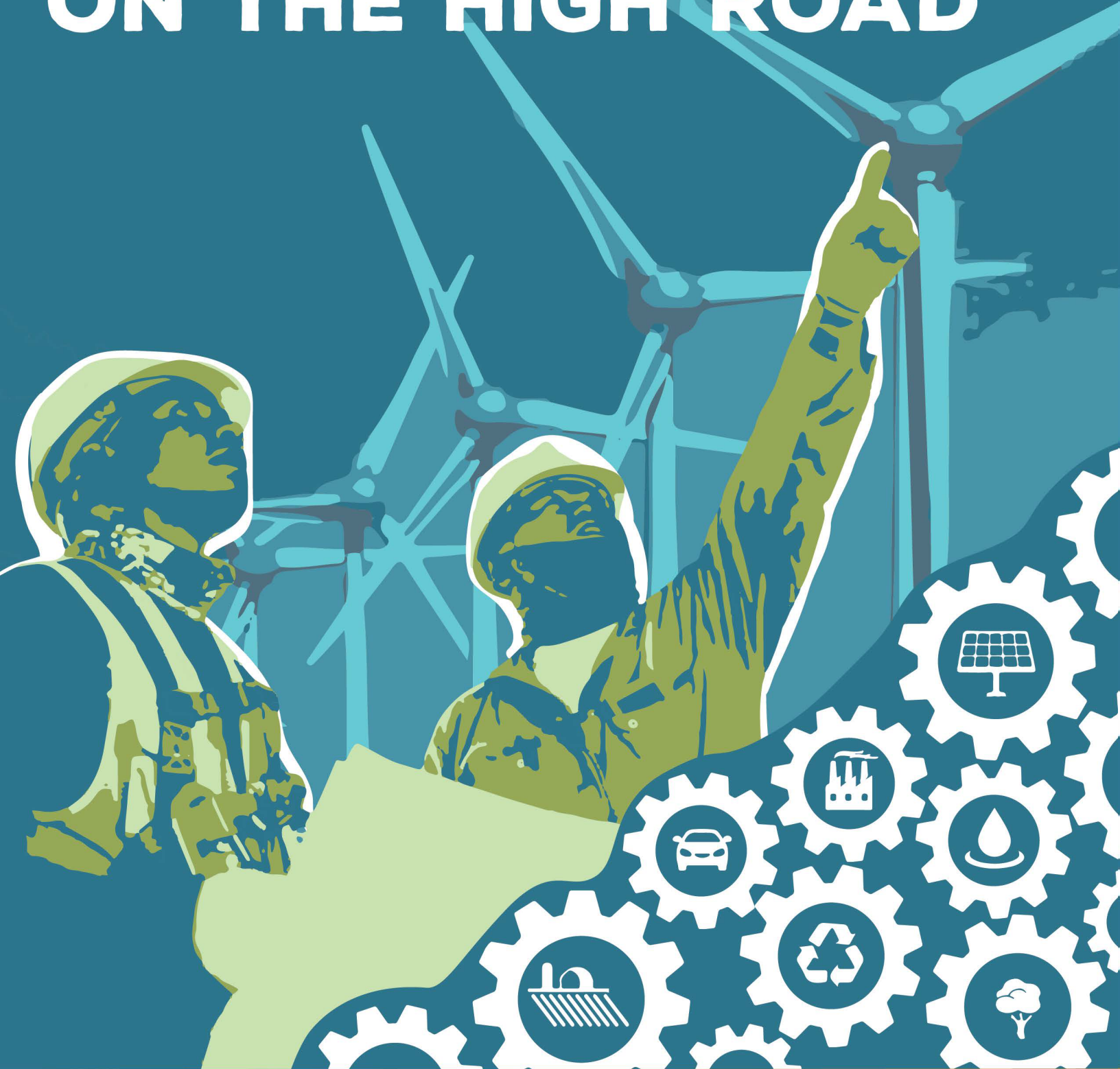


PUTTING CALIFORNIA ON THE HIGH ROAD



A JOBS AND CLIMATE ACTION PLAN FOR 2030

JUNE 2020



The California Workforce Development Board (CWDB) is pleased to submit this report, “Putting California on the High Road: A Jobs and Climate Action Plan for 2030,” to the Legislature pursuant to Assembly Bill 398 (E. Garcia, Chapter 135, Statutes of 2017).

