

California Transportation Infrastructure Landscape Report



Compiled by **WSP** with the generous support of **the James Irvine Foundation**



The **James Irvine** Foundation

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Glossary

AADT	Annual Average Daily Traffic
AGC	Associated General Contractors of America
ASCE	The American Society of Civil Engineers
AVs	Autonomous Vehicles
BRT	Bus Rapid Transit
C/AVs	Connected and Autonomous Vehicles
FTIP	Federal Transportation Improvement Program
IMPLAN©	Impact Analysis for Planning
ITS	Intelligent Transportation Systems
MPOs	Metropolitan Planning Organizations
MTC	Metropolitan Transportation Commission
PCB Programs	Professional Capacity Building
PTC	Positive Train Control (PTC) systems
SCE	Southern California Edison
SHOPP	State Highway Operation and Protection Program
STIP	Statewide Transportation Improvement Program
TIP	Transportation Improvement Programs
TIRCP	Transit and Intercity Rail Capital Program

1 Executive Summary

This Landscape Report is meant to guide investments being made by philanthropic organizations, project owners, contractors, and unions interested in infrastructure and workforce development efforts across California, including the Irvine Foundation and Southern California Infrastructure Working Group. Through a combination of expert interviews with labor unions, project owners, labor cost estimators, and construction contractors, along with research and analysis of publicly available documentation, this report provides a view of the transportation infrastructure landscape in the state. The “landscape” for California includes:

- Expected future funding for surface transportation assets
- Discussion of relevant construction trades
- IMPLAN modeling of anticipated job creation
- Industry trends and impacts on workforce needs in the coming years
- Key takeaways for workforce development programs



Surface transportation was chosen as a representative focus due to the regionally consistent nature of information showing public funding allowing for direct comparisons of investment between major metropolitan areas in California. While the “landscape” depicted in this report focuses on transportation, it is intended to provide insights for workforce development programs focused on all areas within the infrastructure sector.

Analysis of transportation improvement programs across California from various metropolitan areas shows that investment will be concentrated in major metropolitan areas like Los Angeles and the Bay Area. Through a combination of interviews with professional cost estimators and analysis of Davis-Bacon wage determinations, this report provides descriptions of skilled trades that may be used on various highway or transit projects in the state. Heavy civil and electrical trades will be needed the most to meet highway and transit project needs in the coming years. IMPLAN modeling data provides an estimate on the number of jobs created for these types of projects and how job creation differs between regions in the state, showing that projects in the San Diego and the Inland Empire will have more per dollar impact on job creation than other regions.

The following key takeaways will assist workforce stakeholders – philanthropic or community based organizations, project owners, contractors, and labor unions in California – in evaluating the most impactful investments in workforce development programs:

- Highway and road investment are expected to grow and remain the dominant mode of transportation in California in the coming years.
- Rail transit projects provide the most jobs supported per dollar of investment in the project.¹ Transit projects also create jobs to operate and maintain assets.
- The Los Angeles metro region and Bay Area can expect the most transportation funding in the coming years. The San Diego and Sacramento metropolitan regions also can expect significant transportation investment in the coming years.
- Workforce development programs that intend to impact the most workers overall may choose to focus on heavy civil trades - operating engineers, carpenters, ironworkers, and cement; those trades are highly transferable across all areas of infrastructure.
- Workforce development programs should also

¹ Rail projects have a need long-term labor for operations and maintenance activities, whereas highway projects need short-term capital labor.

consider a broader range of crafts such as electricians, ironworkers, boilermakers, insulators, and trades like glaziers and drywall finishers; demand for those crafts will grow with investment in transit infrastructure projects.

- Workforce development programs with the goal of filling demand for workforce gaps could focus on the electrical trades and emerging technology training in networking, databases, cybersecurity, and communication systems.
- Electrical trades often have significant crossover between various infrastructure sectors, and with emerging technologies related to electric vehicles and information technology systems, there is a high potential for sustainable career development.
- When considering investments into workforce development training programs throughout the state, special consideration should be given to whether highly

skilled, specialized jobs are available to sustain a long-term career. The desire to train job seekers for highly skilled and high-paying jobs must be balanced with the availability of the work for their specialization. For example, while bridge and tunnel specialties may pay more per hour, the consistency of the work may make it difficult to form a sustainable career for certain trades.

- San Diego and the Inland Empire would see the most direct job creation per dollar spent on highway maintenance and preservation projects as well as rail transit corridor or extension projects.
- Based on IMPLAN modeling data, construction projects in all transportation types would produce the greatest impact per dollar in Riverside County and San Diego.²
- Most counties in the Bay Area, and thus the region as a whole, would see the lowest impact per dollar spent on transportation projects.



² Variation in job creation by region is explained further in Table 2.

2 Introduction

Through a robust coordination effort involving contractors, labor unions, project owners, and community organizations, the Irvine Foundation plans to invest in workforce development efforts in the infrastructure sector across California. The goal of the Landscape Report is to describe the landscape of infrastructure investment in the state and how those investments might translate into job creation so that efforts to support workforce development programs will result in the greatest impact.

The idea is to first follow the money to describe the landscape of where the investments in infrastructure are happening both in terms of the types of projects and the geographic regions implementing projects. Then, the report describes in both quantitative and qualitative terms the jobs that might be created as a result of those investments. Lastly, the report describes some of the trends and gaps that may influence workforce development programs in infrastructure.

With a clearer picture of how infrastructure investment might impact job creation, workforce development stakeholders can identify where to target training, apprenticeship, and outreach efforts on those jobs – which are often construction trades – that are likely to be created in California over the next several years.

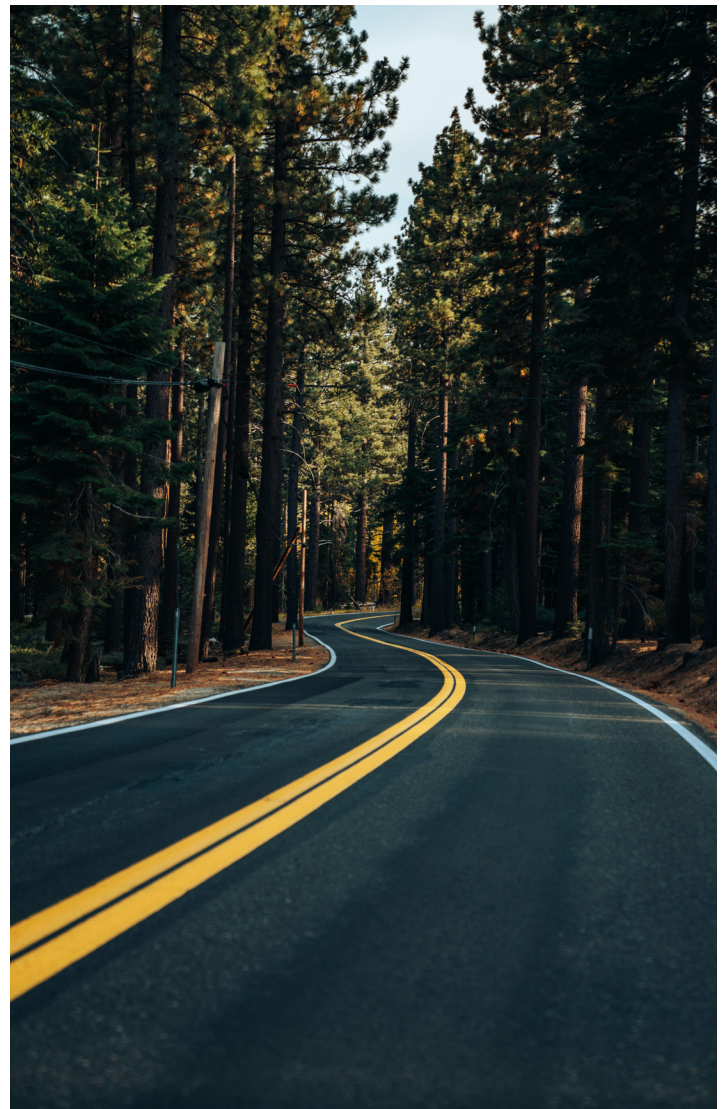
2.1 METHODOLOGY

This report uses just one sector – surface transportation – as representative of the broader category of infrastructure to draw qualitative conclusions about job creation and workforce development in infrastructure.

Surface transportation was chosen as a focus due to the publicly available and regionally consistent data on future funding levels. Metropolitan Planning Organizations³ (MPOs) are the regional agencies responsible for planning investments in surface transportation throughout the state. MPOs are required to submit Transportation Improvement Programs (TIPs) every other year to the state for compilation into the Statewide Transportation Improvement Program (STIP). Regionally comparable funding data can be extrapolated to determine how transportation funding differs across the state.⁴ As a result, the report provides

future funding levels for transportation investment across major population centers in California separated by mode of surface transportation.

Funding information was gathered via the 2021 adopted Federal Transportation Improvement Program (FTIP) and State Transportation Improvement Program (STIP) documents provided by each Metropolitan or Regional Planning Organization within the regions of interest informed by the Irvine Foundation. From these documents, Federal Transit and Federal Highway funds for each year were extracted to include in calculations of expected funding for those two modes.



³ [Metropolitan Planning Organizations](#), or MPOs, are regional agencies or policy boards responsible for carrying out the metropolitan planning and programming process of the region and are responsible for awarding federal formula grant funds to recipients within that region.

⁴ While other types of infrastructure related to water and energy utilities or building construction will make up a large amount of infrastructure investment in the future, the lack of publicly available and regionally consistent funding data for those sectors led to its exclusion from this analysis.

The maps provided in the sections that follow were created using this data and Tableau. After the appropriate mode was applied to the programmatic funding breakdowns provided in the STIP and FTIP documents, they were grouped into the following categories:

- Highways and Roads;
- Transit and Rail; and
- Bike/Pedestrian/Other, where “Other” includes programmed funding for which these categories did not apply or where a funding program was not specified.

IMPLAN version 6.2, released in 2021, was used to estimate the quantitative impact to employment produced by each of the identified transportation investment categories. IMPLAN is an economic impact assessment tool that allows users to develop input-output models by industry and location. The input is a typical-sized project for each type as determined by a review of publicly available information on upcoming projects in California. For example, given LA Metro’s upcoming multi-billion dollar highway expansion projects, the research team identified the [\\$1.3 billion I-5 North Improvement Project](#) as an exemplary project and used \$1 billion as an input to the model for highway expansion employment estimation. Outputs are expected direct, indirect, and induced employment outcomes across counties in California.

Models created through IMPLAN [assume](#) constant returns to scale, meaning an increase in inputs (capital) causes the same proportional increase in outputs (labor). For example, to estimate the impacts of a \$500 million dollar Highway Expansion project, the employment outputs estimated for a \$1 billion Highway Expansion project in Table 2 can be halved.

The models use the most recent year of data on the state of California available in IMPLAN (2018). IMPLAN Codes were chosen based on the most accurate census description.

