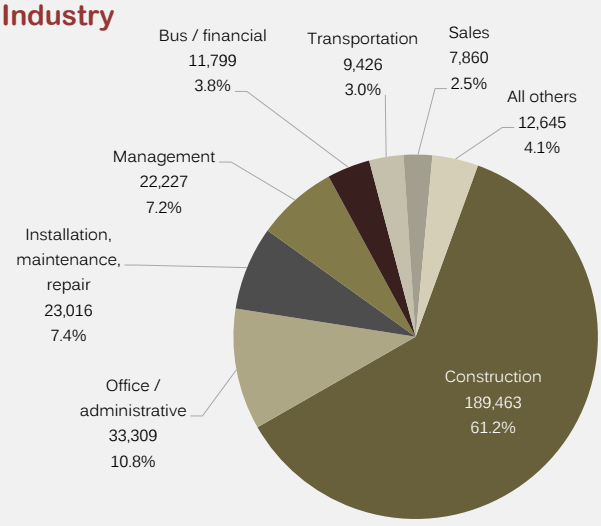
More than 61 percent of industry jobs are in construction occupations, such as carpenters, electricians, plumbers and iron workers.

The work that people do in their jobs is commonly classified using the Standard Occupational Classification (SOC) system, developed by the Bureau of Labor Statistics. Workers are classified into particular occupations with similar job duties, skills, education and training. In Southern California, there are approximately 650 detailed occupations represented in the workforce. These are not generally industry-specific but are common to many industries.

In total, the SOC data set listed almost 309,700 workers (compared 313,700 workers counted in the QCEW industry data) employed in construction occupations in Southern California in 2015, the majority of which, were unsurprisingly, employed in *construction and extraction* occupations. Within that occupational group, however, there are a variety of detailed occupations that are more descriptive of the type of work being done. For example, occupations such as carpenters, tapers, electricians, plumbers, and structural steel and iron workers are all in this category of workers.

Construction industry workers can be found in most of the major occupational groups including: office and administrative occupations (33,300 workers); installation, maintenance and repair occupations (23,000 workers); management occupations (22,200 workers); business and financial occupations (11,800 workers); and transportation and material moving occupations (9,400 workers). The remaining 20,500 construction workers in the region were employed in smaller numbers in 14 additional occupational groups.

Major Occupational Groups in the Construction Industry

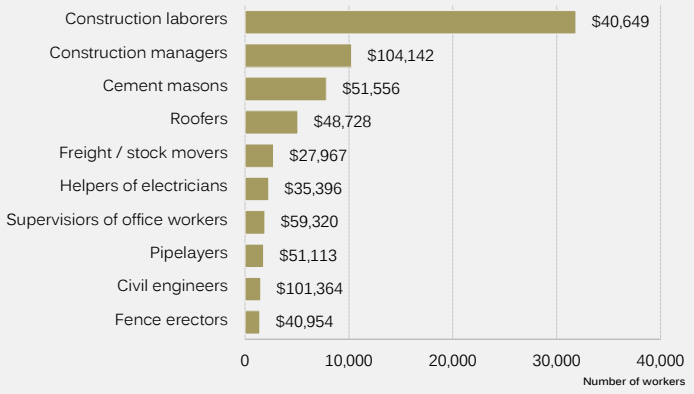


Sources: Bureau of Labor Statistics, estimates by LAEDC

Construction industry workers usually have some sort of post-secondary training, be it in the form of a professional certification, apprenticeship or relevant degree from a two- or four-year college or university. Although many jobs in this industry require a degree of physical strength and knowledge of a specific trade, earning a four-year degree can expedite the contractor licensure process and shorten the path to becoming a construction manager. For those looking to enter the industry as construction laborers, there are numerous job-specific certifications and apprenticeships available.

Although there currently appears to be a sufficient supply construction labor in Southern California, improvements in the labor markets are increasing job opportunities in other industries and may be drawing away younger workers who in the past might have considered a career in construction. Labor shortages and gluts are part of the industry's regular cycles, but if industry activity continues to increase, there could be a shortage of skilled workers stemming from structural changes in the local labor force. The construction industry workforce thinned out dramatically during the recession as work dried up. Many skilled construction workers left the industry, retiring or switching to jobs in other industries. This has prompted industry groups like the Associated General Contractors of America to develop their own construction workforce development programs that include increased outreach to high schools and technical schools.

Common Construction Occupations
Number of Workers and Average Annual Wage



Source: Bureau of Labor Statistics, SOC Data

Exhibit A-5 in the Appendix lists the top 50 detailed occupations in the industry by current employment with entry level educational requirements and mean annual wages.

Future Workforce Needs

Given the expected growth of the industry over the next five years, and assuming a fairly consistent composition of occupations within the industry, the skills needed over the next five years can be reasonably projected.

At its current projected rate of employment growth, industry employment is expected to grow at a rather robust pace of over 3 percent per year.

More of the overall job openings expected over the next five years will be due to new jobs being created than replacement of retiring workers. Replacement needs are estimated by the Census Bureau and depend on many factors, including the age profile of the existing workforce, and skills acquisition through on-the-job training (leading to promotion).

Overall, it is expected that 52,490 new job openings will be created in the industry in Southern California over the next five years. The industry will need an additional 45,520 replacement workers over the same period.

The highest number of openings will be found in occupations related to construction and extraction, such as construction laborers, carpenters, electricians, plumbers and painters. With 34,000 new jobs and 17,660

5 Year Construction Occupational Needs in Southern California by Major Occupational Group

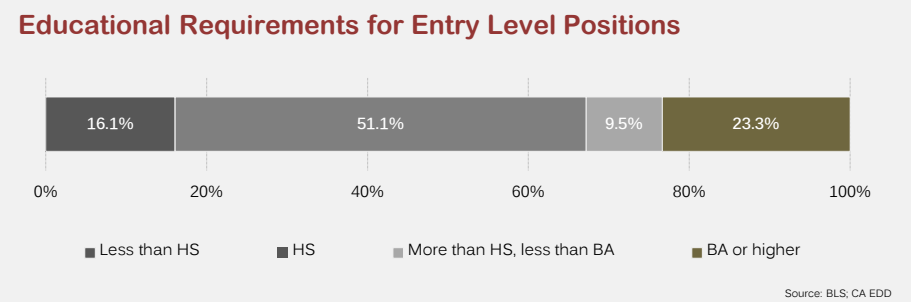
SOC	Occupational Group	New Jobs	Replacement Jobs	Total Job Openings
11-0000	Management occupations	3,520	2,670	6,190
13-0000	Business and financial	2,030	1,320	3,350
15-0000	Computer and mathematical	140	60	200
17-0000	Engineering	700	600	1,300
27-0000	Arts, entertainment, sports and media	60	50	110
37-0000	Building/grounds maintenance	190	140	330
41-0000	Sales and related occupations	1,180	1,310	2,490
43-0000	Office and administrative	5,100	3,600	8,700
47-0000	Construction and extraction	34,000	17,660	51,660
49-0000	Installation, maintenance / repair	3,860	2,880	6,740
51-0000	Production	700	530	1,230
53-0000	Transportation / material moving	940	810	1,750
	All Others	*60*	*40*	*100*
		52,490	**42,520**	**95,010**

Sources: CMP; Census Bureau, OES; Estimates by LAEDC

replacement jobs expected, these jobs represent more than half of all openings expected over the next five years. Installation, maintenance and repair occupations will provide the second highest number of openings, with 3,860 new jobs created over the next five years and 2,880 jobs needing replacement workers.

A full list of projected occupational openings is shown in Exhibit A-5 in the Appendix.

Of all openings over the next five years, approximately 23 percent will require a bachelor's degree or higher. These workers are likely to be employed in architectural, engineering and management occupations. Approximately 51 percent of openings will be available to workers with a high school diploma, and 16 percent will be available to those without a high school credential. These workers are likely to be employed in basic and construction occupations.



Preparing the Workforce

In order to meet the building needs of a growing region, the construction industry requires a continuous supply of workers, ranging from low skilled to very highly skilled. The educational and training programs that exist in Southern California are extremely valuable because they provide paths to careers in construction for all skill levels. Universities and community colleges, as well as trade and technical schools, have developed targeted programs aimed at reducing the time spent by new entrants in on-the-job training to create an occupation-ready workforce.

The remainder of this section will introduce the reader to educational and training programs that are available to prepare students for entry into the construction workforce.

Contractor Licensing and Certification

All businesses or individuals who construct or alter any building, highway, road, parking facility, railroad, excavation or any other structure in California in which the total cost of the project is over $500 must be licensed as contractors by the California Contractors State Licensing Board (CSLB), and must be so before submitting bids for projects. Licensing may be granted to individuals, limited liability companies, partnerships, corporations, and joint ventures. Employees who are paid wages, do not usually work in an independently established business, and do not have direction or control over the final results of the project therefore they do not have to be licensed; other exemptions also exist.

Contractor licenses are divided into three categories: (A) general engineering, (B) general building, and (C) specialty contractors. General engineering contractors work on fixed-works that require knowledge of engineering principles and techniques specific to each project, such as irrigation, drainage, flood control, railroads, airports, bridges, pipelines, chemical plants, etc. General building contractors, such as framers and carpenters, may take on projects requiring trades outside their primary realm of expertise only when they enlist the help of an appropriately licensed specialty contractor. Specialty contractors include those in the construction industry whose work requires special skills and whose principle contracting business requires knowledge of specialty trades or crafts like

installing carpet or servicing and testing fire extinguishing systems. See Exhibit A-6 in the Appendix for a list of specialty contractor certifications in California.

Contractors may hold multiple licenses, as well as gain certification in specific areas of their trade. Some examples of contractor certifications include: boiler, hot water heating, and steam fitting; cabinet, millwork and finish carpentry; low voltage systems; drywall; elevator; and many others. To be more specific, a certified glazing contractor selects, cuts assembles and/or installs all makes and kinds of glass for glazing; executes the fabrication and glazing of frames, panels, sashes and doors; and/or installs these items in any structure.

"Qualifying individuals" or "qualifiers" are required for every classification of each license issued, and are responsible for employers' construction operations. In order to become a qualifier, one must meet experience and examination requirements for a contractor's license, including at least four years of experience as a journeyman, foreman, supervisor, or contractor in the particular field of each project an individual will take on. Although no educational training is required for licensure, up to three years' worth of credit may be granted for completion of relevant apprenticeship training, technical training, or education, and at least one year of experience must be practical.