Prepared by the UC Berkeley Center for Labor Research and Education, the report offers the State of California a vision for integrating economic and workforce development into major climate policies and programs in order to help achieve California’s major climate goals: achieving 2030 greenhouse gas emission reduction targets and transitioning to a carbon neutral economy by 2045. With chapters corresponding to each of the six sectors of the 2017 Climate Scoping Plan, the report responds to the direction in AB 398, focusing on job quality and social equity concerns in assessing the impacts of climate measures on employment and training. It also emphasizes strategies to ensure disadvantaged communities and workers are involved in creating, and benefitting from, the economic gains generated by the work required to stabilize the climate.

In mandating this report, the Legislature understood that the state’s massive climate investments represent a significant opportunity for inclusive economic growth – and also that, without a thoughtful approach, this transition could become a missed opportunity, leaving many communities and workers behind. This report create a framework for maximizing the positive labor market outcomes of our climate investments: to simultaneously advance equity and mobility for Californians, while delivering skills and competitiveness for California employers.

In our view, there are three key messages policymakers and other readers should take from this report:

- First, labor should be considered an investment rather than a cost – and investments in growing, diversifying, and upskilling California’s workforce can positively affect returns on climate mitigation efforts. In other words, well trained workers are key to delivering emissions reductions and moving California closer to its climate targets.
- Second, California can achieve greater social equity in labor market outcomes for disadvantaged workers and communities when policymakers pay attention to job quality. Identifying high-quality careers (i.e., ones that offer family-supporting wages, employer-provided benefits, worker voice, and opportunities for advancement)



first, and then building pathways up and into such careers, is critical to ensuring that investments in workforce education and training meaningfully improve workers' economic mobility.

- Lastly, deliberate policy interventions are necessary in order to advance job quality and social equity as California transitions to a carbon neutral economy, just as such efforts are required to reduce pollution, protect human and environmental health, and to safeguard communities from an already-changing climate.

This report provides insights into these climate and workforce issues and makes recommendations for simultaneously promoting equity and mobility for workers, skills and competitiveness for employers and industry, and long-term environmental sustainability and climate resilience for the state – i.e., a roadmap for putting California's workforce development and climate action plans on the high road.

In approaching the report, it is important to clarify that though commissioned and reviewed carefully by CWDB, this report is ultimately the work of the UC Berkeley Labor Center. It is also a point-in-time document that was undertaken primarily in 2018 based on the available literature and information when it was written.

In addition to the report authors, CWDB would like to thank the many organizations and individuals that participated in meetings held in the summer of 2018 that helped inform the recommendations in the report. We also owe a debt of gratitude to the many organizations that have pioneered and demonstrated the viability of high-road workforce development in climate-related industries. This report would not be possible without their tireless efforts and the sharing of lessons learned.



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PUTTING CALIFORNIA ON THE HIGH ROAD: A JOBS AND CLIMATE ACTION PLAN FOR 2030

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ABBREVIATIONS

| | |
|------------|---|
| AC Transit | Alameda-Contra Costa Transit District |
| AGWET | Agriculture, Water and Environmental Technologies |
| AHSC | Affordable Housing and Sustainable Communities Program |
| ARFVTP | Alternative and Renewable Fuel and Vehicle Technology Program |
| ARRA | American Recovery and Reinvestment Act |
| APP | Apprenticeship Preparation Program |
| AQIP | Air Quality Improvement Programs |
| ATL | Advanced Transportation and Logistics |
| ATP | Active Transportation Program |
| ATU | Amalgamated Transit Union |
| ATRE | Advanced Transportation and Renewable Energy |
| BARCT | Best available retrofit control technology |
| BART | Bay Area Rapid Transit |
| BLM | Bureau of Land Management |
| BLS | Bureau of Labor Statistics |
| BRAC | Base Realignment and Closure |
| BSC | California Building Standards Commission |
| BYD | Build Your Dreams (zero-emission vehicle manufacturer) |
| CARB | California Air Resources Board |
| CARBOB | California Reformulated Gasoline Blendstocks for Oxygenate Blending |
| CALCTP | California Advanced Lighting Controls Training Program |
| CalFire | California Department of Forestry and Fire Protection |
| Cal-OSHA | California Occupational Safety and Health Administration |
| CAISO | California Independent System Operator |
| CalEPA | California Environmental Protection Agency |
| CALGreen | California Green Building Standards |
| Cal-JAC | California Firefighter Joint Apprenticeship Committee |
| CalRecycle | California Department of Resources Recycling and Recovery |
| CalSTA | California State Transportation Agency |
| Caltrans | California Department of Transportation |