Table 1: IMPLAN Industries Associated with Employment Models

Transit Investment Category	IMPLAN Code	Census Description ⁵	Input
Highway Expansion	54 - Construction of new highways and streets	Highways, streets, and related work	\$1 billion
Highway Maintenance/ Preservation	62 - Maintenance and repair construction of highways, streets, bridges, and tunnels	Maintenance and repair of Highways, streets, and related work	\$20 million
Rail Transit Corridor or Extension	56 - Construction of other new nonresidential structures	Mass transit construction	\$1 billion
Complex Bridge or Tunnel	54 - Construction of new highways and streets	Bridges, tunnels, & elevated highways	\$1 billion

⁵ Based on Census Definitions of construction categories: <https://www.census.gov/construction/c30/definitions.html>

The report uses a combination of publicly available information and expert interviews to describe qualitatively the types of jobs that might be created as a result of transportation investment. Using research into Davis-Bacon wage requirements for California, this report provides examples of trades that may be used on a specific surface transportation project. Identified trades were confirmed by cross-referencing existing labor cost estimation documents from similar projects around the country to provide a set of trades that would most likely be used on a particular project in California. Given the unique nature of each surface transportation project, these trades may change on a project-by-project basis, but will provide a high-level idea of the necessary construction trades for a particular project, what the prevailing wage is for different parts of California, and any educational requirements or relevant union representation.

For highway and road projects, the Davis Bacon Act Construction Type for “[Highway](#)” was used to determine prevailing wages across California. For transit projects, the “[Building](#)” construction type was used to determine prevailing wages since the analysis centered around station construction. Information on training and education requirements for construction trades listed in this report came from the representative union requirements, with links provided should more information be needed. Prevailing wages and trade classifications often differ based on the county where the work occurs. For example, definitions for carpentry in [San Diego](#) and the [Bay Area](#) are generally distinguished by broader work classifications, using titles like “Bridge Builder/Highway Carpenter” or “Heavy and Highway Carpenter” to define prevailing wages, as opposed to Los Angeles County, which uses more specific titles related to on-site work with titles such as “Millwright” or “Pneumatic Nailer/Power Stapler”.

Several pieces of this report rely on expert interviews provided by members of WSP and the Southern California Infrastructure Working Group, particularly in the section on Trends and Workforce Needs. An interview guide was developed at the outset of the research, geared towards

three different stakeholders in the workforce development space: project owners (transportation agencies), construction contractors, and unions. Information gathered through these interviews informed the Landscape Report research and provided direction to better understand the workforce development space in California.

2.2 ROADMAP FOR THE REPORT

This report contains two primary sections: Section 3, Transportation Infrastructure Investment in California and Section 4, Trends and Workforce Needs.

Transportation Infrastructure Investment in California is structured by transportation mode: highways and roads, transit, bridges and tunnels, and bicycle and pedestrian infrastructure. Separating the analysis by mode allows for the identification of differences in the type of construction trades used for different projects. While this section does provide expected funding levels for surface transportation that can be used for the high-level identification of regional

investment priorities, it can also be used on a project basis to determine the specific workforce trade needs on a project. This section also briefly discusses how this methodology can be applied to other construction sectors like utility or building construction. IMPLAN modeling data, combined with identification of construction trades used on a particular transportation mode can provide stakeholders with an idea of potential job creation given a specific project.

Trends and Workforce Needs identifies some key trends and gaps that should inform workforce development programs. First, the report identifies trends for new jobs in emerging technologies. Next, the report identifies gaps in the current workforce in California, pointing to a real need for more workforce development programs. The report highlights some opportunities for workforce development programs to meet expected future demand. Lastly, this report distills the information into some key takeaways.



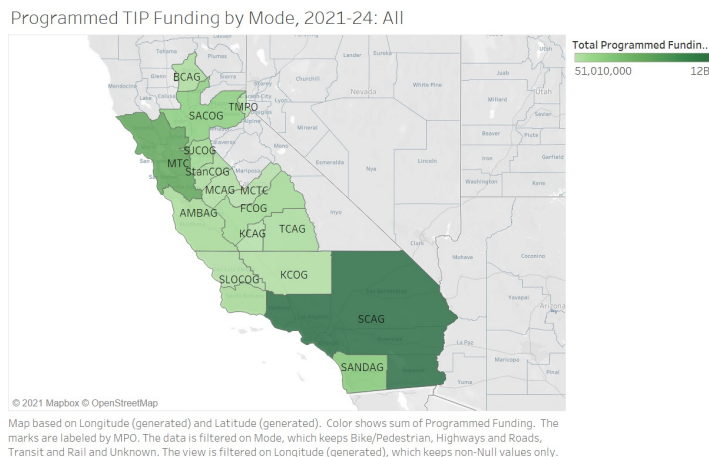
3 Transportation Infrastructure Investment in California

Transportation involves a wide variety of heavy civil construction projects impacting any infrastructure that aids in the movement of people or things. The transportation sector includes cars, rail, bus, airplanes, ferries, and ships. This section focuses on two of the largest areas of surface transportation infrastructure investment in California: first, highways and roads; and second, transit – specifically, bus and rail (intercity, commuter, light rail, subway, and streetcars).

It is widely expected that investments in transportation infrastructure will create jobs. [Senate Bill 1](#) provided a consistent investment by the state in transportation infrastructure. Combined with anticipated [federal investments](#), the transportation sector offers the promise of consistent funding for well-paying jobs across multiple regions in California. This section seeks to provide a description of that impact on the skilled workforce and building trades in order to inform stakeholders where investments to train and grow the workforce will be the most meaningful.

Understanding the landscape for workforce development begins first with the expected transportation funding levels, both by mode and geographic area. Transportation funding is largely determined using the [State Transportation Improvement Plan](#) and other reports from Metropolitan Planning Organizations (MPOs)⁶. As seen in Figure 1 and Figure 2, highways and roads can expect more funding than transit in California, with most funding planned for concentrated urban areas in Southern California and the Bay Area.

Figure 1: Programmed TIP Funding for All Modes



The Los Angeles metro region and Bay Area can expect the most transportation funding in the coming years. Investments in workforce development in those areas have the highest potential for impact, despite not having the highest direct employment outputs per dollar spent.

The San Diego and Sacramento metropolitan regions can also expect significant transportation investment in the coming years.

The next part of this analysis includes an estimate of the number of jobs expected to be supported as a result of a hypothetical project, based on the mode of travel using [IMPLAN](#) modeling data. This report adopts the definitions of direct, indirect, and induced jobs from [IMPLAN definitions](#) of those effects.

- Direct: Jobs that involve designing, constructing, operating, and maintaining the infrastructure asset, with funding provided directly by the project owner.
- Indirect: Jobs that involve providing goods and services to the asset across its lifetime, including supply chain and logistics jobs.
- Induced: Jobs supported as a result of the larger economic activity enabled by construction of the project.

The IMPLAN modeling results presented in this report provide a linear relationship between construction cost and job creation. This allows users of this document to take real-world projects and estimate the labor needs.

There is no formulaic approach to measuring the specific labor needs of a transportation infrastructure project based on the amount of funding available, however. Every project is unique and has its own requirements. Many factors will determine the labor needs of each project including productivity of the workers, productivity of the contractor planning the work, progression of the work, timing of other projects competing for the same labor, and the unique

⁶ [Metropolitan Planning Organizations](#), or MPOs, are regional agencies or policy boards responsible for carrying out the metropolitan planning and programming process of the region and are responsible for awarding federal formula grant funds to recipients within that region.

features of the project. For specific projects, detailed study and outreach to industry groups will determine the availability of specific trades and the inventory of competing projects for those resources. The labor pool is constantly evolving to fill market needs and with each project, owners and contractors anticipate workforce needs and manage gaps with careful planning that can impact the number of jobs supported as part of a project.

Additionally, the report describes the labor trades that are most common on that type of project. This information was determined through a combination of expert interviews from professional cost estimators, contractors and owners. Based on Davis Bacon wage requirements for counties in California, along with state prevailing wage requirements, the report describes a range of expected wages and benefits, along with education requirements, for each labor category. Emerging trends in technology in transportation, including converting to electric bus fleets, autonomous vehicles, and use of intelligent transportation systems (ITS) for highways may impact labor needs and require investment in workforce development programs. Those trends creating new technology-focused careers will be discussed in the next section.

Many of the skilled trades discussed in this section are transferable between different types of transportation projects. For example, operating engineers used on a highway expansion project to pave the roadway would be able to find similar work on local road projects. In order to ensure a sustainable career for workers entering the industry, it is important to ensure that continued work opportunities are available that allow laborers to move from project to project without major gaps in between work.⁷

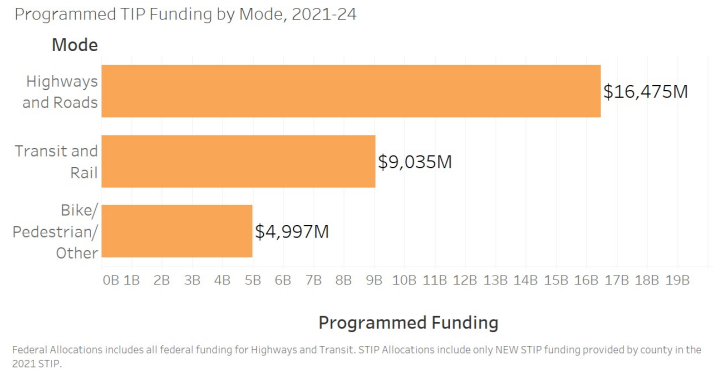
This is discussed further in the Key Takeaways section of this document.

This section of the Landscape Report also discusses transportation projects, whether highway or rail, that incorporate complex project elements like bridges or tunnels and the effects that those elements may have on workforce needs. The addition of these project elements to a highway or rail project will require highly specialized trades that raise further questions for workforce development efforts.

3.1 HIGHWAYS AND ROADS

California’s robust roadway system is a high investment priority due to roads’ importance in the state’s economy.

Californians are reliant on roads; in 2013, Californians traveled over [330 billion](#) miles. The total value of the overall road network in California, based on asset values, exceeds [\\$1.2 trillion](#). This does not include over \$4 trillion in goods that travel on California roadways every year. The figure below shows that programmed highway funding for 2021-2024 is \$16.4 billion, which is significantly more than



programmed transit funding.

Figure 2: Programmed TIP Funding by Mode

Despite these investments, California’s roads remain in a state of disrepair. The condition of California roads is among the worst in the nation, ranking 49th according to the latest US News & World Report Ranking. Meanwhile, Southern California and the Bay Area are the second and third most congested urban areas in the nation, respectively. The American Society of Civil Engineer’s (ASCE) 2019 [Report](#)

Highway and road investments are expected to grow and remain the dominant mode of transportation in California in the coming years.

This will provide consistent work for heavy civil trades: operating engineers, carpenters, ironworkers, and cement masons.

Workforce development programs that intend to impact the most workers overall may choose to focus on these trades because of the consistency of work expected.

⁷ Skilled trades included in the tables throughout this document are mentioned only once to avoid repetition, but many trades are used on different project types within the transportation sector.

[Card for Infrastructure](#) found that driving on deficient roads cost Californian's \$61 billion annually due to congestion-related delays, traffic collisions, and increased vehicle operating costs.