Up to one and a half years of credit towards licensure may be awarded for earning an associate's degree in building or construction management. Two years of credit can be earned by completing a four-year degree in the fields of accounting, architecture (B-General Building Contractor classification only), business, economics, mathematics, physics, or areas related to the specific trade or craft for which the application is being made. Up to two years of credit may also be granted for the completion of a professional degree in law; or substantial college or university course work in accounting, architecture, business, construction technology, drafting, economics, engineering, mathematics or physics.

Earning a bachelor's degree in construction management or in an engineering field related to the desired license could allow the applicant up to three years of credit. Similarly, applicants may be credited for up to three years of experience by completing an accredited apprenticeship program or union-provided apprenticeship training. Lists of educational and training programs, including apprenticeships and certifications, can be found in Exhibits A-7 and A-8 in the Appendix.

Construction Management

The Master's Degree in Construction Management at USC was created through a partnership between five of the university's schools:

- Viterbi School of Engineering (Department of Civil and Environmental Engineering)
- School of Policy, Planning and Development (Program in Real Estate Development
- School of Architecture (Building Science Program)
- Marshall School of Business (Department of Finance and Business Economics)
- Gould School of Law

This diverse program prepares students to find employment as general contractors, real estate developers, and sub-contractors with construction management and architectural firms. In order to accommodate working professionals looking to advance their careers, courses are offered in the late afternoons and evenings, and part-time enrollment is permitted. Although some experience in the industry is preferred, it is not required.

Admission requirements stipulate that students must have earned a bachelor's degree with a GPA of 3.0 or higher from an accredited university, preferably with experience in capital management and statistics. Those without such experience may be counseled to correct for these deficiencies.

Once admitted, students choose to follow one of three tracks: finance; real estate development; or architecture, engineering and construction. Required courses include Building Systems, Functions of the Constructor, Topics in Accounting (as it relates to construction and engineering), and Project Controls-budgeting and Estimating. Elective courses include Heavy Construction Estimating; Environmental and Regulatory Compliance; Performance Analysis; Negotiation and Deal-making; and Cases in New Venture Management.

Students on the financial track take courses in Real Estate Finance and Development; Real Estate Capital Markets; Advanced Topics in Real Estate Finance; Mortgages and Mortgage-backed Securities and Markets; and Real Estate Finance and Investment. In Advanced Topics in Real Estate Finance, students learn about sources of equity and debt, the role of capital markets, real estate investment trusts (REITs), conduits, portfolio analysis, and acquisition of distressed assets.

Students following the real estate development track take courses in Management of Real Estate Development; Feasibility Studies; Advanced Real Estate Analysis; Economics of Urban Land Use; Feasibility Studies; and Real Estate Finance, Investments and Development. In the Economics of Urban Land Use-feasibility Studies course, students learn about the economic, market and financial analysis related to feasibility of real estate development, as well as theory and case analysis.

Students opting for the architecture, engineering, and construction track take courses in Building Information Modeling and Integrated Practice; Sustainability; and Building Information Modeling for Collaborative Construction. Students in the latter-most course work alongside their peers and members of partnered private companies to solve engineering and construction problems.

CSU Long Beach's College of Engineering offers a Bachelor of Science degree in Construction Engineering Management (CEM). Students begin their lower-division course work alongside civil engineering students, where both groups learn fundamentals of mathematics, physics, chemistry, and topics related to structural design and building. As the two majors diverge, CEM students continue to learn about building and design principles, as well as regulatory codes and standards, business and management principles, and best industry practices. Students may take CEM courses in pursuit of the four-year degree, or as transfer credits suitable for military or technical training institutions.

Alongside general education courses, lower division education for this major includes a well-rounded variety of topics in the construction and engineering professions. These fundamental seminar and laboratory courses include introductions to industry practices and trends, computer aided design (CAD) drafting for blueprints, accounting and costing methods specific to the industry, concrete construction and its chemical properties, probability and statistics with relation to the construction industry, and statistics.

Upon completion of lower division and general education courses, upper division students must acquire competency in a number of other topics including: applied mechanics, communication in engineering professions, construction safety, operations management, commercial and industrial construction practices, soil mechanics technology, mechanical

equipment for buildings, fundamentals of integrated project delivery, plant planning and layout, electrical equipment for buildings, structural design construction planning and scheduling, earthwork and civil works, construction practices, business and construction law, advanced estimating and bidding, construction coast control, facility administration, facility financial management, facility and property management, facility operations management, structural design, principles of design build, construction and maintenance of infrastructure facilities, infrastructure management, construction project management, and a senior project.

To further illustrate, students in the Earthwork and Civil Works Construction Practices course learn volume calculation and mass diagrams, soil projection and dewatering systems, volume change characteristics and fundamentals of moving earth, equipment selection, management and economics. Students in the business and construction law course learn about contractor's licensure, mechanics liens, subdivision laws; public works projects, bid and bid requirements; litigation and legal trends in affirmative action, design professionals' liability; and administrative procedures of contractors. Students also study documentation, claims, waivers, arbitration, bonding, insurance and indemnification and discuss ethical practices.

Construction Technology Training

El Camino College offers both a Certificate of Achievement and an Associate of Science in Construction Technology to students interested in the trade. In each of these programs, students learn basic residential construction techniques such as reading blueprints, estimating materials, and meeting code requirements. Completion of one of these programs will grant two years of experience towards becoming a licensed contractor.

Students in Cerritos College's Construction Technology program begin their training with primer courses in calculus, physics, business law, economics, computer information systems, geology, statistics and accounting. As the program progresses, students take industry specific courses that include architectural drafting and design, computer aided design fundamentals, computer programming and machine design. Upon completion, students are set to transfer to a four year engineering degree program or enter the industry directly, working with owners, developers, architects, engineers, building departments, governmental entities, contractors and subcontractors.

Among the relevant construction industry programs at LATTC, the carpentry, electronics, and plumbing degrees and certificates apply most directly to the industry. The Associate of Science and Certificate of Achievement programs are designed for new students looking to acquire skills that can be taken into an entry-level job, whereas the Associate of Arts degrees are offered in the evenings and are designed for working professionals who can practice the skills they learn in class during their respective working hours.

Skills learned in the carpentry programs include the construction, installation, and repair of structures and fixtures made from wood and other materials; working from blueprints, layout, measuring, marking and arranging materials in accordance with local building codes; cutting and shaping wood, plastic, fiberglass, or drywall using hand and power tools; and joining materials with nails, screws, staples or adhesives. On top of these, students will learn to demonstrate sustainable industry principles and practices, perform calculations and practices required for the building construction industry and work dependently and independently to complete shared tasks.

Skills learned in the electronics programs include construction and maintenance of electrical systems; electrical theory; electrical controls; conduit installation; blueprints; low

voltage systems; and maintenance practices. Furthermore, students who successfully complete one of these programs will be able to use hand and power tools to perform electrical construction and maintenance work; demonstrate sustainable electrical construction and maintenance practices; perform trade calculations related to electrical construction and maintenance work; work independently and interdependently to safely accomplish shared professional outcomes; and demonstrate knowledge of reading electronic symbols and schematic diagrams.

Students studying plumbing at LATTC learn skills like reading of blueprints and layouts; installation of piping systems and fixtures and repair of supply and waste water systems. Upon completion of the program, students will be able to use hand and power tools to perform plumbing operations; demonstrate sustainable plumbing practices; perform trade calculations related to plumbing practices; and create and use construction documentation.

Mt. San Antonio College provides several relevant training programs for individuals wishing to enter the construction industry, including certificates of achievement in the advanced field of building automation and the in-demand field of construction inspection. Students pursuing the building automation certificate will be prepared for careers in that field, as well as the fields of energy management and green building technologies. Preparedness comes through course work in topics such as air conditioning and refrigeration, automated building fundamentals, electrical fundamentals, building automation networks and programming, energy management, computer networks and programming, and technical applications in microcomputers. Students earning a construction inspector certificate learn industry standards, such as architectural materials and specifications, building and zoning codes, legal aspects of construction, elements of construction, construction estimating, architectural design and drawing, and reading architectural drawings.

The construction technology program at Orange Coast College (OCC) offers a variety of specialized certificates. The Construction Technology Certificate of Achievement is geared towards students with little to no work experience, and prepares them for entry level positions in the industry. The residential Construction Certificate has students focusing on one aspect of residential construction, such as cabinet making, drywall, building code and law, concrete construction, specialty crafts, plumbing, residential electrical wiring, residential steel frame construction and more. Returning students may receive multiple awards for this certificate. The Master of Construction Specialist Certificate is awarded to students who complete at least 54 units of education at OCC. Residential Electrical and Fine Woodworking Certificates of Specialization are also offered at OCC. Students may also receive a Certificate of Completion in Residential Construction with a specialization in concrete and masonry and plumbing.

Looking Ahead

Future trends and emerging technologies.

Although the basic construction process of assembling a building piece by piece has in many ways remained unchanged for decades, this does not mean the industry has stood still in the face of technological change. Additionally, the industry in Southern California faces a challenging regulatory environment and high costs. In this section, we present a brief look emerging technologies and other issues that will shape the construction industry in the years to come.

Top Near-Term Trends to Watch

Industry analysts and company executives alike are optimistic about the future and predict another strong year or two of growth for the construction industry. Construction industry trade publications report on a variety of wide-ranging trends that are expected to shape that growth over the next few years. The most commonly cited are:

- The multi-family sector will slow as single-family housing gains momentum, especially in more affordable inland areas;
- Homebuyers will continue to seek out walkable communities near employment centers and transportation hubs;
- Demand for "green" building features for both commercial and residential structures will continue to rise;
- Remodeling and renovations will continue at a robust pace;
- Construction companies will struggle with shortages in some skilled trades;
- Prefabricated and offsite construction methods will become more popular;
- The use of building information modeling (BIM) technology will become a necessity;
- Laser scanning technology used to create a digital models will gain wider usage;
- Construction companies will be more cautious about project selection because of lingering caution from the last recession

Near term trends include increased urban density, energy-efficiency, and technological enhancement, yet some caution remains.

Technology Innovations

No industry in recent decades has remained untouched by technological change, even one as labor intensive as construction. Technology is changing the way projects are managed, how materials are produced and the building process itself. The introduction of new technologies has helped to streamline, automate and speed up building design and construction. Innovations include 3D printing, which has the potential to reduce the amount of time it takes to produce complex building forms. Already, researchers are experimenting with 3D technology to build entire homes.

Drones equipped with high-resolution digital cameras have also become a useful tool for builders. The use of drones can streamline the survey process making it easier and less time consuming. On the ground, building information modeling (BIM) allows developers to

create 3D models of buildings in great detail. This allows design and build teams to spot potential problems and conflicts before the first form is built.