ABBREVIATIONS

| | |
|-------------------|---|
| CAP | Climate Action Plan |
| CARE | California Alternate Rates for Energy Program |
| CBA | Community Benefits Agreement |
| CBO | Community-based organization |
| CCA | Community Choice Aggregation |
| CCC | California Conservation Corps |
| CCEJA | California Clean Energy Jobs Act |
| CCI | California Climate Investments |
| CCP | Construction Careers Policy |
| CCS | Carbon capture and sequestration |
| CDFA | California Department of Food and Agriculture |
| CDPH | California Department of Public Health |
| CEC | California Energy Commission |
| CEQA | California Environmental Quality Act |
| CETI | Clean Energy and Transportation Initiative |
| CFT | Clean Fuels and Technology |
| CHP | Combined Heat & Power |
| CNG | Compressed Natural Gas |
| CNRA | California Natural Resources Agency |
| CO ₂ | Carbon dioxide |
| CO ₂ e | Carbon dioxide equivalent |
| COE | Center of Excellence for Labor Market Research |
| CPA | California Partnership Academies |
| CPF | California Professional Firefighters |
| CPUC | California Public Utilities Commission |
| CSD | California Department of Community Services and Development |
| CSI | California Solar Initiative |
| CSU | California State University |
| CTE | Career Technical Education |
| CVRP | Clean Vehicle Rebate Project |
| CWA | Community Workforce Agreements |
| CWDB | California Workforce Development Board |
| DAS | California Division of Apprenticeship Standards |



ABBREVIATIONS

| | |
|----------|---|
| DDRDP | Dairy Digester Research and Development Program |
| DER | Designated Engineering Representatives |
| DGE | Diesel gallon equivalent |
| DGS | California Department of General Services |
| DIR | California Department of Industrial Relations |
| DOL | U.S. Department of Labor |
| DWR | California Department of Water Resources |
| E3 | Energy and Environmental Economics |
| EA | Environmental analysis |
| EAR | Electronic Annual Report |
| EBEE | Existing Buildings Energy Efficiency |
| EDD | California Economic Development Department |
| EE | Energy efficiency |
| EEI | Education and Environment Initiative |
| EIR | Environmental impact report |
| EJAC | Environmental Justice Advisory Committee |
| EMDI | Equity Metrics Data Initiative |
| EMI | Energy Market Innovations Inc. |
| EPIC | Electric Program Investment Charge Program |
| EPRI | Electric Power Research Institute |
| EPA | U.S. Environmental Protection Agency |
| EPR | Extended producer responsibility |
| ESA | Energy Savings Assistance |
| ESAM-TAC | Energy Storage and Micro-grid Training and Certification |
| ESCO | Energy services company |
| ETC | Energy Training Centers |
| ETP | California Employment Training Panel |
| EVITP | Electric Vehicle Infrastructure Training Program |
| EVSE | Electrical vehicle supply equipment |
| EVSP | Electric Vehicle Service Provider |
| F-gases | Fluorinated gases |
| FARMER | Funding Agricultural Replacement Measures for Emission Reductions Program |