Caltrans is the state agency responsible for pavement conditions and road preservation in California, [spending over \\$3.1 billion](#) on pavement projects on nearly 5,300 lane-miles of roadway from 2018 to 2020. This is primarily funded through the [State Highway Operation and Protection Program \(SHOPP\)](#) at the state level, although localities provide a significant portion of the funding to rehabilitate and preserve local roads.

Fixing the state's aging infrastructure is a major priority for transportation stakeholders. In 2017, the legislature passed the Road and Repair Accountability Act (SB 1), which provides \$52 billion for local and state roads over the next 10 years. Supported by the state's contracting industry, the legislation provides a consistent source of funding. Even with that level of state investment, California also relies on existing and new sources of federal funding. A total of more than [\\$130 billion](#) is needed to bring the system back to a state of good repair. SB1 programs, including the Local Streets and Roads Program, dedicate \$1.5 billion per year in new formula revenues to cities and counties for basic road maintenance, rehabilitation, and critical safety projects on the local streets and roads system. Other important programs from SB1 related to preservation include the [State of Good Repair Program](#) (\$105 million annually), and the Local Partnership Program (\$200 million annually). Additionally, California's [long-range transportation plan](#) lists "Preserve and maintain existing multimodal transportation assets in a state of good repair" as its number one infrastructure priority. This distinction between system preservation and expansion is similar to many other state DOTs around the country, meaning this analysis has national relevance.



Another reason highway and road investments are a priority is that the population in California continues to grow; while [population shifts](#) as a result of the Covid-19 pandemic are impacting California, trends in population growth overall will continue to mean increased use of roads. According to the [California Transportation Plan 2050](#), the state's population is estimated to grow by six million residents by 2050. The coastal urban areas such as the Bay Area, Los Angeles, and San Diego will retain the majority of the state's population, but the Central Valley and Inland Empire currently outpace the rate of growth in the Bay Area and Los Angeles.

If current trends continue, driving will remain the dominant mode of transportation in 2050, with expected increases of up to 35 percent in vehicle miles traveled. In 2019, [annual average daily traffic](#) (AADT) for all California highways exceeded 400 million trips. While highway preservation is a major priority, expansion will be necessary to meet future demand. Therefore, even though major population centers are seeing most investment, the growth in the Central Valley and Inland Empire means more investment in the future for those regions.

3.1.1 HIGHWAY EXPANSION

This section focuses on large highway expansion projects, distinguished from the next section on local roads for two reasons: levels of funding and commonly used trades.

In terms of levels of funding, local roads in California are prioritized under the "[fix-it-first](#)" policy, meaning that a majority of funding is directed to preservation of the existing roadway as opposed to the type of capacity expansion outlined in this section. However, given the growing population and associated roadway demand mentioned in the previous section, highway expansion and new construction projects will be needed across the state to meet demand, making it important to understand how highway expansion projects function differently than local road projects.

The second reason for this distinction is that there is a difference in the type and extent of labor used on a new highway construction project in comparison to a local roadway paving or rehabilitation project. The type of craft labor required on a highway may require more heavy civil crafts involving structures and drainage, whereas a local roadway project may involve more straightforward work such as paving. Additionally, the overall labor hours and workers needed on a single highway expansion project often exceed that of a single local road project, as can be seen in the IMPLAN modeling data shown in Table 1 and Table 3.

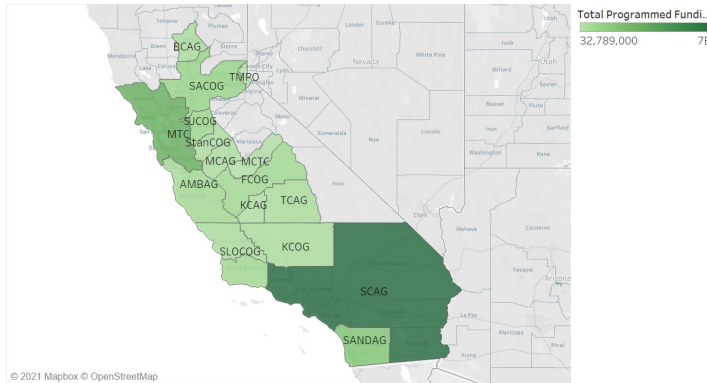
What is the expected level of investment?

Much of the state funding for highway expansion comes from programs created by [Senate Bill 1, which invests \\$1.5 billion in the State Highway System](#). This includes programs like the Solutions for Congested Corridors Program or the Trade Corridor Enhancement Program, both of which provide approximately \$550 million per year in competitive funding. Additionally, the state has allocated almost \$23 billion until 2026 for State Highway Maintenance and

The IMPLAN results show that projects of the same magnitude can have different impacts on employment in each county and region.

- San Diego and the Inland Empire would see the most direct job creation per dollar spent on highway maintenance and preservation projects as well as rail transit corridor or extension projects.
- Overall, construction projects in all transportation types evaluated in this report would produce the greatest impact per dollar in Riverside County and San Diego, while most counties in the Bay Area would see the lowest impact per dollar on similar projects.

Programmed TIP Funding by Mode, 2021-24: Highways and Roads



Map based on Longitude (generated) and Latitude (generated). Color shows sum of Programmed Funding. The marks are labeled by MPO. The data is filtered on Mode, which keeps Highways and Roads. The view is filtered on Longitude (generated), which keeps non-Null values only.

Improvement, which includes numerous projects meant to increase capacity on California’s highways.

Figure 3: Highway Investment in California based on MPO TIP funding

On a regional level, Southern California has invested significantly more in highways and roads than other

regions (approximately \$10 billion annually), followed by the Bay Area. Los Angeles County is a sprawling area with eight interstates and 29 state routes and has the most extensive freeway network of any major metropolitan area in California. LA Metro, which manages many highways in the county, is expected to invest nearly \$27 billion in highways over the next 30 years according to the agency’s [Long Range Transportation Improvement Program](#). In the short-term, LA Metro will invest \$4.2 billion in highways by 2025. Metro’s highway program includes many multi-billion dollar freeway widening projects such as the \$1.3 billion [I-5 North Improvement Project](#). In the Bay Area, similar levels of highway investment are expected.

Based on these levels of investment, it can be expected that the most job creation related to highway expansion projects will occur within these major metropolitan areas. Figure 3 breaks down highway investment in each of the MPO regions in California.

How many jobs could be supported?

Overall job creation for a highway expansion project will differ based on a variety of factors such as scope, scale and location. By assuming a standard project size and type, in this case a \$1 billion highway expansion project, a comparison can be made on job creation between geographic areas using IMPLAN modeling data, as seen in Table 2 below.



Table 2: IMPLAN Modeling of Employment for a \$1 billion Highway Expansion Project^{8,9}

Region	County	Direct Jobs	Indirect Jobs	Induced Jobs
Los Angeles Metro	Los Angeles	4,300	2,100	1,600
	Ventura	4,500	900	1,500
	Orange	3,900	900	1,500
Bay Area	San Francisco	3,200	500	500
	Marin	3,900	700	800
	Alameda	3,600	800	1,000
	Contra Costa	3,900	800	1,100
	Santa Clara	3,500	500	800
	San Mateo	3,500	500	600
Central Coast	San Luis Obispo	4,200	900	1,700
	San Benito	4,400	700	600
	Monterey	4,300	900	1,300
	Santa Cruz	4,200	1,000	1,500
	Santa Barbara	4,500	900	1,400
Inland Empire	San Bernardino	4,500	800	1,200
	Riverside	4,600	1,000	1,400
San Diego	San Diego	4,400	1,100	1,700

While a standard project size is assumed in order to determine the values displayed above, this information can be applied to any highway expansion project to determine the expected job creation due to the linear nature of the IMPLAN model. For example, LA Metro is constructing the [I-5 North Improvement project](#) (\$1.3 billion), which, based on the above data, would result in over 5,500 direct jobs in LA County.

What types of jobs might be supported?

The types of craft labor required for highway expansion projects should be fairly consistent, with some variation depending on the project location and complexity. On-site construction labor on these projects is short-term, with some of the [lowest average salaries](#) for workers among the infrastructure projects explored in this report. As compared with some transit or bridge projects, highway infrastructure relies more heavily on general labor and less specialized trades.¹⁰ As with any heavy civil project, there may be significant surveying and planning needs as well.

Table 3 below identifies the most common trades starting with the highest hourly wages gathered from [Sam.gov](#) using the “Highway” Construction Type for California.

⁸ The regions prioritized in this analysis were informed by the Irvine Foundation.

⁹ IMPLAN data presented in this report may understate impacts of job creation due to the county-level nature of the data displayed. Due to this granularity, the job creation presented in this analysis does not account for leakage of activity to another county, e.g. a project in Orange County (OC) is likely to use suppliers from LA County. Those jobs won’t be reflected in OC’s county-specific results – this explains the large (+2x) difference in indirect jobs supported in LA vs. OC and Ventura in the table – LA is a much larger economy so the OC and Ventura projects are likely to be using LA-based suppliers, reducing local (in-the-county) indirect effects. County-level data is presented in this analysis since many workforce development efforts occur at the county level or below.

¹⁰ Highway tolling does have the added potential of attracting private investment which will not create more jobs than a project not funded by toll revenue necessarily. However, toll revenue does have the potential to attract private investment, which is an additional funding source, potentially leading to more funding for another project that wouldn’t otherwise have been built, and therefore leading to more jobs.

Table 3: Common Trades and Rates on Highway Expansion Projects

Trade	Description	Prevailing Wages	Education
Carpenters	Build and assemble forms for concrete structures such as bridges, retaining walls, tunnels, and drainage structures. Carpenters in the state of California are generally represented by chapters of the United Brotherhood of Carpenters .	Bay Area - \$52.75 Southern California - \$42.75 ¹¹	High School Diploma or GED equivalent, or Verified 6 months full time work experience in a construction related trade Apprenticeship requires four-years, 4800 work hours, and 612 hours of instructional classes.
Plumbers/ Pipelayers	Modify storm drains, sanitation sewers, drains, and water mains underneath or around the roadway. Sewer and storm drain plumbing work is defined fairly consistently across regions in California. ¹² The United Association Union of Plumbers, Fitters, and Welders , with various chapters in California.	Bay Area - \$67.75 ¹³ Southern California - \$39.39	High School Diploma or GED Equivalent Apprenticeship program of three to five years
Heavy Equipment Operators	Drive and control construction equipment including bulldozers, excavators, cranes, forklifts, road graders, loaders, and rollers. ¹⁴ Heavy equipment operators and power equipment operators, if part of a union, are generally represented by the International Union of Operating Engineers with local chapters throughout California.	Varies between \$42 and \$52 per hour.	High School Diploma or GED Three to four years of apprenticeship Depending on the municipality, licenses may need to be acquired by workers in order to operate equipment
Ironworkers	Use reinforcing steel to strengthen the concrete that forms highways. Demand for this type of work depends significantly on the scope of the project. ¹⁵ The International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers is the primary union that represents these workers, with various chapters throughout California.	Approximately \$41 per hour and does not vary significantly based on region.	High School Diploma or GED Three to four years of apprenticeship
Laborers	Perform many tasks that require manual, physical labor on construction sites including preparing and cleaning up construction sites or assisting skilled trades with various tasks on the construction site. ¹⁶ Laborers are represented by Laborers International Union of North America , with various chapters throughout California.	Construction craft laborers are generally earning \$30 an hour in the Bay Area . Laborers in Los Angeles County may earn up to \$40 an hour . ¹⁷	No prior education On-the-job training ¹⁸
Cement Mason	Pour, smooth, and finish concrete roads and curbs and are needed whenever concrete is used on a project. Cement masons are generally represented by the Operative Plasterers and Cement Masons International Association and there are various chapters throughout California.	Bay Area - \$33.49 Los Angeles County - \$38.50 ¹⁹	High School Diploma or GED Three-year apprenticeship programs that include on the job training.
Truck Drivers/ Teamsters	Transport and haul material equipment, and personnel to the construction site. ²⁰ The International Brotherhood of Teamsters represents a majority of truck drivers around the country, with various chapters throughout California.	Ranges between \$30- \$35 an hour ²¹	Drivers license and several state certifications

11 Prevailing wages for this trade differ based on the type of work being completed on a project site. The two wages listed here are based on the “Millwright” classification, allowing for a comparison between regions.