Software improvements are speeding up the process of energy-modeling. Energy-modeling is a computerized simulation of a building or complex that focuses on energy consumption, utility bills and life cycle costs of various energy-related items such as air conditioning, lights and hot water. Previously, these models have taken weeks to design and build. Today users can analyze performance data within hours and make immediate design changes if needed.

Mobile technology in the field is also becoming more common and is increasingly being utilized to manage projects and workers more efficiently. Managers can analyze daily production, transmit blueprints and change orders, and track worker hours. GPS tracking is now commonly used to monitor the location of equipment and how it is being used.

Technological innovation has also come to workers in the field. New tools are lighter and designed to be easier to use, safer and to reduce stress on the body. Wearable technology may soon be used to optimize workforce productivity and safety by placing workers in optimal positions on a job site.

Regulatory Environment

Regulatory compliance can affect project costs and scheduling, but may also improve worker safety.

Contractors throughout the construction industry have expressed frustration with the time and cost of meeting regulatory requirements. Developers in California must negotiate their way through a complex set of environmental laws and a lengthy permitting process. For the most part, this is simply viewed as a cost of doing business in California. While regulation may be a contributing factor in the state's housing shortage popular resistance to increasing density in desirable areas likely plays as large a role in limiting residential construction as regulation.

Industry trade associations are also balking at new stipulations by the Department of Labor in the agency's silica rule that places additional restrictions on exposure levels, and the new overtime rule, which raises the exempt threshold for salaried workers from $23,660 to $47,476 per year. Industry advocates say the new rules will again raise compliance costs.

The Davis-Bacon Act of 1931 is still a point of contention. This legislation requires contractors to pay prevailing wages on public works projects and provide detailed pay forms to the lead contractor on a project. Those in favor of the rule say it prevents contractors from lowering wages as a way to cut costs. Opponents argue that union wages used the regulation's benchmark do not always align with regional pay rates.

Moving Forward

Technological change, workforce development, government regulations and the ups and downs of the business cycle are continuing challenges facing the construction industry in Southern California as it moves forward. While still somewhat short of prerecession employment and activity levels, the region's growing population, employment base, infrastructure needs and expanding economy give construction firms and workers reason to be optimistic about the growth of their industry in the coming years.

Appendix

How (and why) we did what we did.

Here we explain why we are interested in learning about regional industries and industry clusters in more detail, and how we measure them. Data sources and methodologies are outlined, and a description of the component sectors in the construction industry is provided. A series of exhibits fill in some of the details that were summarized in the report.

Cluster Theory and Economic Development

Clusters are agglomerations of related industries, consisting of companies, suppliers and service providers, as well as government agencies and other support institutions. By bringing together talent, technology, information and competing companies, such geographic proximity allows firms to learn from each other, develop specialized labor, shared infrastructure, service providers, suppliers and support institutions. This local collaboration and competition spurs innovation and productivity, attracting other firms to the region as they seek to benefit from spillovers present in the clustered industry.

We look at the economy by categorizing its industries into clusters rather than aggregating them into larger sectors. Clusters allow us to see industries linked with others through technology, skills, common supply chains, specialized labor pools, infrastructure needs and so on.

Research shows that regions with comparatively strong industry clusters achieve better economic performance through increased job creation, wage growth, business formation and entrepreneurial activity and innovation.

Michael E. Porter, professor in the Harvard Business School at the Institute for Strategy and Competitiveness, is a leading expert on the competitiveness of businesses and his insights have brought focus to how regions can develop competitiveness and economic prosperity by recognizing the importance of industry clusters. Funded by the Economic Development Administration of the U.S. Department of Commerce, Porter's Cluster Mapping Project (www.clustermapping.us) has provided a categorization of industries into industry clusters based on their locational correlation of employment.

A further distinction is made between industry clusters that serve the local market, such as retail industries, health services and restaurants, and those that sell goods and services to larger markets outside the economic region.

Because local industry clusters exist wherever there is a local population base, they are likely to grow at the rate of population growth. They may also provide the majority of the region's jobs.

Traded clusters, on the other hand, are not dependent on local sales but find markets outside the region in which they are located. Because they are exposed to the global market, they must be competitive in order to thrive and grow, and will choose to locate

where there exist locational advantages, such as availability of labor, land and capital suited to their needs, as well as supplier networks and other supporting institutions.

Hence, investments made by such firms in technology, innovation, labor and the upgrading of their goods and services result in improved productivity and efficiency, increasing the firm's competitiveness in the global marketplace, growing the market share of the industry and driving industry growth, which creates higher-wage jobs and regional prosperity.

The first step in this virtuous cycle is to foster an environment where industry clusters can grow organically. Knowing our regional strengths and weaknesses provides us with a useful baseline on which we can build economic development strategies.

Data Sources

Employment and wage data were obtained from the Bureau of Labor Statistics (BLS) and the California Employment Development Department (EDD). Annual employment and payroll data are from the Quarterly Census of Employment and Wages series. Occupational data are from the Occupational Employment Statistics program. Data pertaining to building permits were obtained from the California Homebuilding foundation. Gross product figures were provided by the Bureau of Economic Analysis (BEA), while lending data were acquired from the Federal Reserve and Dataquick Information Systems (via the Real Estate Research Council). CBRE provided figures related to nonresidential construction completions. The California Association of Realtors provided median home prices in the region. Additional data was obtained from the U.S. Census Bureau.

Economic Impact and Contribution Analysis

Economic contribution analysis is used to estimate the portion of a region's economic activity that can be attributed to an existing industry sector. The primary economic contribution to the Southern California economy of the construction industry is the expenditure of billions of dollars towards goods and services from regional vendors. These purchases circulate throughout the regional economy.

The construction industry also spends billions of dollars every year for the wages and benefits of employees and contingent workers. These workers, as well as the employees of suppliers, spend a portion of their incomes on groceries, rent, vehicle expenses, healthcare, entertainment, and so on. This recirculation of household earnings multiplies the initial industry spending through such indirect and induced effects.

The extent to which the initial expenditures multiply is estimated using econometric models that depict the relationships between industries (such as construction and its suppliers) and among different economic agents (such as industries and their employees). These models are built upon data of expenditure patterns that are reported to the U.S. Bureau of Labor Statistics, the U.S. Census Bureau and the Bureau of Economic Analysis of the U.S. Department of Commerce. Data is regionalized so that it reflects local conditions such as wages rates, commuting patterns, and resource availability and costs.

The magnitude of the multiplying effect differs from one region to another depending on the extent to which the local region can fill the demand for all rounds of supply needs. For example, the automobile manufacturing industry has high multipliers in Detroit and Indiana since these regions have deep supplier networks, while the same industry

multiplier in Phoenix is quite small. In another example, the jobs multiplier for the construction industry is higher in, say, Arkansas, than in California because a given amount of spending will purchase fewer workers in Los Angeles than in Little Rock. Multipliers also differ from year to year as relative material and labor costs change and as the production "recipe" of industries change. For example, the IT revolution significantly reduced the job multiplier of many industries (such as manufacturing, accounting and publishing) as computers replaced administrative and production workers.

The metrics used to determine the value of the economic contribution are employment, labor income, value-added and the value of output. *Employment* includes full-time, part-time, permanent and seasonal employees and the self-employed, and is measured on a job-count basis regardless of the number of hours worked. *Labor income* includes all income received by both payroll employees and the self-employed, including wages and benefits such as health insurance and pension plan contributions. *Value-added* is the measure of the contribution to GDP made by the industry, and consists of compensation of employees, taxes on production and gross operating surplus (otherwise known as profit). *Output* is the value of the goods and services produced. For most industries, this is simply the revenues generated through sales; for others, such as retail, output is the value of the services supplied.

Estimates are developed using software and data from IMPLAN Inc., which traces inter-industry transactions resulting from an increase in demand in a given region. The economic region of interest in this document is Southern California defined as including the five counties of Los Angeles, Orange, Riverside, San Bernardino and Ventura. The activity is reported for 2015, the most recent year for which a complete set of data is available. Estimates for labor income and output are expressed in 2015 dollars to maintain consistency with the reported industry activity.

The total estimated economic contribution includes *direct*, *indirect* and *induced* effects. *Direct activity* includes the materials purchased and the employees hired by the industry itself. *Indirect effects* are those which stem from the employment and business revenues resulting from the purchases made by the industry and any of its suppliers. *Induced effects* are those generated by the household spending of employees whose wages are sustained by both direct and indirect spending.

Contribution analysis differs from economic impact analysis in that linkages between the individual component industries are removed so that indirect activity is not double-counted as also part of direct activity. For example, firms in the construction industry purchase supplies from smaller manufacturers of construction inputs, which would then be included as both direct revenue of the parts supplier and as an expense of the construction industry, resulting in a double-counting of overall revenue. Breaking these inter-industry linkages eliminates this double-counting and is a more accurate method of estimating the economic contribution of the industry.

The Construction Industry and Its Subsectors

The construction industry is composed of the following subsectors:

NAICS 2361: Residential building construction
This industry comprises establishments primarily responsible for the construction or remodeling and renovation of single-family and multi-family residential buildings. Included in this industry are residential housing general contractors (i.e., new construction, remodeling, or renovating existing residential structures), for-sale builders and remodelers of residential structures, residential project construction management firms, and residential design-build firms.

NAICS 2362: Nonresidential building construction
This industry group comprises establishments primarily responsible for the construction of nonresidential buildings including new work, additions, alterations, maintenance and repairs. This industry group includes nonresidential general contractors, nonresidential for-sale builders, nonresidential design-build firms, and nonresidential project construction management firms.

NAICS 2371: Utility system construction
This industry group comprises establishments primarily engaged in the construction of distribution lines and related buildings and structures for utilities (i.e. water, sewer, petroleum, gas, power and communication). All structures (including buildings) that are integral parts of utility systems (e.g. storage tanks, pumping stations, power plants, and refineries) are included in this industry group.

NAICS 2372: Land subdivision
This industry comprises establishments primarily engaged in servicing land and subdividing real property into lots for subsequent sale to builders. Servicing of land may include excavation work for the installation of roads and utility lines. The extent of work may vary from project to project. Land subdivision precedes building activity and the subsequent building is often residential, but may also be commercial tracts and industrial parks. These establishments may do all the work themselves or subcontract the work to others. Establishments that perform only the legal subdivision of land are not included in this industry.

NAICS 2373: Highway, street and bridge construction
This industry comprises establishments primarily engaged in the construction of highways (including elevated), streets, roads, airport runways, public sidewalks, or bridges. The work performed may include new work, reconstruction, rehabilitation and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to highway, street and bridge construction (e.g. installing guardrails on highways).