12 [The Bay Area](#) uses a slightly broader definition for a “Pipe Tradesman”; these workers support drainage improvements on highway expansion projects.

13 Alameda County prevailing wage

14 The definitions of this type of work vary considerably based on the project type and location. For example, power equipment operators in the [Bay Area](#) are separated into nearly 10 groups based on the type of work being completed. Piledrivers alone have six groups defining the type of work with different prevailing wages for each group.

15 Ironworkers that have certifications in welding, rigging, and crane signaling are often considered more desirable by [employers](#). This is because certifications in ironworking specialties allow a worker to complete more specialized tasks, saving a contractor the need to hire multiple ironworkers and improving productivity.

16 There are several groupings of laborers on project sites that differ in terms of type of work, required training or experience, and prevailing wage. The differentiation in this type of work is very detailed. For example, laborers working with asphalt fit into different groupings; in Los Angeles County, an “asphalt shoveler” is grouped differently than an “asphalt raker.”

17 Laborers are by far the most diverse in terms of Davis-Bacon definitions making it more difficult to draw comparisons across project types. Significant variation occurs depending on the type of work being completed

18 Due to the extreme variety in types of “laborer” across California, the education requirement may change depending on the type of work being completed.

19 The definition for this type of work is fairly consistent across regions in California.

20 The definition for this type of work varies significantly, not only in the type of work completed on projects, but also between regions and counties. For example, [Los Angeles County](#) has 12 groupings for truck drivers on highway projects, whereas the [Bay Area](#) has five groupings. The majority of these groupings are dictated by the type of truck being driven.

21 For a highway expansion project, a cement mason distribution truck may be used frequently; in [Los Angeles County](#), the prevailing wage for this type of truck driving work is \$32.87 an hour.

Foremen/Supervisors

The next step in career advancement for many of the trades listed above is a supervisor or foreman. Usually more experienced tradespeople, foremen supervise the skilled work completed on site. While the average salary for a construction foreman in California is just [\\$51,000](#) per year, there is a significant amount of variation in average salaries across the state, suggesting that there are opportunities for salary increases based on skill level, location, and years of experience. Since foremen are generally needed to supervise each trade, whether skilled or unskilled, on a job site, their compensation may differ in relation to the craft supervised. For example, a foreman for piledrivers will, in general, earn more per hour of labor than a foreman for unskilled laborers on a project site.

When considering investments into workforce development training programs throughout the state, special consideration should be given to the availability of higher skilled, specialized jobs when compared to lower skilled jobs.

While certain highly skilled construction jobs provide the highest pay when taken at face value, there is considerable variation in prevailing wages and availability of consistent work between trades and regions.

The desire to train job seekers for highly skilled and high-paying jobs must be balanced with the availability of the work for their specialization.

Advanced-Degree Jobs

While the trades listed above are primarily focused on the construction phase of a project, planners and design engineers are needed during pre-construction and design. Professional engineers and construction managers are essential throughout the project. These jobs require advanced degrees and are hired in a different manner. Project owners may use in-house engineers or use private consulting firms. A general contractor is generally responsible for staffing the professional engineer and construction manager positions using in-house salaried staff.

3.1.2 HIGHWAY AND LOCAL ROAD PRESERVATION

This section details the expected funding sources and job creation for local road and highway preservation projects. The differentiation for this type of project from highway expansion is explained in the previous section.

What is the expected level of investment?

Following the state's "fix-it-first" policy, preservation projects receive a majority of state highway funding in California. While investment at the state level is notable, cities and counties are primarily responsible for these type of preservation projects and use significant local funds. Los Angeles County, for example, invested [\\$177.2 million](#) in pavement preservation on State Route 14, which included \$13.5 million in SB-1 funding. In the Bay Area's Alameda County, \$73.5 million is allocated to a single pavement rehabilitation project encompassing Dublin and Castro Valley set to begin in September 2021.

Local road work can vary beyond simple repaving projects and includes, for example, traffic signal upgrades, sidewalk repairs, median or curb improvements, and drainage work. According to the 2021 SHOPP for Caltrans District 7 (Los Angeles and Ventura Counties), a \$15.6 million project will do the following:

Near the city of Ventura, from North 101 Junction - Solimar Undercrossing to Mobil Pier Road. Grind and overlay pavement, upgrade guardrail/end treatment, install traffic signs and crosswalks.

While many local projects center around repaving and rehabilitating the roadway itself, there are coordinated improvements included in the scope of the project like traffic signal or drainage improvements. This has an impact when attempting to determine the type of labor needed for these projects, as every project is genuinely unique. These aspects, and how they differ between local road projects, are important when considering the appropriate focus for workforce development investments.

How many jobs will be supported?

Overall job creation for a road preservation project will differ based on scope, scale, and location. By assuming a standard project size and type, in this case a \$20 million highway or local road preservation project, a comparison can be made on job creation between regions displayed in Table 4 below.

Table 4: IMPLAN Modeling of Employment for a \$20 million Highway Maintenance/Preservation Project²²

Region	County	Direct Jobs	Indirect Jobs	Induced Jobs
Los Angeles Metro	Los Angeles	180	40	60
	Ventura	180	40	55
	Orange	170	35	60
Bay Area	San Francisco	150	15	20
	Marin	150	25	30
	Alameda	165	30	40
	Contra Costa	160	35	40
	Santa Clara	160	35	40
	San Mateo	145	25	25
	San Luis Obispo	165	40	65
Central Coast	San Benito	175	20	20
	Monterey	175	35	45
	Santa Cruz	150	35	50
	Santa Barbara	185	35	55
Inland Empire	San Bernardino	190	40	45
	Riverside	195	40	55
San Diego	San Diego	195	40	70

What types of jobs might be supported?

Table 5 below displays one trade commonly seen on local road projects. This table does not include previously discussed trades to avoid repetition, but many of the trades discussed in the previous section will be used on these types of projects. Laborers will be needed to spread and shovel asphalt and complete other general tasks on local road projects. Pipelayers and plumbers will be needed to modify storm drains, sanitation sewers, drains, and water mains that may be underneath or around the roadway. These requirements likely will be less than highway expansion given the size of the projects, with most of the work focusing on rehabilitation or repair as opposed to installation. Heavy equipment operators use graders, rollers, or diggers to excavate and replace pavement or asphalt.

²² The regions prioritized in this analysis were informed by the Irvine Foundation.

²³ Electric work is often differentiated between “inside electrical” or “outside line” work. For the purposes of this type of project, most electricians would be used for inside electrical work on ITS, traffic signals, CCTV, and underground cable systems. Oftentimes local road projects include utility relocation needs, requiring outside linemen to ensure no power interruptions occur as a result of the project.

²⁴ Counties tend to provide additional wage requirements for cable splicing work.

Electricians and linemen, as well as operating engineers, also are needed to excavate right-of-way and relocate utility lines.

Table 5: Common Trades and Rates on Highway and Local Preservation Projects

Trade	Description	Prevailing Wages	Education
Electrician/Lineman	Responsible for the installation, maintenance, and repair of Intelligent Transportation System (ITS) on the roadway like traffic signal electronics. ²³ Work can also include relocation of critical power utilities to make way for road construction. Journeyman Electricians are supported by technicians. Electricians that are union members are represented by the International Brotherhood of Electrical Workers with various local chapters throughout California.	Los Angeles County -journeyman electricians can expect to earn approximately \$51 per hour while technicians earn approximately \$38 per hour. In the Bay Area, there are significant variations in the prevailing wages for this type of work among counties in the Bay Area. ²⁴	High School Diploma or GED Four-year apprenticeship program with on-the-job training

3.2 TRANSIT

This section details the expected funding sources and job creation for transit infrastructure projects.

In 2011, the [California Transportation Commission](#) estimated that the state needed approximately \$174 billion for expansion and state of good repair transit projects over the next 10 years, but at the time only 45% of funding had been identified, leaving a shortfall of \$96 billion. Released March 2021, President Joe Biden’s [American Jobs Plan](#) includes \$85 billion for transit system expansion and modernization, [doubling previous funding](#) for the sector. The analysis conducted for this report shows the high-density regions of the Bay Area and Southern California have allocated the most to transit infrastructure projects in the upcoming years, including big ticket projects like the \$2.7 billion BART Transbay [Core Capacity program](#) in the Bay Area and the \$5.7 billion Sepulveda Pass [Transit Corridor](#) in Los Angeles.

Transit investment will increase the demand for electricians, ironworkers, boilermakers, insulators, and trades like glaziers and drywall finishers that are often used to construct key elements of transit stations.

A particular shortage is expected of electricians, and therefore, a workforce development program that intends to fill gaps in the workforce may choose to focus on the electrical trades.

Additionally, transit projects have a greater potential than highway projects to create long-term operation and maintenance jobs, potentially leading to sustainable career pathways for certain trades like transit operators and mechanics.

Transit investment in California is central to equitable mobility planning for the state. The [US Census](#) estimates 37.5% of California households have one or no vehicle. This number jumps to nearly 31% with no vehicles and 41% with only one vehicle in San Francisco where [growth in ridership demand is expected to outpace supply](#). More than half of the Bay Area's transit investment for 2021-2025 is allocated towards transit and rail projects, which has potential to provide additional mobility options to these low- and no-car households. For the purposes of this analysis, understanding the demand for transit infrastructure and the growth in anticipated funding for its modernization and expansion is essential to understanding associated needs of a transit workforce. As demand for transit increases, investment increases, leading to more jobs supported by these projects, thereby affecting the strategy for workforce investment in the state.

There are distinctions between the workforce required to maintain and expand rail infrastructure and bus transit systems. Subway and rail transit projects involve dedicated tracks, tunnels, signals and control systems, which require a different set of specialized laborers than bus transit, which generally operates on existing roads, meaning bus projects primarily require workers to construct shelters, bus stations and other transit facilities, in addition to workers that operate and maintain buses. The following section describes the types of labor required for both bus and rail infrastructures and the expected employment generation from a typical project.