NAICS 2379: Other heavy and civil engineering contractors
This industry comprises establishments primarily engaged in heavy and engineering construction projects (excluding highway, street, bridge and distribution line construction). The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to engineering construction projects (excluding highway, street, bridge, distribution line, oil and gas structures, and utilities building and structure construction). Construction projects involving water resources (e.g. parks and trails) are included in this industry.

NAICS 2381: Foundation, structure and building exterior contractors
This industry group comprises establishments primarily engaged in the specialty trades needed to complete the basic structure (i.e. foundation, frame and shell) of buildings. These trades include concrete foundations and structure contractors, structural steel and precast concrete contractors, and framing, masonry, glass and glazing, roofing and siding contractors. The work performed may include new work, additions, alterations, maintenance and repairs.

NAICS 2382: Building equipment contractors
This industry group comprises establishments primarily engaged in installing or servicing equipment that forms part of a building's mechanical system (e.g. electricity, water, heating and cooling). The work performed may include new work, additions, alterations, maintenance, and repairs. Contractors installing specialized building equipment, such as elevators, escalators, service station equipment and central vacuum cleaning systems are also included.

NAICS 2383: Building finishing contractors
This industry group comprises establishments primarily engaged in the specialty trades needed to finish buildings, such as drywall, painting, flooring, tile and finish carpentry contractors. The work performed may include new work, additions, alterations, maintenance and repairs.

NAICS 2389: Other specialty trade contractors
This industry comprises establishments primarily engaged in site preparation activities, such as excavating and grading, demolition of buildings and other structures and septic system installation. Earth moving and land clearing for all types of sites (e.g. building, non-building, and mining) is included in this industry. Establishments primarily engaged in construction equipment rental with operator (except cranes) are also included.

Exhibit A-1
Major Industries in Southern California 2015

NAICS	Industry Name	Establishments	Employment	Average Annual Wage
11	Agriculture, forestry, fishing and hunting	1,721	48,331	30,317
21	Mining, quarrying, and oil and gas extraction	235	6,743	113,096
22	Utilities	516	21,582	113,417
23	Construction	28,679	313,658	59,150
31-33	Manufacturing	21,389	637,254	66,039
42	Wholesale trade	31,940	376,605	67,737
44-45	Retail trade	47,071	777,843	33,652
48-49	Transportation and warehousing	9,914	266,285	51,525
51	Information	11,860	245,497	105,648
52	Finance and insurance	21,413	251,283	105,224
53	Real estate and rental leasing	22,332	137,273	65,089
54	Professional and technical services	58,839	452,655	96,392
55	Management of companies and enterprises	1,894	98,103	105,383
56	Administrative and waste services	20,759	504,085	37,145
61	Educational services	5,287	140,981	50,317
62	Health care and social assistance	285,843	1,012,732	43,849
71	Arts, entertainment and recreation	13,910	152,690	67,993
72	Accommodation and food services	34,488	718,288	21,222
81	Other services, except public administration	41,813	235,325	35,298
99	Unclassified	27,633	46,775	45,674
	TOTAL All Industries	**687,523**	**6,443,985**	**$54,670**

Source: Bureau of Labor Statistics

Exhibit A-2
Component Industries of the Construction Industry in Southern California 2015

NAICS	Industry Name	Establishments	Employment	Average Annual Wage
236	Construction of Buildings	9,031	67,483	$64,180
2361	Residential Building Construction	7,249	41,385	$55,512
2362	Nonresidential Building Construction	1,782	26,098	$77,927
237	Heavy and Civil Engineering Construction	1,327	34,097	$84,872
2371	Utility system Construction	471	18,436	$83,535
2372	Land Subdivision	476	4,480	$101,548
2373	Highway, Street, and Bridge Construction	236	8,226	$83,042
2379	Other Heavy and Civil Engineering Construction	144	2,955	$73,027
238	Specialty Trade Contractors	18,326	212,082	$53,171
2381	Foundation, Structure and Building Exterior Contractors	3,081	46,021	$48,384
2382	Building Equipment Contractors	8,096	85,421	$60,139
2383	Building Finishing Contractors	4,954	54,239	$44,257
2389	Other Specialty Trade Contractors	2,195	26,401	$57,282
23	**TOTAL All Construction Industries**	**28,684**	**313,662**	**$58,986**

Source: Bureau of Labor Statistics

Exhibit A-3
Economic Contribution of the Construction Industry Across Industries

NAICS	Industry Sector	Total Jobs	Total Labor Income ($ millions)	Total Output ($ millions)
11	Agriculture, forestry and fishing	783	40.4	80.0
21	Mining	1,957	198.1	946.5
22	Utilities	463	68.2	487.3
23	Construction	313,671	17,371.4	58,520.3
31-33	Manufacturing	20,901	1,507.3	9,220.2
42	Wholesale trade	18,632	1,534.3	4,659.3
44-45	Retail trade	98,545	3,408.9	9,099.6
48-49	Transportation and warehousing	17,120	1,032.3	2,810.1
51	Information	4,841	626.9	2,846.3
52	Finance and insurance	16,609	1,305.1	3,750.1
53	Real estate and rental	19,960	776.2	6,735.8
54	Profession and technical services	26,870	2,365.2	4,190.9
55	Management of companies	3,300	397.2	786.5
56	Administrative and waste services	25,656	949.9	1,745.0
61	Educational services	6,276	308.5	516.6
62	Health and social services	31,921	1,843.5	3,228.4
71	Arts, entertainment and recreation	5,706	220.9	536.6
72	Accommodation and food services	22,753	596.3	1,452.4
81	Other services	18,908	769.9	1,554.3
92	Government	3,302	348.2	853.4
	TOTAL All Industry Sectors	**655,173**	**$35,668.5**	**$114,019.6**

Source: Estimates by LAEDC

Exhibit A-4
Construction Industry Purchases of Intermediate Goods and Services

NAICS	Industry Sector	Gross Inputs ($ millions)	% of All Intermediate Purchases	Regional Inputs ($ millions)	% of Gross Inputs Purchased Regionally
11	Agriculture, Forestry, Fishing and Hunting	$ 164.8	0.3	$ 30.0	21.5
21	Mining, Quarrying and Oil and Gas Extraction	771.9	1.6	245.9	31.9
22	Utilities	330.6	0.7	180.0	54.4
23	Construction	38.1	0.1	0.0	
31-33	Manufacturing	22,954.2	48.4	9,164.3	39.9
42	Wholesale Trade	4,099.0	8.6	4,095.8	99.9
44-45	Retail Trade	10,345.7	21.8	10,114.0	97.8
48-49	Transportation and Warehousing	1,667.2	3.5	1,536.7	92.2
51	Information	451.6	1.0	424.8	94.1
52	Finance and Insurance	580.9	1.2	498.4	85.8
53	Real Estate and Rental and Leasing	1,585.9	3.3	1,564.3	98.6
54	Professional, Scientific and Technical Services	2,964.5	6.2	2,795.6	94.3
55	Management of Companies and Enterprises	128.7	0.3	100.6	78.2
56	Administrative and Support and Waste Management and Remediation Services	615.1	1.3	594.4	96.6
61	Educational Services	1.9	0.0	1.9	97.5
71	Arts, Entertainment and Recreation	29.3	0.1	27.9	95.3
72	Accommodation and Food Services	157.6	0.3	95.2	60.4
81	Other Services	423.1	0.9	402.1	95.0
	TOTAL All Intermediate Purchases	**$ 47,449.6**	**100.0**	**$ 31,878.2**	**67.2**

Sources: IMPLAN Group; Analysis by LAEDC

Exhibit A-5
Detailed Construction Occupations (Top 50 by Employment) in Southern California

SOC	Occupation Title	2015 SoCal Payroll Jobs	Projected Openings Over 5 Years	Education Needed for Entry Level	Work Experience Needed for Entry Level	On-the-Job Training to Attain Competency	Average Annual Wage SoCal 2015
47-2061	Construction Laborers	32,547	8,946	8	None	ST OJT	$ 40,649
47-2031	Carpenters	31,611	7,107	7	None	APP	51,102
47-2111	Electricians	20,414	5,473	7	None	APP	58,607
47-1011	Supervisors of Construction Trade Workers	15,612	3,265	7	≥5 years	None	74,828
47-2152	Plumbers, Pipefitters and Steamfitters	14,326	3,685	7	None	APP	54,868
47-2141	Painters, Construction and Maintenance	11,977	3,202	8	None	MT OJT	44,410
11-9021	Construction Managers	10,679	2,554	3	None	MT OJT	104,142
47-2081	Drywall and Ceiling Tile Installers	9,480	2,018	8	None	MT OJT	54,168
47-2051	Cement Masons and Concrete Finishers	8,245	2,025	8	None	MT OJT	51,556
11-1021	General and Operations Managers	8,120	2,445	3	<5 Years	None	127,512
43-9061	Office Clerks, General	7,838	2,278	7	None	ST OJT	33,263
47-2073	Operating Engineers, Equipment Operators	7,712	2,036	7	None	MT OJT	70.039
49-9021	Heating, AC & Refrig. Mechanics/Installers	7,386	1,997	5	None	LT OJT	51,916
13-1051	Cost Estimators	7,238	2,358	3	None	None	66,435
47-2181	Roofers	6,379	1,706	8	None	MT OJT	48,728
43-6014	Secretaries and Administrative Assistants	5,928	1,330	7	None	ST OJT	39,529
43-3031	Bookkeeping, Accounting and Auditing	5,685	1,258	7	None	MT OJT	43,857
41-3099	Sales Representatives	5,519	1,622	7	None	ST OJT	61,412
47-2211	Sheet Metal Workers	3,888	1,163	7	None	APP	55,725
47-2161	Plasterers and Stucco Masons	3,180	663	8	None	LT OJT	42,601
47-2044	Tile and Marble Setters	3,085	790	8	None	LT OJT	46,676
47-2221	Structural Iron and Steel Workers	2,473	721	7	None	APP	67,144
47-2082	Tapers	2,337	497	8	None	MT OJT	49,333
43-1011	Supervisors of Office/Admin Workers	2,337	602	7	<5 Years	None	59,320
47-2121	Glaziers	2,248	616	7	None	APP	56,513
51-4121	Welders, Cutters, Solderers and Brazers	2,234	734	7	None	MT OJT	38,896
47-2041	Carpet Installers	2,117	557	7	None	ST OJT	44,928
49-2022	Telecom Equipment Installers and Repairers	2,024	492	5	None	MT OJT	56,366
49-9052	Telecom Line Installers and Repairers	2,023	568	7	None	LT OJT	56,063
53-3032	Heavy and Tractor-Trailer Truck Drivers	1,941	505	5	None	ST OJT	44,972
47-2021	Brickmasons and Blockmasons	1,941	453	7	None	APP	55,470
47-3013	Helpers -- Electricians	1,931	524	7	None	ST OJT	35,396
47-2071	Paving, Surfacing and Tamping Eqmt	1,923	559	7	None	MT OJT	67,111
13-2011	Accountants and Auditors	1,817	574	3	None	None	78,041
47-2171	Reinforcing Iron and Rebar Workers	1,801	482	7	None	APP	52,688
17-2051	Civil Engineers	1,562	484	3	None	None	101,364
43-4171	Receptionists and Information Clerks	1,557	520	7	None	ST OJT	30,387
47-3011	Helpers-Brickmasons, Blockmasons, Tile	1,466	393	8	None	ST OJT	32,634
49-9099	Installation, Maintenance and Repair	1,399	376	8	None	ST OJT	30,991
53-7062	Laborers, Movers – Freight, Stock, Materials	1,353	479	8	None	ST OJT	27,967
47-2231	Solar Photovoltaic Installers	1,349	345	7	None	MT OJT	42,391
49-9071	Maintenance and Repair Workers, General	1,336	404	7	None	LT OJT	42,821
47-4031	Fence Erectors	1,327	353	7	None	MT OJT	40,954
43-5032	Dispatchers	1,324	433	7	None	MT OJT	40,281
43-6011	Executive Secretaries/Admin Assistants	1,315	287	7	<5 Years	None	59,196
47-3015	Helpers -- Pipelayers, Plumbers, Pipefitters	1,312	366	7	None	ST OJT	32,221
43-3051	Payroll and Timekeeping Clerks	1,302	408	7	None	MT OJT	45,272
49-2098	Security and Fire Alarm Installers	1,295	392	7	None	MT OJT	50,786
13-1199	Business Operations Specialists, All Other	1,208	262	3	None	None	75,348
47-2151	Pipelayers	1,173	266	8	None	ST OJT	51,113
	All Other	*35,385*	*23,444*				
	TOTAL All Occupations	**313,660**	**95,010**				**$ 51,791**