3.2.1 BUS TRANSIT

From 2012 to 2018, bus transit made up [over 60%](#) of the transit trips in California. Transit agencies are investing significantly in expanding and maintaining bus options in metropolitan areas.

An illustrative example of workforce planning on a bus rapid transit (BRT) project in a suburban area might not be all that different than a highway project. To start, workers who specialize in utility relocation would work underground to relocate “wet” utilities such as water and wastewater (plumbers and pipefitters) and “dry” utilities such as power lines and fiber for cable (electricians and lineman). Once the above-ground activities get started, the work will involve paving, requiring heavy equipment operators, traffic control workers, and concrete installers to build queue jumps or station platforms. Carpenters may need to install canopies and benches, and landscapers install trees, grass and plants. Plumbers will be needed to install irrigation or pipes for drainage improvements. The amount of workers needed for this project type will vary depending on the sequencing of the work along the corridor and traffic management needs. The project may be scheduled so that a small crew works on segments of the corridor, moving as work is completed in one area; another approach may demand that multiple crews work along different segments of the corridor at one time. Unlike a highway project, however, a BRT project may need specialty electricians to install digital information signs and traffic signal hardware and software both in the signal cabinet and on the buses.

Table 6 identifies trades that may be used on this type of project that have not yet been described in this report.



Table 6: Common Trades and Rates on Highway and Bus Transit Projects

Trade	Description	Prevailing Wages	Education
Painters, Drywall Finishers, and Glaziers	Construct and finish bus shelters, accomplishing a variety of tasks including painting, installing drywall and glass panes or other pieces of the bus shelter. These trades are often represented by the International Union of Painters and Allied Crafts with various chapters around California.	Painters are paid \$33.12 per hour; drywall finishers are paid \$43.18 per hour; and glaziers are paid \$45.55. ²⁵	The training for each discipline will vary, but each do require some form of apprenticeship and a high school diploma or GED. Painters have the least per hour requirements as part of the apprenticeship, followed by drywall finishers and then glaziers.
Roofers	Installs new roofs on facilities and ensures that facilities are moisture resistant. Roofers may work with a variety of materials and may require coordination with other trades like sheet metal workers (see Rail Transit Section). Roofers are generally represented by the United Union of Roofers, Waterproofers and Allied Workers with various chapters around California.	The Bay Area and Los Angeles have a prevailing wage of \$40.77 while San Diego and Imperial Counties have a prevailing wage of \$36.25. ²⁶	Require a high school diploma or GED and apprenticeships run from 3 to 5 years with on the job training.

3.2.2 RAIL TRANSIT CORRIDORS OR EXTENSION PROJECTS

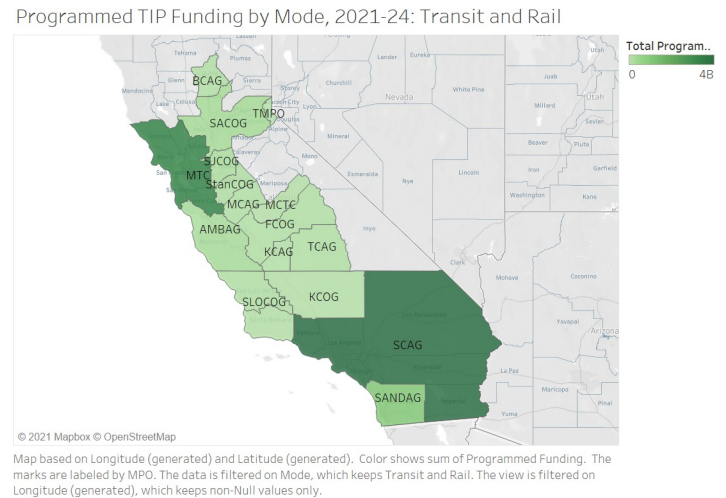
This section details the expected funding and job creation for rail transit projects including new corridors and extension projects. Rail transit is a major priority in both Northern and Southern California, with billions of dollars expected in the coming years.

The major capital funding program for transit and intercity rail is the [Transit and Intercity Rail Capital Program \(TIRCP\)](#), enabled by SB1; additionally, the [Solutions for Congested Corridors Program](#) sometimes awards funds for rail projects. Between these two programs, approximately \$500 million is available on a bi-annual basis. There is significant federal funding for transit expansion through the [Capital Investment Grants](#) Program administered by the Federal Transit

²⁵ Wages and classifications for painters, drywall finishers, and glaziers are consistent across regions, with exceptions for San Diego County.
²⁶ The title of roofer is consistent across different counties in California, but the prevailing wages differ from region to region.

Administration. TIP funding for transit and rail totaled over \$9 billion for the next four years and is concentrated in the Bay Area and Southern California, seen in Figure 4.

Figure 4: Rail and Transit Investment in California based on MPO TIP Funding



LA Metro and Bay Area Rapid Transit (BART) have several major rail transit projects planned for the coming years. LA Metro is constructing the [Purple Line](#), a \$9.5 billion subway extension that will extend nine miles and add seven new stations to the Westside of Los Angeles. Similarly, the [Transbay Core Capacity Program](#), a \$2.7 billion program managed by BART, will significantly expand the capacity of the congested Transbay Corridor.

Overall job creation for a rail transit corridor or extension project will differ based on scope, scale and location. By assuming a standard project size and type, in this case a \$1 billion rail transit corridor or extension project, a comparison can be made on job creation between various locations, seen in Table 7.

Table 7: IMPLAN Modeling of Employment for a \$1 billion Rail Transit Corridor or Extension Project

Region	County	Direct Jobs	Indirect Jobs	Induced Jobs
Los Angeles Metro	Los Angeles	10,500	1,500	3,400
	Ventura	10,500	1,400	3,200
	Orange	9,800	1,400	3,500

Bay Area	San Francisco	8,700	700	1,300
	Marin	8,700	900	1,600
	Alameda	9,500	1,200	2,400
	Contra Costa	9,300	1,100	2,300
	Santa Clara	9,000	800	1,800
Central Coast	San Mateo	8,200	800	1,300
	San Luis Obispo	9,500	1,200	3,400
	San Benito	10,100	1,000	1,300
	Monterey	10,100	1,200	2,600
	Santa Cruz	8,500	1,100	2,800
Inland Empire	Santa Barbara	10,700	1,300	2,900
	San Bernardino	11,200	1,300	2,600
	Riverside	11,300	1,500	3,100
San Diego	San Diego	11,400	1,600	3,900

Many rail projects in California will involve complex structural elements such as tunnels and bridges (discussed further in the next section). Rail projects may be more sequential than a highway or bus project, meaning that the ground upon which the rail is laid must be prepared, requiring more drainage and structural work before other construction can begin. In a rail project requiring a tunnel, specialty workers that operate equipment designed to “dig” out and secure the structural integrity of the tunnel will be needed before more traditional workers. Once the tunnel is prepared, workers with skills in operating other heavy equipment or installing concrete may be needed. Workers will also install and relocate utilities, which may allow for the same skillset as in a BRT or highway project, but when it comes to installing fiber and other signaling and communication systems to operate the rail, that is a more specialized area of expertise that might not be available

The IMPLAN data shows that rail transit projects provide the most value for money in terms of jobs supported per dollar of investment in the project.

locally. Once the project is ready to install rail, ironworkers, boilermakers, and others with expertise in heavy equipment haul, deliver and install the large steel rail beams and cross ties. The project may also require crane operators to place the heavy rail. However, at the end of a rail project, the same types of workers that install pavement and concrete, such as for parking lots, sidewalks and platforms would also be needed on the rail project. Underground facilities require significant concrete and foundational work that leads to a higher demand for excavation and heavy equipment, electrical work, and ventilation work. Many of these trades are also found in common building trades such as carpenters, ironworkers, cement masons, laborers and other heavy civil trades.

Table 8 below highlights additional trades used on rail projects not yet described in previous tables.

Table 8: Common Trades and Rates on Rail and Transit Projects

Trade	Description	Prevailing Wages	Education
Sheet Metal Workers	Fabricate and install heating, venting, and air conditioning systems. ²⁷ The Sheet Metal Workers International Association is the primary union representing these workers, with various chapters in California.	The prevailing wage for this type of work is the same in Los Angeles and the Bay Area at \$48.28 , both the classification and wage differ in other areas like San Diego and Imperial Counties .	High-school diploma or GED 4-5 year apprenticeship that includes technical instruction and on the job training.
Boilermakers	Participate in a variety of work in construction and maintenance of these types of projects, including metal fabrication and welding of the rail tracks. The International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers & Helpers represents many of these workers, with various chapters in California.	Prevailing wage is \$46.03 . ²⁸	High-school diploma or GED 4 year apprenticeship that includes technical instruction and on the job training

27 Sheet metal workers participate in several building industries but are particularly important in underground rail projects for ventilation work

28 While the work done on a rail project may be varied for a boilermaker, the classification and prevailing wage for this type of work is standard among the large counties in California.

Insulators	Applies insulation to pipes, tanks, and other surfaces requiring thermal control of temperatures. ²⁹ The International Association of Heat and Frost Insulators represents many of these workers, with two local chapters in California.	Prevailing is \$45.39 . ³⁰	High-school diploma or GED 4 year ap-prenticeship that includes technical instruction and on the job training
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Compared to highway projects, rail projects create operations and maintenance jobs in addition to the construction jobs supported. This includes conductors and dispatchers who operate the trains, and maintenance workers who service the rolling stock, track, and train control and signal systems. While the needs for O&M jobs are less than the immediate construction needs on a project, they provide a longer, more sustainable pathway for workers participating in workforce development programs (as opposed to relying on consistent construction work).

While agencies like [LA Metro](#) invest in developing an internal workforce to fill these O&M jobs, other agencies like [Metrolink](#) rely on contractors. This is important because it determines who the major stakeholders are for hiring workers to operate and maintain rail systems throughout the state.

3.3 COMPLEX PROJECTS – TUNNELS AND BRIDGES

Tunnels and bridges add a significant amount of complexity to a highway or transit project. Because they are often integrated into existing project work, it is difficult to specifically identify funding for bridge and tunnel projects as that work is usually captured in the total project cost of the associated highway or rail project.

There is specific investment in California allocated for repair and replacement of bridges and tunnels. The [Road Repair and Accountability Act](#), under SB1, includes funding specifically for bridges and tunnels. In particular, [seismic retrofitting](#) is a prominent need for bridges. Approximately half of bridges in the state have exceeded their design life and have significant maintenance and repair backlogs. Some of the largest bridges in California, along corridors such as I-5 in San Diego, Highway 101 in Los Angeles, and I-80 in Sacramento need major repair and rehabilitation. In the Bay Area, the [Horizon Crossings Plan](#) outlines the

need for a new crossing for the San Francisco Bay, whether bridge or transit tunnel, costing up to \$50 billion. Major tunneling projects also are planned, including LA Metro’s Regional Connector Project, a \$1.76 billion project currently under construction. These complex projects require specialized labor requiring certifications or extra training.

Table 9 below displays how prevailing wages or classifications for certain trades that may be used on tunnel projects differ from the same trades listed in previous tables.

Table 9: Common Trades and Rates on Tunnel and Bridge Projects

Trade	Difference
Laborers	In Los Angeles, tunnel laborers earn approximately \$6-\$8 more per hour for underground work compared to their surface counterparts.
Electricians	Electricians and cable splicers in the Bay Area working on tunneling projects make approximately \$2 more per hour than their surface counterparts.
Heavy Equipment Operators	There are separate groupings and classifications for power and heavy equipment operating engineers on tunnel and underground work, placing more of a focus on excavation and boring type equipment. ³¹

Bridges require specialized craft labor such as boat drivers and divers. Divers commonly serve as underwater welders for bridge and tunnel projects. Four different roles fit under the “diver” category including the diver, the standby diver, the [tender](#) and assistant tender. Prevailing wages for primary divers in the Bay Area are [\\$101.42](#) per hour, while per diem rates are given in Los Angeles and San Diego Counties at [\\$712.48 per day](#). Prevailing wages for tenders and standby divers are less, approximately \$58 per hour in the Bay Area and approximately \$350 per day in Southern California.

Jobs requiring more specialized expertise present unique challenges for workforce development programs. Workers with the right expertise might not be available locally, making it difficult to satisfy local-hire requirements. Travel and temporary housing for out-of-state workers increases the price of labor and adds constraints to project planning.

There are challenges with training local workers to obtain specialty certifications. Work needed to obtain the certification might not always be available at the right time and location; without consistent work locally, individuals might not find it worthwhile to obtain such certifications,

29 This is particularly relevant when considering the need to regulate temperatures within underground rail stations.

30 Consistent across California, defined as “Insulator/Asbestos Removal”

31 Experts interviewed for this research made specific reference to the unique challenges with tunneling. For example, few skilled Tunnel Boring Machine operators exist in California full-time requiring these workers to temporarily relocate near the worksite..

finding it more advantageous to remain in a lower paying classification that provides more consistent work closer to home (and thus, a higher quality of life). Table 10 provides the expected job creation for a \$1 billion bridge or tunnel project.

Table 10: IMPLAN Modeling of Employment for a \$1 billion Complex Bridge or Tunnel Project[1]

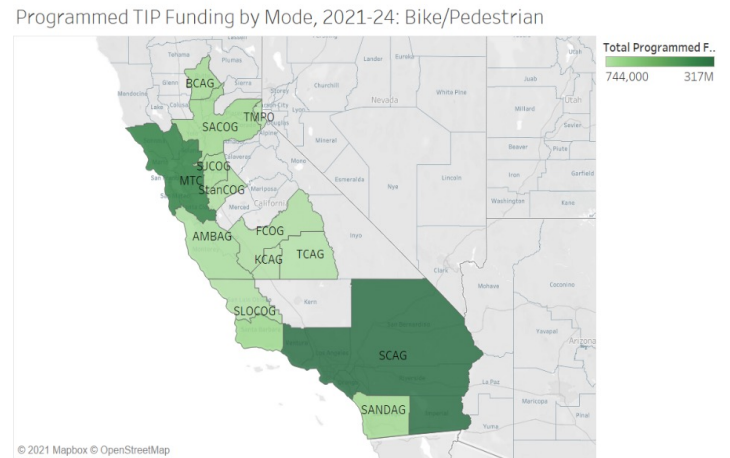
Region	County	Direct Jobs	Indirect Jobs	Induced Jobs
Los Angeles Metro	Los Angeles	4,300	2,100	1,600
	Ventura	4,400	900	1,500
	Orange	3,900	900	1,500
Bay Area	San Francisco	3,200	500	500
	Marin	3,900	700	800
	Alameda	3,600	800	1,000
	Contra Costa	3,900	800	1,100
	Santa Clara	3,500	500	800
Central Coast	San Luis Obispo	4,200	900	1,700
	San Benito	4,400	700	600
	Monterey	4,300	900	1,300
	Santa Cruz	4,200	1,000	1,500
Inland Empire	Santa Barbara	4,500	900	1,400
	San Bernardino	4,500	800	1,200
San Diego	Riverside	4,600	1,000	1,400
	San Diego	4,400	1,100	1,700

[1] The regions prioritized in this analysis were informed by the Irvine Foundation.

3.4 BIKE AND PEDESTRIAN INFRASTRUCTURE

Active transportation projects such as bike paths and greenways are also receiving infrastructure investment, as shown in the figure below. Bicycle and pedestrian projects generally require the same types of labor as local road projects. Oftentimes, these projects will be grouped so that a local road repaving project also rehabilitates or extends sidewalk and bike lane options. For example, more municipalities are pursuing [complete streets](#) projects that provide street-level improvements that encourage pedestrian access such as restaurants with patios and outdoor public gathering spaces.

Figure 5: Bike/Pedestrian Investment in California based on MPO TIP Funding



3.5 APPLICABILITY TO OTHER SECTORS

Transportation is just one piece of the significant infrastructure investment and construction job creation occurring in California. However, while construction is unique at the project level, similarities can be drawn between construction trades needed for transportation and those needed for other infrastructure sectors like energy and water utilities or building construction. Specifically, information on prevailing wages will be useful regardless of the infrastructure sector. At the state level, the Governor’s [Five-Year Infrastructure Plan](#) proposes over \$53 billion in spending on infrastructure in the state, \$8 billion of which is allocated to industries other than transportation.

Based on the Governor’s Five-Year Plan, the planned public construction projects outside of the surface transportation sector include courthouses, natural resource improvements (e.g. groundwater management and other natural resource protections), hospitals, correction facilities, and schools.

In addition to publicly funded projects, a number of private infrastructure projects are in progress or planned for the next five years. In general, investment in public infrastructure tends to lead to further private investment in infrastructure. For example, the [Transit Oriented Development Housing Program](#) in California provides subsidies and low-interest loans to incentivize housing development within a half-mile of transit stations. Outside of California, one major example of transportation spurring private development can be found in New York City with the [Hudson Yards](#) development, in which a subway extension to the west side of Manhattan was essential to bring in private developers to

create a new commercial and residential hub in New York City. In Los Angeles, several examples exist, including the [\\$300 million Ivy Station Development](#), which replaces the Culver City Light Rail Station’s park and ride lot to include a new apartment complex, hotel, and 242,000 square foot office building. [Diridon Station](#) in San Jose, while still in the planning stages, will incentivize major private investment around the station area to maximize ridership and the benefits of transit hubs for economic development.

Many of these investments revolve around building construction, making the crossover with bus or train station construction trades discussed earlier particularly relevant. Trades outlined in the transit section of this report are based on trades commonly used to construct the building and structural elements of transit (i.e. stations). Skill sets used on these projects are comparable to building construction, and the prevailing wage determinations would be similar for both given the “Building” construction type used in this report. For example, Painters, Drywall Finishers, and Glaziers are all used in the construction of bus transit and rail transit stations but will also be used extensively in the construction of buildings. The same goes for many electrician-type trades or insulators and HVAC trades.

Another area for job creation seeing significant investments is water: drinking water purification and wastewater treatment. The table below highlights some of the major investments in water infrastructure occurring across California at the municipal level.³²

Agency	Program	Amount	Timeline
Los Angeles Department of Water and Power	Capital Program	\$6.5 billion	10-year
City of San Diego	Environmental Capital Improvement Program	\$3.25 billion	5-year
City of San Jose	Water Pollution Capital Program	\$1.5 billion	5-year
Inland Empire Utilities Agency	Inland Empire Water Capital Improvement Program	\$0.5 billion	10-year
San Francisco Public Utilities Commission	Water System Improvement Program (WSIP) ³³	\$4.8 billion	2-year

Jobs already discussed in this report that may crossover with water and wastewater investment primarily revolve around plumbers and pipefitters. However, due to the

nature of many water projects, roles within a drinking water or wastewater treatment facility would also be required. Investment in water infrastructure can also require [water treatment plant operators](#) or environmental engineers to ensure that these integral systems remain in operation. Technicians and dispatchers are also needed in these facilities and may be considered the “entry-level” position that does not require more than a high school diploma and [technical training](#).

As the country and California seek to meet zero-emission goals in the next several decades, energy work and renewable energy investment has the potential to create and sustain many skilled trade jobs. Energy can include actual energy generation, whether it be renewable or non-renewable, as well as energy distribution.

Energy, specifically utility work, also has the potential to be a driver of workforce development within California, specifically when it comes to meeting the needs of vehicle electrification. Southern California Edison (SCE), the electric provider for LA County and others in Southern California, primarily uses contractors to carry out its capital program. SCE anticipates workforce needs with those contractors in the coming years, specifically for low-voltage electricians to install charging stations and complete building electrification projects. Designers and electrical engineers are also needed for this type of work. As EV charging stations become more prolific across the state, with 350,000 charging stations planned by 2040, training will need to be expanded for electricians across the state in order to meet the maintenance and operational needs of these infrastructure assets.



³² Due to the regional nature of these plans and the difference in timelines, a direct comparison of funding levels was not completed for water investment.

³³ The San Francisco portion of the program is 100% complete as of October 2020. The Regional Portion is approximately 99% complete.

4 Trends and Workforce Needs

4.1 TRENDS FOR JOBS IN EMERGING TECHNOLOGY

Infrastructure is becoming more and more technology focused, and as result, project owners and contractors are planning to fill jobs that do not exist today. Those jobs will require specific knowledge and expertise in technology, specifically networking and databases, electrical systems, cybersecurity and other smart technologies. Some examples are infrastructure for electric vehicles, intelligent transportation systems (ITS), and railroad communication systems and positive train control.

Electrical trades often have significant crossover between various infrastructure sectors. With emerging technologies related to electric vehicles and information technology systems, there is a high potential for sustainable career development in those areas.

4.1.1 ELECTRIC VEHICLES

For the transportation industry in particular, the state's zero emission mandates are leading to a proliferation of battery-electric buses. Battery-electric buses are an important technological trend to consider when discussing workforce development in California. California has a goal to be a carbon-neutral state by 2045, an aggressive target that will require transit agencies to prioritize bus fleet conversion from diesel buses to zero-emission bus (ZEB) fleets. In order to meet this goal, the state plans to invest \$3.9 billion over the next three years to expand charging infrastructure and equipment³⁴. Soon, all transit agencies in California will be required to operate a ZEB only fleet — and ultimately, transition to fully electrified transit bus fleets — to comply with the [Innovative Clean Transit](#) regulation, adopted by the California Air Resources Board in 2018. For example, [LA Metro has prioritized](#) transitioning its bus fleet to over 2,200 battery-electric buses by 2030. The massive investment in electrification will propel the industry forward and increase economic opportunity across the sector.

In addition to manufacturing jobs created from factories building electric vehicles, the infrastructure sector will see an increase in jobs, with one study noting up to [6.4 jobs per \\$1 million invested](#) depending on the method of fleet and bus depot conversion.

The impact on job creation is two-fold. First, transit agencies will invest in converting existing facilities and building new facilities to charge and maintain electric vehicles. Transit agencies also will need maintenance workers (i.e. heavy equipment technicians) to maintain electric vehicle fleets. Second, utility companies will invest in building new charging stations and connecting power to these new sites, requiring technicians to maintain this new infrastructure.