Education: 1=Doctoral or professional degree; 2=Master's degree; 3=Bachelor's degree; 4=Associate's degree; 5=Postsecondary non-degree award; 6=Some college, no degree; 7=High school diploma or equivalent; 8=Less than high school; **On-the-Job Training**: LT OJT=Long-term on-the-job training (more than one year); MT OJT=Moderate-term on-the-job training (1-12 months); ST OJT=Short-term on-the-job training (1 month or less) Sources: Estimates by LAEDC; Education and skills requirements from BLS

Exhibit A-6
Contractor Certifications in California

C2 Insulation and Acoustical Contractor
C4 Boiler, Hot Water Heating and Steam Fitting Contractor
C5 Framing and Rough Carpentry Contractor
C6 Cabinet, Millwork and Finish Carpentry Contractor
C7 Low Voltage Systems Contractor
C8 Concrete Contractor
C9 Drywall Contractor
C10 Electrical Contractor
C11 Elevator Contractor
C12 Earthwork and Paving Contractors
C13 Fencing Contractor
C14 Metal Roofing Contractor (repealed)
C15 Flooring and Floor Covering Contractors
C16 Fire Protection Contractor
C17 Glazing Contractor
C20 Warm-Air Heating, Ventilation and Air-Conditioning Contractor
C21 Building Moving/Demolition Contractor
C23 Ornamental Metal Contractor
C26 Lathing Contractor (repealed)
C27 Landscaping Contractor
C28 Lock and Security Equipment Contractor
C29 Masonry Contractor
C31 Construction Zone Traffic Contractor
C32 Parking and Highway Improvement Contractor
C33 Painting and Decorating Contractor
C34 Pipeline Contractor
C35 Lathing and Plastering Contractor
C36 Plumbing Contractor
C38 Refrigeration Contractor
C39 Roofing Contractor
C42 Sanitation System Contractor
C43 Sheet Metal Contractor
C45 Sign Contractor
C46 Solar Contractor
C47 General Manufacturing Housing Contractor
C50 Reinforcing Steel Contractor
C51 Structural Steel Contractor
C53 Swimming Pool Contractor
C54 Ceramic and Mosaic Tile Contractor
C55 Water Conditioning Contractor
C57 Well Drilling Contractor
C60 Welding Contractor
C61 Limited Specialty
ASB Asbestos Certification
HAZ Hazardous Substance Removal Certification
HIC Home Improvement Certification (repealed)

Source: California Department of Consumer Affairs

Exhibit A-7
Construction Apprenticeship Programs Located in the 5-County Region

County	Trade/Certification	Apprenticeship provider
Los Angeles, Riverside, San Bernardino, Ventura	Acoustical installer	SoCal Acoustical Installer JATC
Orange	Fastener technician	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Orange, Riverside, San Bernardino, Ventura	Auto glass glazier	SoCal Glaziers & Glassworkers Industry JAC
Orange, Riverside, San Bernardino	Automatic screw machine set up operator	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Los Angeles, Orange, Riverside, San Bernardino	Boilermaker	Boilermakers Western States JAC
LA, Orange, Riverside, San Bernardino, Ventura	Bricklayer	Bricklayers & Allied Craftsman Local #4 California JAC
Los Angeles, Orange, Riverside, San Bernardino	Bricklayer (construction)	Masonry Industry Training Association of SoCal Bricklayers UAC
Riverside	Bridge, structural, ornamental and reinforcing ironworker	International Association of Bridge, Structural, Ornamental & Reinforcing Ironworkers Local Union 229 JATC
LA, Orange, Riverside, San Bernardino, Ventura	Building construction inspector	SoCal Operating Engineers JAC
Orange, Riverside, San Bernardino	CNC Machine technician	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
LA, Orange, Riverside, San Bernardino, Ventura	Cabinet maker	Cabinet and Store Fixture JAC of SoCal
LA, Orange, Riverside, San Bernardino, Ventura	Carpenter	SoCal Carpenter JATC
Orange, Riverside, San Bernardino	Carpenter	San Diego Associated General Contractors JAC
LA, Orange, Riverside, San Bernardino, Ventura	Carpet and resilient installer	SoCal Resilient Floor and Decorative Covering Crafts JATC
LA, Orange, Riverside, San Bernardino, Ventura	Cement mason	SoCal Cement Masons JAC
Orange, Riverside, San Bernardino	Cement mason	San Diego Associated General Contractors, JAC
LA, Orange, Riverside, San Bernardino, Ventura	Chainman	SoCal Surveyors JAC
Orange, Riverside	Construction Craft Laborer	Associated General Contractors of America, San Diego Chapter
Orange, Riverside, San Bernardino	Construction Equipment Operator	Associated General Contractors of San Diego, Inc., Construction Equipment Operator, JAC
Orange	Acoustical installer	SoCal Acoustical Installer, JATC
Orange, Riverside, San Bernardino, Ventura	Dredge operator	SoCal Operating Engineers JAC
LA, Orange, Riverside, San Bernardino, Ventura	Drywall Finisher	SoCal Drywall Finishers JATC
Orange, Riverside, San Bernardino	Drywall Finisher (taper)	San Diego Associated General Contractors JAC
LA, Orange, Riverside, San Bernardino, Ventura	Drywall/lather	SoCal Drywall/Lather JATC
Orange, Riverside, San Bernardino	Drywall/lather	San Diego Associated General Contractors JAC
Los Angeles	Electrician	Motion Picture Studio electrician (Journeyman Wireman) JAC
Los Angeles, Orange, Riverside, San Bernardino	Electrician	SoCal Chapter of the Associated Builders and Contractors Inc. Electrical UAC
Riverside	Electrician	Riverside Area Electrical JAC
San Bernardino	Electrician	San Bernardino, Mono and Inyo Counties Electrical JAC
Los Angeles	Electrician (inside wireman)	Los Angeles Electrical JA and ETC
Orange	Electrician (inside wireman)	Orange County Electrical JAC
Ventura	Electrician (inside wireman)	Ventura County Electrical JATC
LA, Orange, Riverside, San Bernardino, Ventura	Electrician Construction	Western Electrical Contractors Association, Inc. (WECA) Apprenticeship and Training Committee
Los Angeles, Ventura	Electrician (inside wireman)	Los Angeles/Ventura Chapter of ABC Inc. EUAC
Los Angeles	Electronic systems technician/Voice data video	SoCal Chapter of ABC, Inc. Electronic Systems Technicians/Voice Data Video UAC
LA, Orange, Riverside, San Bernardino, Ventura	Elevator constructor	SoCal Elevator Construction JATC
Riverside	Emergency medical technician	California Fire Fighter JAC
LA, Orange, Riverside, San Bernardino, Ventura	Equipment operator	SoCal Operating Engineers JAC
LA, Orange, Riverside, San Bernardino, Ventura	Exhibit builder	California Tradeshow and Sign Crafts JATC
Los Angeles, Riverside, San Bernardino	Fastener technician	SoCal Tool & Die Mold, Machinist & Metal Working Apprenticeship Committee
LA, Orange, Riverside, San Bernardino, Ventura	Field reinforcing ironworker	International Association of Bridge, Structural, Ornamental & Reinforcing Ironworkers Local 146 JATC
LA, Orange, Riverside, San Bernardino, Ventura	Field structural ironworker	International Association of Bridge, Structural, Ornamental & Reinforcing Ironworkers Local 433 JATC
LA, Orange, Riverside, San Bernardino, Ventura	Glazier	SoCal Glaziers & Glassworkers Industry JAC
Los Angeles	Hardwood floor worker	Southwest Hardwood, Carpet & synthetic Floor Layers JATC
Los Angeles	Hazardous materials technician	California Fire Fighter JAC
LA, Orange, Riverside, San Bernardino, Ventura	Heat & frost insulators, asbestos & fire stoppers workers	SoCal Heat & Frost Insulators & Fire stoppers Allied Workers JAC
LA, Orange, Riverside, San Bernardino, Ventura	Heating, ventilation & air conditioning worker	SoCal Chapter of ABC, Inc. Heating, Ventilation & Air Conditioning UAC
LA, Orange, Riverside, San Bernardino, Ventura	Heavy duty repair person	SoCal Operating Engineers JAC
Los Angeles	Highway maintenance workers	Northern California Construction Training

Exhibit A-7 (Continued)