Utility work within energy-related construction has the potential to be a driver of workforce development within California. Southern California Edison (SCE) is the electric utility provider for LA County and other counties in Southern California. In addition to assisting with the installation of electric charging stations, SCE's \$375 million [Charge Ready Program](#) is expanding to make the installation of electric vehicle (EV) charging stations on private properties easier. This program, with a second iteration called Charge Ready 2, is meant to meet the growing demand for charging stations as single-use electric vehicles become more prominent.

SCE primarily relies on contractors to carry out its capital program. The agency anticipates workforce demand to fulfill electrification needs in the coming years, specifically for low-voltage electricians to install charging stations and complete building electrification projects. Designers and electrical engineers are also needed for this type of work. As EV charging stations become more prolific across the state, with 350,000 charging stations planned by 2040, training will need to be expanded for electricians across the state in order to meet the maintenance and operational needs of these infrastructure assets.

Electrical engineers and electrical engineering technicians will [oversee the design and construction](#) of the electrical equipment within the bus facility and the connections to the power grid. Engineering jobs require advanced degrees and engineering technician jobs may require associate degrees. Additional jobs will not need degrees. Power linemen, or [electrical distribution linemen](#), will install and maintain the electrical infrastructure connecting charging stations to the power grid. Electricians and [maintenance](#) personnel will maintain the infrastructure and vehicles.

³⁴ <https://cal.streetsblog.org/2021/10/01/ca-to-vastly-increase-investments-in-zero-emission-vehicles-and-infrastructure/33> The San Francisco portion of the program is 100% complete as of October 2020. The Regional Portion is approximately 99% complete.

4.1.2 INTELLIGENT TRANSPORTATION SYSTEMS

Like buildings and vehicles, roads now use “smart” technology to monitor usage and safety and are becoming mainstays in most transportation improvement programs.

Intelligent Transportation System (ITS) advances and the onset of connected and autonomous vehicles (C/AV’s) will both have similar impacts on the transportation infrastructure environment in terms of workforce development. [ITS](#) is an operational system of various technologies that, when combined and managed, improve the operating capabilities of the overall transportation system. This can include [ramp metering technology](#), [dynamic toll pricing](#), or even [dynamic messaging signs](#). Making highways and roads “smarter” can provide substantial benefits for motorists including reduced crashes, congestion mitigation, and improved travel times. As [congestion worsens](#) in California, express and toll lanes with advanced technology systems that can track road usage are expected to become more prevalent. Additionally, new methods of funding highways based on road usage, like [mileage based user fees](#), are being further evaluated through [pilot programs](#). Road user charging, while still in its early phases, may require large scale infrastructure upgrades across California, specifically related to technology and ITS deployment and installation.

4.1.3 RAILROAD SYSTEMS AND SIGNALING

Intercity and commuter rail operators in Southern California interviewed for this report noted that there are only two contractors that specialize in train communication and signal work due to the “safety-critical” nature of the work. This shortage is felt by rail operators working on simultaneous train control/communications or signal work. More generally, there has been significant investment into Positive Train Control (PTC) systems – technologies designed to address human error – since the [Rail Safety Improvement Act of 2008](#) mandate. Railroads across the nation were required implement PTC; in 2020, FRA announced that PTC technology is in operation on all 57,536 required freight and passenger railroad route miles. While the installation of these technologies is complete, the need for rail systems technicians to maintain and manage this technology is still prevalent. PTC systems can include [several components](#): back office server systems, onboard systems, signal systems, communication network components, and dispatching systems. As with any complex system of databases and networks, workers skilled in electrical systems will be needed in order to upgrade and

maintain the technological assets on America’s railroads. The background needed for this work is similar to the ITS and system technicians described in the next section. Train control systems [engineers](#) are needed to design, implement, and manage the PTC database and networks while field technicians will be needed to maintain the assets on the railroad right-of-way.

4.2 GAPS IN THE WORKFORCE

The construction industry has struggled to meet the high demand for skilled workers to complete projects within time and budget constraints. Together, contractors, construction firms, and training organizations face the challenge of increased demand driven by the need to complete infrastructure improvements in California prior to the Olympics in 2028.

The Associated General Contractors of America (AGC) produced a [report](#) on the state of the construction workforce, surveying construction firms across California. In their 2018 report, 78% of firms reported difficulty filling hourly craft positions and 68% reported difficulty hiring salaried positions. As a result of these staffing challenges, 39% of respondents reported projects taking longer than anticipated and 38% reported projects costing more than anticipated. More than half of firms initiated or increased in-house training and base pay rates fearing loss of hourly craft or salaried personnel to other employers, and nearly a third utilize overtime to address worker and skill shortages.

While demand for standard transportation infrastructure expansion and maintenance projects continues, new technologies in transportation will require training of new skills. An academic white paper published by the US Department of Transportation’s ITS Joint Program Office describes how changing workforce demographics and the rapid onset of ITS technology is creating a growing demand for degree and certificate programs in electrical-based skillsets and information technologies. The report notes that stakeholders should look to expand university engineering programs and develop certificate programs in ITS and connected vehicles in order to adequately prepare for future workforce needs. [ITS technicians](#) and other electrical fields are needed to bring these technologies to infrastructure. This skilled trade is already used consistently on projects in California, but organizations looking to invest in workforce development should consider how needs for workers skilled in non-traditional construction jobs will increase.

4.3 NEED FOR WORKFORCE TRAINING PROGRAMS

The existing relationships between construction firms and training programs suggest that there is opportunity to invest

in recruitment and training programs.

Harbor Freight Tools For Schools is a leading producer of such programs, collaborating with high schools and colleges to provide technical education and career pathways. A Harbor Freight Tools report³⁵ notes a lack of high-quality skilled trades programs. Of the 3,996 career and technical education courses offered in LA County high schools in the 2018-19 school year, only 333 fell under “Building and Construction Trades.” A total of only 4% of high school CTE course-takers were enrolled in construction and building trades.

According to the Harbor Freight Tools For Schools report, the majority of pathways to the construction industry providing credentials or union apprenticeships are offered in settings designed to teach students over 18. This, along with a lack of awareness of these programs and often a lack of accessibility, are cited as possible barriers to recruiting and training youth for construction jobs.

Included in the recommendations is the utilization of Community Colleges and technical schools to address gaps in the workforce that don’t require a university degree such as maintenance technicians and transportation communications specialists. Community colleges also provide individuals already working within the transportation industry additional training on new and emerging technologies. The ITS Professional Capacity Building (PCB) Programs began working with community colleges to develop ITS and CV instruction through a 2015 Small Business Innovation Research award, utilizing methods like web-based training and continuing education units along with standard classroom instruction to train a new class of skilled construction workers.

Stakeholders should look to these community college, technical school, and high school programs to engage young individuals entering the workforce and existing construction workers seeking to advance their skills to bridge the gap in the construction industry.

4.4 KEY TAKEAWAYS

The following takeaways attempt to identify the areas where investments in workforce development programs may be most impactful given anticipated job creation from infrastructure investments:

- Highway and road investments are expected to grow and remain the dominant mode of transportation

in California in the coming years. This will provide consistent work for heavy civil trades - operating engineers, carpenters, ironworkers, and cement masons. Workforce development programs that intend to impact the most workers overall may choose to focus on these trades because of the consistent work expected. This will differ between highway expansion and local road or preservation projects, which may require certain electrical trades to manage the installation and maintenance of traffic systems.

- Transit infrastructure investment also will provide a significant amount of jobs, especially considering federal priorities related to transit and stimulus funds on the horizon. Transit investment will increase the demand for electricians, ironworkers, boilermakers, insulators, and trades like glaziers and drywall finishers that are often used to construct key elements of transit stations. In particular, it is expected that there will be a shortage of electricians, and therefore, a workforce development program that intends to fill gaps in the workforce may choose to focus on the electrical trades. Additionally, transit projects have a greater potential than highway projects to create long term operation and maintenance jobs, potentially leading to sustainable career pathways for certain trades like transit operators and mechanics.
- If the priority is to fill expected gaps, a workforce development program may focus on the electrical trades and emerging technology training in networking, databases, cybersecurity, and communication systems. Electrical trades often have significant crossover between various infrastructure sectors, and with emerging technologies related to electric vehicles and information technology systems, there is a high potential for sustainable career development in those trades. Further research may help identify which specific skills or trades are most transferable to different types of projects and whether investments in training programs for those trades offer more sustained workforce development benefits.
- When considering investments into workforce development training programs throughout the state, special consideration should be given to whether certain highly skilled, specialized jobs are available to sustain a career. While certain highly skilled construction jobs provide the highest pay when taken at face value, there is considerable variation in prevailing wages and availability of consistent work

35 “The High School Skilled Trades Education Landscape & Career Pathways in Los Angeles County” Davey & Kramer, 2021.

between trades and regions. The desire to train job seekers for highly skilled and high-paying jobs must be balanced with the availability of the work for their specialization. For example, while underwater welders have some of the highest hourly rates in the state for bridge construction projects, there may not be enough consistent work to produce that wage over the long run, as bridge construction projects that require underwater welders may occur infrequently and in fewer locations throughout California over the span of the welder's career.

- As the IMPLAN data shows, rail transit projects provide the most value for money in terms of jobs supported per dollar of investment in the project. Transit projects also create jobs to operate and maintain assets. More research may help identify the best workforce development programs that are able to train workers for both project and operational jobs.
- Geographically, the IMPLAN results show that projects of the same magnitude can have different impacts on

employment in each county and region. San Diego and the Inland Empire would see the most direct job creation per dollar spent on highway maintenance and preservation projects as well as rail transit corridor or extension projects. Overall, construction projects in all transportation types evaluated in this report would produce the greatest impact per dollar in Riverside County and San Diego, while most counties in the Bay Area, and thus the region as a whole, would see the lowest impact per dollar on similar projects. These impacts are important when considering where to optimally invest in construction workforce development.

- The Los Angeles metro region and Bay Area can expect the most transportation funding in the coming years. Investments in workforce development in those areas have the highest potential for impact, despite not having the highest direct employment outputs per dollar spent. However, two other regions warrant attention as well. The San Diego and Sacramento metropolitan regions can also expect significant transportation investment in the coming years.

5 Appendix

The following tables show the common trades and wages associated with each type of project included in the report. Additionally, a list of projects referenced in the report are included after the tables.