County	Trade/Certification	Apprenticeship provider
Los Angeles, Orange	HVAC service technician	LA & Orange Counties Air Conditioning & Refrigeration JATC
LA, Orange, Riverside, San Bernardino, Ventura	Industrial painter	District Council #36 Industrial Painter JATC
Los Angeles	Inside wireman electrician	IBEW Local Union #40 Los Angeles County Chapter NECA JAC
LA, Orange, Riverside, San Bernardino, Ventura	Insulating worker	SoCal Insulator & Weatherization JATC
Orange	Intelligent transportation systems installer	Orange County Electrical JAC
Ventura	Intelligent transportation systems installer	Ventura County Electrical JATC
Los Angeles	Laborer	Laborers SoCal JAC
LA, Orange, Riverside, San Bernardino, Ventura	Laborer Cement Mason	SoCal Laborers Cement Mason JAC
Los Angeles, Orange, Riverside, Ventura	Laborer landscape & irrigation fitter	Laborers SoCal Landscape & Irrigation Fitter JAC
LA, Orange, Riverside, San Bernardino, Ventura	Landscape & irrigation fitter	Landscape & Irrigation Fitter of SoCal JATC
Los Angeles, Orange, Riverside, San Bernardino	Machine set up operator fastener technologist	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Los Angeles, Orange, Riverside San Bernardino	Machine tool rebuilder	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Los Angeles, Orange, Riverside San Bernardino	Machinist	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Los Angeles, Orange, Riverside San Bernardino	Maintenance machinist	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Los Angeles	Maintenance plumber	Pomona & San Gabriel Valley Plumbers & Steamfitters JAC
Ventura	Maintenance plumber	Ventura County Plumbing & Pipefitting JAC
Los Angeles	Maintenance plumber (service & repair)	Glendale, Burbank, San Fernando Valley & Antelope Valley Plumbers & Steamfitters JATC
LA, Orange, Riverside, San Bernardino, Ventura	Marble finisher	Tile & Terrazzo Industry JAC
LA, Orange, Riverside, San Bernardino, Ventura	Marble setter	Bricklayers & Allied Craftsman Local #4 California JAC
LA, Orange, Riverside, San Bernardino, Ventura	Mason finisher	Bricklayers & Allied Craftsman Local #4 California JAC
Orange, Riverside, San Bernardino	Metal forming set-up technician	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Orange, Riverside, San Bernardino, Ventura	Millwright	SoCal Millwrights & Machinery Erectors JATC
Orange, Riverside, San Bernardino, Ventura	Modular furniture installer	SoCal Modular Furnishings Installer JATC
Orange, Riverside, San Bernardino	Mold maker	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Orange, Riverside, San Bernardino	Mold, die & metal surface finisher	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Orange, Riverside, San Bernardino, Ventura	Operating & maintenance engineer (stationary engineer)	Operating & Maintenance Engineers Apprenticeship & Training Trust for SoCal
LA, Orange, Riverside, San Bernardino, Ventura	Operations & maintenance technician IV (mechanical)	Metropolitan Water District of SoCal JATC
LA, Orange, Riverside, San Bernardino, Ventura	Operations & maintenance technician IV (electrician)	Metropolitan Water District of SoCal JATC
LA, Orange, Riverside, San Bernardino, Ventura	Painter	SoCal Painting & Decorating Contractors of America UAC
Orange, Riverside, San Bernardino	Painter	San Diego Associated General Contractors JAC
Orange, Riverside, San Bernardino, Ventura	Painter, paperhanger & decorator	Painter, Paperhanger & Decorator JATC
Los Angeles, Orange	Pavement striper	SoCal Pavement Striper, Road Slurry, Seal Coat & Highway Maintenance JAC
Orange, Riverside, San Bernardino, Ventura	Pile driver	SoCal Pile Drivers JATC
Ventura	Pipefitter	Ventura County Plumbing & Pipefitting JAC
Los Angeles	Pipefitter/steamfitter	Pomona & San Gabriel Valley Plumbers & Steamfitters JAC
Orange, Riverside, San Bernardino, Ventura	Plant equipment operator	SoCal Operating Engineers JAC
LA, Orange, Riverside, San Bernardino, Ventura	Plaster tender	SoCal Plasters Tenders JAC
LA, Orange, Riverside, San Bernardino, Ventura	Plasterer	SoCal Plastering Institute Apprenticeship Trust JAC
Los Angeles	Plumber	Glendale, Burbank, San Fernando Valley & Antelope Valley Plumbers & Steamfitters JATC; LA Metropolitan Plumbers JATC; Pomona & San Gabriel Valley Plumbers & Steamfitters JAC
LA, Orange, Riverside, San Bernardino, Ventura	Plumber	SoCal Chapter of the Associated Builders & Contractors, Inc. Plumbers UAC
Orange	Plumber	Orange County Plumbers & Steamfitters JATC
Riverside, San Bernardino	Plumber	San Bernardino & Riverside Counties Plumbing & Steamfitter Trade JAC
Ventura	Plumber	Ventura county Plumbing & Pipefitting JAC
Los Angeles	Power lineman	Cal-Nev Power Lineman JATC

Exhibit A-7 (Continued)

County	Trade/Certification	Apprenticeship provider
Los Angeles, Orange, Riverside, San Bernardino	Precision grinding technician	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Los Angeles, Orange, Riverside, San Bernardino	Precision machining technician	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Ventura	Refrigeration & air conditioning mechanics	Ventura county Plumbing & Pipefitting JAC
Riverside	Reinforcing ironworker	International Association of Bridge, Structural, Ornamental & Reinforcing Ironworkers Local Union 229 JATC
Los Angeles	Residential wireman	Los Angeles electrical JA & ETC
Los Angeles, Orange, Riverside, San Bernardino	Residential wireman	Western Electrical Contractors Association, Inc. Apprenticeship & Training Committee
LA, Orange, Riverside, San Bernardino, Ventura	Rock, sand & gravel operator	SoCal Operating Engineers JAC
LA, Orange, Riverside, San Bernardino, Ventura	Roofer & waterproofer	SoCal Roofers Waterproofers JAC
LA, Orange, Riverside, San Bernardino, Ventura	Scaffold & shoring erector	SoCal Carpenter JATC
Los Angeles	Sheet metal worker	Kern & Northern Los Angeles Counties Air Conditioning & Sheet Metal Workers JATC
LA, Orange, Riverside, San Bernardino, Ventura	Sheet metal worker	SoCal Chapter of Associated Builders & Contractors, Inc., Sheet Metal UAC
LA, Orange, Riverside, San Bernardino	Sheet metal worker	SoCal Sheet Metal JA & ETC
Ventura	Sheet metal worker	Tri-Counties Sheet Metal & Air Conditioning Industry JAC
Riverside, San Bernardino	Sound & communications system installer	Riverside, San Bernardino, Mono & Inyo Counties Sound Technician JAC
LA, Orange, Riverside, San Bernardino, Ventura	Sound & communications systems installer (voice-data-video)	Western electrical contractors Association, Inc. Apprenticeship & Training Committee
Orange	Sound technician	Orange County Sound Technician JAC
LA, Orange, Riverside, San Bernardino, Ventura	Sprinkler fitter	Road Sprinkler Fitters U.A. Local 669 JATC
LA, Orange, Riverside, San Bernardino, Ventura	Sprinkler fitter	Sprinkler Fitters UA Local 709 JAC
Orange	Steamfitter	Orange County Plumbers & Steamfitters JATC
Ventura	Steamfitter	Ventura County Plumbing & Pipefitting JAC
Riverside, San Bernardino	Steamfitter & industrial pipefitter	San Bernardino & Riverside Counties Plumbing & Steamfitter Trade JAC
LA, Orange, Riverside, San Bernardino, Ventura	Steamfitter & industrial pipefitter	LA & Vicinity Steamfitters & Industrial Pipefitters JATC
Los Angeles	Steamfitter/pipefitter	Glendale, Burbank, San Fernando Valley & Antelope Valley Plumbers & Steamfitters JATC
LA, Orange, Riverside, San Bernardino, Ventura	Stone mason	Bricklayers & Allied Craftsman Local #4 California JAC
LA, Orange, Riverside, San Bernardino, Ventura	Teamsters construction dump/cement/ready mix truck & articulation driver	Construction Teamsters Apprenticeship Fund of SoCal JAC
LA, Orange, Riverside, San Bernardino, Ventura	Teamsters construction fuel truck driver	Construction Teamsters Apprenticeship Fund of SoCal JAC
LA, Orange, Riverside, San Bernardino, Ventura	Teamster construction low bed driver, five axels or more	Construction Teamsters Apprenticeship Fund of SoCal JAC
LA, Orange, Riverside, San Bernardino, Ventura	Teamsters construction oil spreader truck driver	Construction Teamsters Apprenticeship Fund of SoCal JAC
LA, Orange, Riverside, San Bernardino, Ventura	Teamsters construction water truck/pull single engine, dust control	Construction Teamsters Apprenticeship Fund of SoCal JAC
LA, Orange, Riverside, San Bernardino, Ventura	Teamsters construction working driver	Construction Teamsters Apprenticeship Fund of SoCal JAC
Orange, San Bernardino	Teamsters warehouseman/forklift operator	Construction Teamsters Apprenticeship Fund of SoCal JAC
Ventura	Telecommunications installer	Ventura County Electrical JATC
LA, Orange, Riverside, San Bernardino, Ventura	Tile finisher	Joint Apprenticeship Committee Tile & Terrazzo Industry
LA, Orange, Riverside, San Bernardino, Ventura	Tile setter	Joint Apprenticeship Committee Tile & Terrazzo Industry
Orange, Riverside, San Bernardino	Tool & die maker	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Orange, Riverside, San Bernardino	Tool maker	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee
Los Angeles	Transportation systems electrician	LA County Intelligent Transportation Systems Electrical JATC
Los Angeles, Ventura	Weatherization installer & technician	SoCal Weatherization Installers & Technicians
Los Angeles	Wire EDM & conventional technician	SoCal Tool & Die Mold, Machinist & Metal Working Trades Apprenticeship Committee

Note: JAC = Joint Apprenticeship Council; JATC = Joint Apprenticeship Training Committee; UAC = Unilateral Apprenticeship Committee

Source: California Department of Industrial Relations

Exhibit A-8
Construction Education and Training Programs Located in the 5-County Region

County	Institution	Program	Degree/Certificate Awarded
Los Angeles	Baldwin Park Adult and Community Education	Industrial Electronics Technology Technician	Non-degree Training Program
	California State Polytechnic University Pomona	Construction Engineering Technology	BA
	California State University Long Beach	Construction Engineering Technology	BA
	California State University Northridge	Construction Management	BA
	Capstone College	Heating, Ventilation and Air Conditioning	Certificate Program
	Cerritos College	Engineering Technology	AA
		Engineering Technology – Electrical and Electronic Engineering Technician	Certificate Program
		Engineering Technology – Mechanical Engineering Technician	Certificate Program
		Engineering Technology – Industrial Engineering Technician	Certificate Program
		Industrial Technology – Automated Manufacturing	AA, Certificate
		Industrial Technology – Construction/Transportation	AA
		Industrial Technology – Electronics	AA, Certificate
		Machine Tool Technology	AA, Certificate
		Machine Tool Technology – Numerically Controlled Machine Operator	AA, Certificate
		Machine Tool Technology – Numerically Controlled Tool Programmer	AA, Certificate
		Machine Tool Technology – Tool and Die Maker	AA, Certificate
		Welding – Arc Welding	AA, Certificate
		Welding – Gas Tungsten Arc Welding	AA, Certificate
		Welding – Pipe Welding	AA, Certificate
		Welding – Welding Fabrication and Layout	AA, Certificate
	Citrus College	Heating and Air Conditioning	Certificate Program
	College of the Canyons	Welding	AA, Certificate
	Cypress College	Air Conditioning and Refrigeration	AA, Certificate
	East Los Angeles College	Electronics	Certificate Program
	El Camino College	Air Conditioning and Refrigeration	AA, Certificate
		Construction Technology	AA, Certificate
		Electronics and Computer Hardware Technology	AA, Certificate
		Engineering Technology	AA, Certificate
		Machine Technology	AA, Certificate
		Manufacturing Technology	AA, Certificate
		Welding	AA, Certificate
	Glendale Community College	Electronics & Computer Technology – Electronics Engineering Technician	AA, Certificate
		Electro Mechanical Fabrication Technician	Certificate Program
		Machinist	AA, Certificate
		Welding	Certificate
		Welding, Occupational (Combination Welder)	AA
	InterCoast College	Electrical Training Program	Non-degree Training Program
		Heating, Ventilation and Air Conditioning	Non-degree Training Program
	ITT Technical College	Electrical Engineering Technology	Certificate Program
		Industrial Engineering Technology	Certificate Program
	Learnet Academy	Construction management: General Contractor	Non-degree Training Program
	Long Beach City College	Carpentry	AA, Certificate
		Electrical Technology	Certificate Program
		Engineering	AA
		Mechanical Maintenance Technology	AA, Certificate
		Heating, Ventilation, Air Conditioning and Refrigeration	AA, Certificate
		Sheet Metal	Certificate Program
	Los Angeles City College	Electronic Systems Technology	AA
		Electronic Science and Technology	AA, Certificate
		Basic Electronics	Certificate Program
	Los Angeles Mission College	Electronics Technician	Certificate Program
	Los Angeles Pierce College	Electronics Training Program	Certificate Program
		Welding	Certificate Program
	Los Angeles Southwest College	Electronics	AA
		Electronics Technician	Certificate Program
		Engineering	Certificate Program

Exhibit A-8 (Continued)

County	Institution	Program	Degree/Certificate Awarded
	Los Angeles Trade Tech.	Carpentry	AA, Certificate
		Carpentry – Construction Technologies	AA, Certificate
		Electrical Construction and Maintenance	AA, Certificate
		Electrical Construction and Maintenance – Construction Technologies	AA, Certificate
		Plumbing	AA, Certificate
		Plumbing – Construction Technology	AA, Certificate
		Refrigeration and Air Conditioning	AA, Certificate
		Welding, Gas and Electric – Construction Technologies	Certificate Program
	Los Angeles Valley College	Electronics	AA
		Electronics Technician	Certificate Program
		Electronics Technology	Certificate Program
		Manufacturing Technology – Metal Machining	AA, Certificate
		Sustainable Construction Management	AA, Certificate
		Mechanical Engineering Technology	Certificate
	Mt. San Antonio College	Air Conditioning and Refrigeration	AA, Certificate
		Construction Inspection	AA, Certificate
		Electronic Assembly and Fabrication	Certificate Program
		Electronic Systems Technology – Level I	Certificate Program
		Electronic Systems Technology – Level II	Certificate Program
		Electronics Technology	Certificate Program
		Electronics – Industrial Systems	Certificate Program
		Landscape Construction	Certificate Program
		Manufacturing Technology	AA
	National University	Engineering Technology	AA
	NTMA Training Center	Inspection Training	Non-degree Training Program
		Machinist Training	Non-degree Training Program
		MasterCAM Programming I	Non-degree Training Program
		MasterCAM Programming II	Non-degree Training Program
	Pasadena City College	Building Construction	Certificate Program
		Construction Inspection	Certificate Program
		Electricity	Certificate Program
		Electronics	Certificate Program
		Electronics Technology – Basic Digital Technician	Certificate Program
		Electronics Technology – Certified network Associate Preparation	Certificate Program
		Engineering Technology	AA
		Industrial Technology	AA
		Manufacturing Technology I	Certificate Program
		Manufacturing Technology II	Certificate Program
		Machine Shop – CNC	Certificate Program
		Welding – Construction, Aerospace and Pipe Welding	Certificate Program
		Welding – Construction Welding	Certificate Program
		Welding – Gas Tungsten and Metal Gas Welding	Certificate Program
	Rio Hondo College	Electronics Technology	AA, Certificate
		Welding Technology	AA, Certificate
	University of Southern California	Construction Management	Non-degree Training Program
	Westwood College	Construction Management	BA
	Wyotech-Long Beach	Electrician	Non-degree Training Program
		Heating, Ventilation and Air Conditioning	Non-degree Training Program
		Plumbing Technology	Non-degree Training Program
Orange	Cypress College	Air Conditioning and Refrigeration	AA, Certificate
		Drafting	AA
		Engineering Technology	Assoc. in Science for Transfer
		Engineering	Assoc. in Science for Transfer
	Fullerton College	Architecture	AA
		Architecture Technology	AA, Certificate
		Carpentry	AA
		Construction Estimating Skills	Certificate Program
		Construction Inspection	AA, Certificate
		Construction Management	AA
		Construction Technology	AA, Certificate
		Industrial Drafting (DRAF)	AA
		Industrial Drafting Level I	Certificate Program

Exhibit A-8 (Continued)

County	Institution	Program	Degree/Certificate Awarded
		Industrial Drafting Level II	Certificate Program
		Engineering	AA
		Machine Technology (MACH)	Certificate Program
		CNC Operator	Certificate Program
		Computer Numerical Control (CNC)	Certificate Program
		Machine Technology Level I Skills	Certificate Program
		Machine Technology Level II Skills	Certificate Program
		Mastercam Skills	Certificate Program
		Surfcam Skills	Certificate Program
		Manufacturing Technology	AA
		Welding Technology	Certificate Program
	Golden West College	Computer Aided Drafting	Certificate of Specialization
		International Trade Marketing and Management	Certificate of Specialization
	Irvine Valley College	Design Model Making and Rapid Prototyping	AA, Certificate
		Drafting Technology	AA, Certificate
		Electronics Technology	AA, Certificate
	Orange Coast College	Architectural Design I	AA, Certificate
		Architectural Design 2	AA, Certificate
		Design/Build	Certificate Program
		Digital Fabrication for Architecture	Certificate Program
		Integrated Project Design	Certificate Program
		Sustainable Design	Certificate Program
		Construction Technology	AA, Certificate
		Residential Construction Development	AA, Certificate
		Residential Construction Development Second Award	Certificate Program
		Residential Construction Development Third Award	Certificate Program
		Master Construction Specialist	AA, Certificate
		Residential Electrical	Certificate of Specialization
		Concrete and Masonry	Certificate of Specialization
		Plumbing	Certificate of Specialization
		Electro-Mechanical Technician	Certificate of Specialization
		Electronics Engineering Technician	AA, Certificate
		Electronic Reliability Technician	Certificate Program
		Industrial Automation Technician	Certificate Program
		HVAC Technology	AA, Certificate
		Machinist	AA, Certificate
		CNC Machine Operator	AA, Certificate
		CNC Machine Programmer	AA, Certificate
		Tooling	AA, Certificate
		CNC Operator	Certificate of Specialization
		CNC Programmer	Certificate of Specialization
		Welding	AA, Certificate
		Basic Welding	AA, Certificate
		Intermediate Welding	Certificate of Specialization
		Advanced Welding	Certificate of Specialization
		Advanced II Welding	Certificate of Specialization
		Gas Tungsten Arc Welding	Certificate of Specialization
		Gas Metal Arc Welding	Certificate of Specialization
		Pipe Welding	Certificate of Specialization
	Saddleback College	Architectural Drafting	AA, Certificate
		Construction Inspection	AA, Certificate
		Drafting Technology	AA, Certificate
		Electronic Technology – Analog and Digital Circuit	AA, Certificate
		Digital Electronic Technology	AA, Certificate
		General Electronic Technology	AA, Certificate
		Basic Analog and Digital Electronics	Occupational Skills Award
		Interiors Merchandising	Certificate Program
		Interior Design Assistant	Certificate Program
		Interior Design Professional	AA, Certificate
		Landscape Design	AA, Certificate
		General Landscape Design	Occupational Skills Award
	Santiago Canyon College	Carpentry Apprenticeship	AA, Certificate
		Electrician	AA

Exhibit A-8 (Continued)