TABLE 3: COMMON TRADES AND RATES ON HIGHWAY EXPANSION PROJECTS

TRADE	DESCRIPTION	PREVAILING WAGES	EDUCATION
Carpenters	Build and assemble forms for concrete structures such as bridges, retaining walls, tunnels, and drainage structures. Carpenters in the state of California are generally represented by chapters of the United Brotherhood of Carpenters .	<ul style="list-style-type: none"> • Bay Area - \$52.75 • Southern California - \$42.75³⁶ 	<ul style="list-style-type: none"> • High School Diploma or GED equivalent, or Verified 6 months full time work experience in a construction related trade • Apprenticeship requires four-years, 4800 work hours, and 612 hours of instructional classes.
Plumbers/ Pipelayers	Modify storm drains, sanitation sewers, drains, and water mains underneath or around the roadway. Sewer and storm drain plumbing work is defined fairly consistently across regions in California. ³⁷ The United Association of Plumbers, Fitters, and Welders , with various chapters in California.	<ul style="list-style-type: none"> • Bay Area - \$67.75 • Southern California - \$39.39³⁸ 	<ul style="list-style-type: none"> • High School Diploma or GED Equivalent • Apprenticeship program of three to five years
Heavy Equipment Operators	Drive and control construction equipment including bulldozers, excavators, cranes, forklifts, road graders, loaders, and rollers. ³⁹ Heavy equipment operators and power equipment operators, if part of a union, are generally represented by the International Union of Operating Engineers with local chapters throughout California.	Varies between \$42 and \$52 per hour.	<ul style="list-style-type: none"> • High School Diploma or GED • Three to four years of apprenticeship • Depending on the municipality, licenses may need to be acquired by workers in order to operate equipment

36 Prevailing wages for this trade differ based on the type of work being completed on a project site. The two wages listed here are based on the “Millwright” classification, allowing for a comparison between regions.

37 The Bay Area uses a slightly broader definition for a “Pipe Tradesman”; these workers support drainage improvements on highway expansion projects.

38 Alameda County prevailing wage

39 The definitions of this type of work vary considerably based on the project type and location. For example, power equipment operators in the Bay Area are separated into nearly 10 groups based on the type of work being completed. Piledrivers alone have six groups defining the type of work with different prevailing wages for each group.

TRADE	DESCRIPTION	PREVAILING WAGES	EDUCATION
Ironworkers	Use reinforcing steel to strengthen the concrete that forms highways. Demand for this type of work depends significantly on the scope of the project. ⁴⁰ The International Association of Bridge, Structural, Ornamental and Reinforcing Ironworkers is the primary union that represents these workers, with various chapters throughout California.	Approximately \$41 per hour and does not vary significantly based on region.	<ul style="list-style-type: none"> • High School Diploma or GED • Three to four years of apprenticeship
Laborers	Perform many tasks that require manual, physical labor on construction sites including preparing and cleaning up construction sites or assisting skilled trades with various tasks on the construction site. ⁴¹ Laborers are represented by Laborers International Union of North America , with various chapters throughout California.	Construction craft laborers are generally earning \$30 an hour in the Bay Area . Laborers in Los Angeles County may earn up to \$40 an hour . ⁴²	<ul style="list-style-type: none"> • No prior education • On-the-job training⁴³
Cement Mason	Pour, smooth, and finish concrete roads and curbs and are needed whenever concrete is used on a project. Cement masons are generally represented by the Operative Plasterers and Cement Masons International Association and there are various chapters throughout California.	<ul style="list-style-type: none"> • Bay Area - \$33.49 • Los Angeles County-\$38.50⁴⁴ 	<ul style="list-style-type: none"> • High School Diploma or GED • Three-year apprenticeship programs that include on the job training.
Truck Drivers/ Teamsters	Transport and haul material equipment, and personnel to the construction site. ⁴⁵ The International Brotherhood of Teamsters represents a majority of truck drivers around the country, with various chapters throughout California.	Ranges between \$30-\$35 an hour ⁴⁶	<ul style="list-style-type: none"> • Drivers license and several state certifications

40 Ironworkers that have certifications in welding, rigging, and crane signaling are often considered more desirable by employers. This is because certifications in ironworking specialties allow a worker to complete more specialized tasks, saving a contractor the need to hire multiple ironworkers and improving productivity.

41 There are several groupings of laborers on project sites that differ in terms of type of work, required training or experience, and prevailing wage. The differentiation in this type of work is very detailed. For example, laborers working with asphalt fit into different groupings; in Los Angeles County, an “asphalt shoveler” is grouped differently than an “asphalt raker.”

42 Laborers are by far the most diverse in terms of Davis-Bacon definitions making it more difficult to draw comparisons across project types. Significant variation occurs depending on the type of work being completed

43 Due to the extreme variety in types of “laborer” across California, the education requirement may change depending on the type of work being completed.

44 The definition for this type of work is fairly consistent across regions in California.

45 The definition for this type of work varies significantly, not only in the type of work completed on projects, but also between regions and counties. For example, Los Angeles County has 12 groupings for truck drivers on highway projects, whereas the Bay Area has five groupings. The majority of these groupings are dictated by the type of truck being driven.

46 For a highway expansion project, a cement mason distribution truck may be used frequently; in Los Angeles County, the prevailing wage for this type of truck driving work is \$32.87 an hour.

TABLE 5: COMMON TRADES AND RATES ON HIGHWAY AND LOCAL PRESERVATION PROJECTS

TRADE	DESCRIPTION	PREVAILING WAGES	EDUCATION
Electrician/ Lineman	Responsible for the installation, maintenance, and repair of Intelligent Transportation System (ITS) on the roadway like traffic signal electronics. ⁴⁷ Work can also include relocation of critical power utilities to make way for road construction. Journeyman Electricians are supported by technicians. Electricians that are union members are represented by the International Brotherhood of Electrical Workers with various local chapters throughout California.	Los Angeles County -journeyman electricians can expect to earn approximately \$51 per hour while technicians earn approximately \$38 per hour. In the Bay Area , there are significant variations in the prevailing wages for this type of work among counties in the Bay Area. ⁴⁸	<ul style="list-style-type: none"> • High School Diploma or GED • Four-year apprenticeship program with on-the-job training

TABLE 6: COMMON TRADES AND RATES ON HIGHWAY AND BUS TRANSIT PROJECTS

TRADE	DESCRIPTION	PREVAILING WAGES	EDUCATION
Painters, Drywall Finishers, and Glaziers	Construct and finish bus shelters, accomplishing a variety of tasks including painting, installing drywall and glass panes or other pieces of the bus shelter. These trades are often represented by the International Union of Painters and Allied Crafts with various chapters around California.	Painters are paid \$33.12 per hour; drywall finishers are paid \$43.18 per hour; and glaziers are paid \$45.55. ⁴⁹	The training for each discipline will vary, but each do require some form of apprenticeship and a high school diploma or GED. Painters have the least per hour requirements as part of the apprenticeship, followed by drywall finishers and then glaziers.
Roofers	Installs new roofs on facilities and ensures that facilities are moisture resistant. Roofers may work with a variety of materials and may require coordination with other trades like sheet metal workers (see Rail Transit Section). Roofers are generally represented by the United Union of Roofers, Waterproofers and Allied Workers with various chapters around California.	The Bay Area and Los Angeles have a prevailing wage of \$40.77 while San Diego and Imperial Counties have a prevailing wage of \$36.25 . ⁵⁰	Require a high school diploma or GED and apprenticeships run from 3 to 5 years with on the job training.

47 Electric work is often differentiated between “inside electrical” or “outside line” work. For the purposes of this type of project, most electricians would be used for inside electrical work on ITS, traffic signals, CCTV, and underground cable systems. Oftentimes local road projects include utility relocation needs, requiring outside lineman to ensure no power interruptions occur as a result of the project.

48 Counties tend to provide additional wage requirements for cable splicing work.

49 Wages and classifications for painters, drywall finishers, and glaziers are consistent across regions, with exceptions for San Diego County.

50 The title of roofer is consistent across different counties in California, but the prevailing wages differ from region to region.

TABLE 8: COMMON TRADES AND RATES ON RAIL AND TRANSIT PROJECTS

TRADE	DESCRIPTION	PREVAILING WAGES	EDUCATION
Sheet Metal Workers	Fabricate and install heating, venting, and air conditioning systems. ⁵¹ The Sheet Metal Workers International Association is the primary union representing these workers, with various chapters in California.	The prevailing wage for this type of work is the same in Los Angeles and the Bay Area at \$48.28 , both the classification and wage differ in other areas like San Diego and Imperial Counties .	<ul style="list-style-type: none"> • High-school diploma or GED • 4-5 year apprenticeship that includes technical instruction and on the job training.
Boilermakers	Participate in a variety of work in construction and maintenance of these types of projects, including metal fabrication and welding of the rail tracks. The International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers & Helpers represents many of these workers, with various chapters in California.	Prevailing wage is \$46.03 ⁵² .	<ul style="list-style-type: none"> • High-school diploma or GED • 4 year apprenticeship that includes technical instruction and on the job training
Insulators	Applies insulation to pipes, tanks, and other surfaces requiring thermal control of temperatures. ⁵³ The International Association of Heat and Frost Insulators represents many of these workers, with two local chapters in California.	Prevailing is \$45.39 ⁵⁴ .	<ul style="list-style-type: none"> • High-school diploma or GED • 4 year apprenticeship that includes technical instruction and on the job training

TABLE 9: COMMON TRADES AND RATES ON TUNNEL AND BRIDGE PROJECTS

TRADE	DESCRIPTION
Laborers	In Los Angeles, tunnel laborers earn approximately \$6-\$8 more per hour for underground work compared to their surface counterparts.
Electricians	In Los Angeles, tunnel laborers earn approximately \$6-\$8 more per hour for underground work compared to their surface counterparts.
Heavy Equipment Operators	There are separate groupings and classifications for power and heavy equipment operating engineers on tunnel and underground work, placing more of a focus on excavation and boring type equipment. ⁵⁵

51 Sheet metal workers participate in several building industries but are particularly important in underground rail projects for ventilation work
 52 While the work done on a rail project may be varied for a boilermaker, the classification and prevailing wage for this type of work is standard among the large counties in California.
 53 This is particularly relevant when considering the need to regulate temperatures within underground rail stations.
 54 Consistent across California, defined as “Insulator/Asbestos Removal”
 55 Experts interviewed for this research made specific reference to the unique challenges with tunneling. For example, few skilled Tunnel Boring Machine operators exist in California full-time requiring these workers to temporarily relocate near the worksite.

The following sections provide the specific project examples referenced throughout the report.

HIGHWAYS AND ROADS

I-5 North Improvement project (\$1.3 billion): LA Metro freeway widening project projected to result in over 5,500 direct jobs in LA County

TRANSIT

BART Transbay Core Capacity program (\$2.7 billion): Upcoming transit expansion project in the Bay Area that will allow BART to operate up to 30 ten-car trains per hour

Sepulveda Pass Transit Corridor (\$5.7 billion): Metro expansion project in Los Angeles to improve transit options between the San Fernando Valley and the Westside

Purple Line (\$9.5 billion): subway extension that will extend nine miles and add seven new stations to the Westside of Los Angeles

TUNNELS AND BRIDGES

Link 21 Project: Link21 is a new transbay passenger rail crossing between Oakland and San Francisco.

Regional Connector Project (\$1.76 billion): LA Metro's project currently under construction to provide riders a seamless journey from Azusa to Long Beach, and from East Los Angeles to Santa Monica, through the downtown LA core

BIKE AND PEDESTRIAN INFRASTRUCTURE

Ivy Station Development (\$300 million): LA Metro project that replaces the Culver City Light Rail Station's park and ride lot to include a new apartment complex, hotel, and 242,000 square foot office building

Diridon Station: San Jose project in the planning stages that will incentivize major private investment around the station area to maximize ridership and the benefits of transit hubs for economic development