County	Institution	Program	Degree/Certificate Awarded
			Assoc. in Science for Transfer
			Certificate Program
		Electricity Apprenticeship	AA, Certificate of Achievement
		Engineers	Certificate Program
		Maintenance Mechanic Apprenticeship	AA, Certificate
		Operating Engineers Apprenticeship	AA, Certificate
		Power Lineman Apprenticeship	AA, Certificate
		Surveying Apprenticeship	AA, Certificate
		Survey/Mapping Sciences	Certificate Program
	Santa Ana College	CNC Lathe Set Up and Operation	Certificate Program
		CNC Machine Set Up and Operation	Certificate Program
		CNC Milling Machine Set Up and Operation	Certificate Program
		CNC Programmer A-Mastercam	Certificate Program
		Conventional Machining	Certificate Program
Riverside	College of the Desert	Air Conditioning/HVCR	AA, Certificate
		Architectural Technology	AA, Certificate
		Building Inspection Technology	Certificate Program
		Construction Management	AA, Certificate
		Energy Systems Technology	Certificate Program
		General Drafting	AA, Certificate
		Landscape and Irrigation Technician	Certificate Program
		Real Estate Development	Certificate Program
		Turfgrass Management	AA, Certificate
		Turfgrass Management Technician	Certificate Program
	California Baptist University	Architecture	BA, MA
		Construction Management	BA, Minor
	Mt. San Antonio College	Air Conditioning and Refrigeration	AA
		Architectural Design Concentration	AA
		Building Automation	AA
		Construction Inspection	AA
		Electronics and Computer Engineering Technology	AA
		Industrial Design Engineering	AA
		Interior Design	AA
		Interior Design – Kitchen and Bath	AA
		Manufacturing Technology	AA
		Welding	AA
	Mt. San Jacinto College	Turf and Landscape Management	AA, Certificate
	Norco College	Construction Technology	AA, Certificate
	Palo Verde College	Building Technology	AA, Certificate
		Welding Technology	Certificate Program
	Riverside City College	Air Conditioning and Refrigeration	Certificate Program
		Electrical	Certificate Program
		Welding Technology	Certificate Program
		Stick Welding (SMAW)	Certificate Program
		TIG Welding (GTAW)	Certificate Program
		Wire Welding (FCAW, GMAW)	Certificate Program
San Bernardino	Chaffey College	Architectural Drafting Technology	AA, Certificate
		Engineering	AA, Certificate
		Engineering Technology	AA, Certificate
		Industrial Electrical Technology	AA, Certificate
		Interior Design	AA, Certificate
	San Bernardino Valley College	Architectural Design	AA
		CAD Technician	Certificate Program
		Electric Power Technology	AA, Certificate
		Electronics Technology	AA, Certificate
		General Technician	Certificate Program
		Heating, Ventilation, Air Conditioning and Refrigeration	AA, Certificate
		Inspection Technology	AA, Certificate
		Basic Machine Operator	Certificate Program
		Basic CNC Operator	Certificate Program
		CAD/CNC	AA, Certificate
		Machine Technology	Certificate Program

Exhibit A-8 (Continued)

County	Institution	Program	Degree/Certificate Awarded
		Machinist Standard	AA, Certificate
		Tool and Die	AA, Certificate
		General Welding	AA, Certificate
		Shielded Metal Arc Welding	Certificate Program
		Welding Inspection Technology	Certificate Program
	Victor Valley College	Construction and Manufacturing Technology	AA
		Electronics Engineering Technology	AA
		Welding	AA, Certificate
Ventura	Ventura College	Architecture	AA, Certificate
		Construction Technology – Building Inspection	AA, Certificate
		Construction Technology – Construction Management	AA, Certificate
		Welding	AA, Certificate

About the Authors

The LAEDC team.

Christine Cooper, Ph.D.

Senior Vice President, LAEDC

Dr. Cooper leads the LAEDC Institute for Applied Economics whose work involves research in regional issues such as economic impact studies, regional industry analysis and forecasts, workforce development analysis and policy studies. Her fields of expertise include development economics, environmental economics, regional analysis and urban sustainability.

Prior to joining the LAEDC, Dr. Cooper was co-founder of a start-up company in Hong Kong concentrating on equity transactions software and computer accessories manufacturing, which expanded production into the special economic zone of Shenzhen, China and distributed products throughout the United States and Asia. With her business partner, she established the first authorized Apple Computer retailer in China. She has been a lecturer at California State University, Long Beach and at the Pepperdine Graziadio School of Business and Management.

Dr. Cooper is a citizen of the United States and Canada. She earned a Bachelor of Arts in Economics from Carleton University in Ottawa, Canada, and a Ph.D. in Economics from the University of Southern California. With funding from the National Science Foundation, she earned a Graduate Certificate in Environmental Sciences, Policy and Engineering.

Kimberly Ritter-Martinez

Economist

Kimberly Ritter-Martinez joined the Los Angeles County Economic Development Corporation (LAEDC) in January 2009 as an Economist for the Kyser Center for Economic Research.

Ms. Ritter-Martinez studies the regional economy of the greater Los Angeles region, analyzing employment and industry trends, housing and construction, and demographics. Ms. Ritter-Martinez is a principal contributor to the annual *Otis Report on the Creative Economy* and regularly contributes to economic reports and briefings presented to corporate and government groups. Additionally, she studies and writes about the aerospace, retail trade, tourism and entertainment industries for the LAEDC's Economic Forecasts and industry reports. Ms. Ritter-Martinez contributes to and is the editor of the LAEDC's online weekly e-EDGE economics newsletter. She also gives presentations to corporations, government agencies, non-profits and educational institutions, and frequently speaks to the media about issues pertaining to the local economy.

Prior to joining the LAEDC, Ms. Ritter-Martinez worked in the automotive industry as an office manager for a manufacturer's representative, and before that as operations manager for forest products trading firm, directly managing the company's international sales and purchasing activities.

Kimberly earned her Bachelor's and Master's degrees in Economics from California State University Long Beach and is active in a number of professional and community

organizations related to economic and regional development including the National Association for Business Economics and the American Economic Association. Kimberly is also concurrently serving as President of both the League of Women Voters, Los Angeles County and her local League chapter (Long Beach Area) working in both capacities to further the League's mission of promoting voter education and protecting voters' rights.

Somjita Mitra, Ph.D.
Economist

Somjita Mitra joined the LAEDC Institute for Applied Economics as an Economist in June 2013. She is involved in planning, designing and conducting research and analysis for consulting clients and local businesses and governments, as well as for LAEDC's internal departments. Her focus is in regional analysis, economic impact studies and the industrial and occupational structure of local economies.

Before joining the LAEDC, Dr. Mitra was an Economist for a local economic research and litigation consulting company evaluating economic damages, estimating lost profits, identifying key economic issues and developing necessary analytical and empirical frameworks. Prior to this, Dr. Mitra was Project Director for a consumer research firm in Los Angeles where she managed projects that identified and analyzed key market issues for local firms as well as multinational corporations.

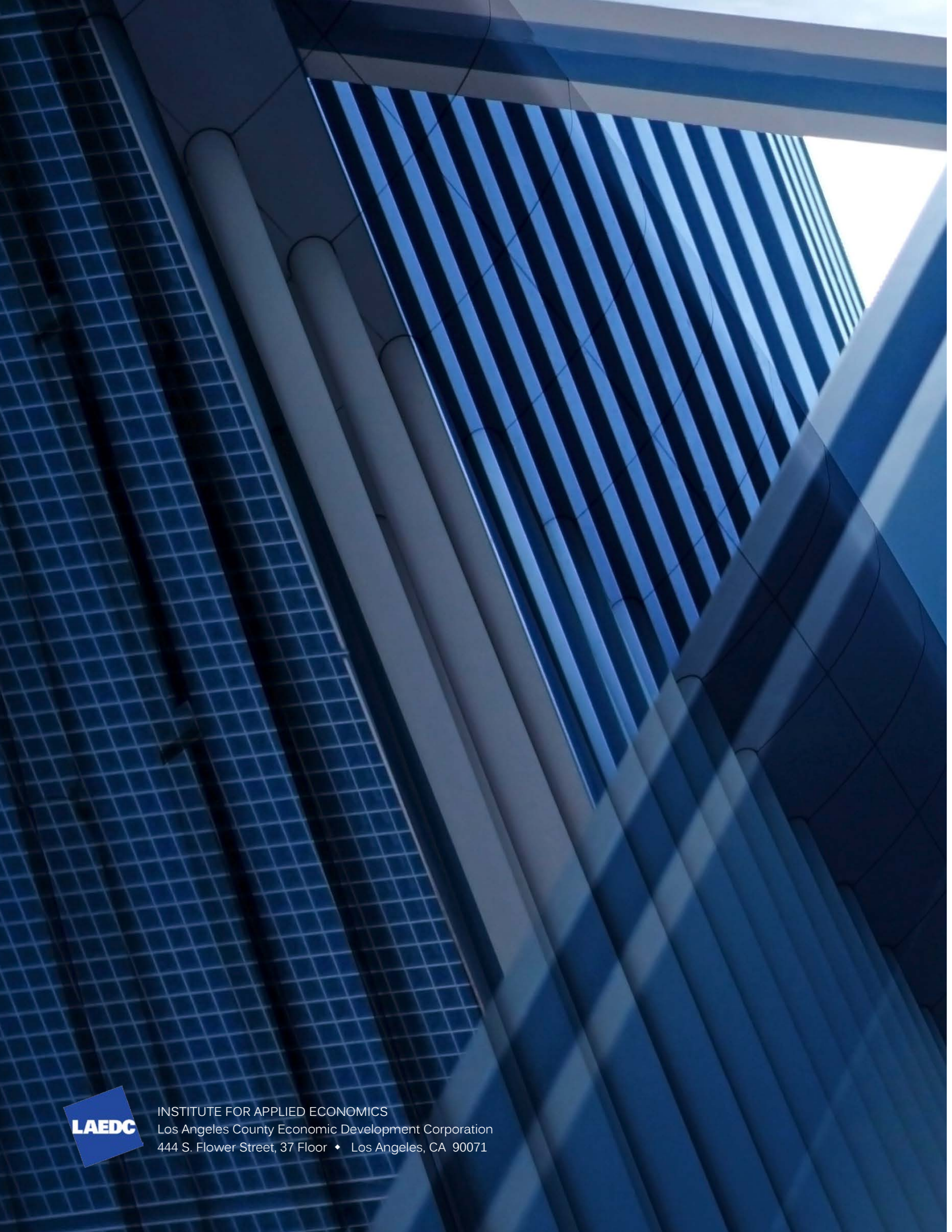
Dr. Mitra received her Bachelor of Arts in Economics and Political Science from the University of California, Los Angeles and her Master of Arts in Politics, Economics and Business as well as her Ph.D. in Economics from Claremont Graduate University. Dr. Mitra enjoys volunteering in the local community and is actively involved in both women's welfare and animal rescue organizations.

Wesley DeWitt
Research Analyst

Wesley DeWitt is a research analyst with the IAE, where he has contributed to industry cluster reports, workforce analysis and data visualization needs for the Institute's private and public sector clients.

Mr. DeWitt received undergraduate degrees in Economics and Environmental Science and Policy, and a master's degree in Geographic Information Science from California State University Long Beach.

Outside of the LAEDC, Mr. DeWitt provides GIS consulting services. His projects have included the statistical and spatial analysis of landfill air chemistry, the identification of spatial trends in the residential and commercial real estate market in Los Angeles, and the monitoring of humanitarian aid distribution in East Africa. His academic research uses geo-referenced social media data to plot and analyze trends in public health, equality, hate speech and issues of internet privacy.



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