ABBREVIATIONS

| | |
|--------|--|
| FCEV | Fuel-cell electric vehicle |
| FCP | California Forest Carbon Plan |
| FERA | Family Electric Rate Assistance |
| FPIP | Food Production Investment Program |
| FTE | Full-time equivalent |
| FY | Fiscal Year |
| GAO | U.S. Government Accountability Office |
| GCF | Governors' Climate and Forests Task Force |
| GGRF | Greenhouse Gas Reduction Fund |
| GHG | Greenhouse gas |
| GI | Green infrastructure |
| GO-Biz | Governor's Office of Business and Economic Development |
| GSA | Groundwater sustainability agencies |
| GSP | Groundwater sustainability plans |
| GWP | Global warming potential |
| HCD | California Department of Housing and Community Development |
| HFC | Hydrofluorocarbon |
| HRCC | High Road Construction Careers initiative |
| HRTTP | High Road Training Partnership initiative |
| HVAC | Heating, ventilation and air conditioning |
| HVIP | Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project |
| IBEW | International Brotherhood of Electrical Workers |
| IBMA | International Building Management Association |
| ICAP | International Carbon Action Partnership |
| IEPR | Integrated Energy Policy Report |
| IOU | Investor-owned utility |
| IPCC | United Nations Intergovernmental Panel on Climate Change |
| IRP | Integrated resource plan |
| IWMA | Integrated Waste Management Act |
| JAC | Joint Apprenticeship Committee |
| JMA | Jobs to Move America |
| JVS | Jewish Vocational Service |
| KSA | Knowledge, skills and abilities |



ABBREVIATIONS

| | |
|---------------------|---|
| LADWP | Los Angeles Department of Water and Power |
| LCFS | Low Carbon Fuel Standard |
| LCTOP | Low Carbon Transit Operations Program |
| LCTP | Low Carbon Transportation Program |
| LDV | Light-duty vehicle |
| LEV | Low-Emission Vehicle |
| LIWP | Low-Income Weatherization Program |
| LNG | Liquefied Natural Gas |
| LOS | Level of service |
| MASH | Multi-family Affordable Solar Housing Program |
| MC3 | Multi-Craft Core Curriculum |
| MGS | Mohave Generating Station |
| MMTCO _{2e} | Million metric tons of carbon dioxide equivalent |
| MOU | Memorandum of understanding |
| MRF | Material Recovery Facility |
| MRR | Regulation for Mandatory Reporting of GHG Emissions |
| MTCO ₂ | Metric tons of carbon dioxide |
| MUSH | Municipal, university, schools and hospital |
| MW | Megawatt |
| MWELO | Model Water-Efficiency Landscaping Ordinance |
| N ₂ O | Nitrous oxide |
| NABTU | North America's Building Trades Unions |
| NAICS | North American Industry Classification System |
| NCSU | North Carolina State University |
| NECA | National Electrical Contractors Association |
| NEM | Net-Energy Metering |
| NF ₃ | Nitrogen trifluoride |
| NHTSA | National Highway Traffic Safety Administration |
| NOX | Nitrogen oxide |
| NWL | Natural and working lands |
| NZE | Near-zero emission |
| OES | Occupational Employment Statistics |
| OEHHA | California Office of Environmental Health Hazard Assessment |



ABBREVIATIONS

| | |
|-----------------|--|
| OPR | Governor’s Office of Planning and Research |
| PE | Professional Engineers |
| PEV | Plug-in electric vehicle |
| PFC | Perfluorocarbon |
| PG&E | Pacific Gas and Electric Company |
| PHEV | Plug-in hybrid electric vehicle |
| PLA | Project labor agreement |
| PM | Particulate matter |
| PM2.5 | Fine particulate matter |
| POWER | Partnerships for Opportunity and Workforce and Economic Revitalization |
| PV | Photovoltaic |
| RA | Registered Architects |
| R&D | Research and Development |
| RFP | Request for proposals |
| RPS | Renewables Portfolio Standard |
| RTP | Regional transportation plan |
| SCE | Southern California Edison |
| SCS | Sustainable Communities Strategies |
| SFMTA | San Francisco Metropolitan Transportation Agency |
| SFPUC | San Francisco Public Utilities Commission |
| SGC | Strategic Growth Council |
| SGIP | Self-Generation Incentive Program |
| SLCP | Short-lived climate pollutant |
| SMART | Sheet Metal, Air, Rail and Transportation Workers Union |
| SMUD | Sacramento Municipal Utility District |
| SO ₂ | Sulfur dioxide |
| SOC | Standard Occupational Classification |
| STEM | Science, Technology, Engineering and Math |
| SWEEP | State Water Efficiency and Enhancement Program |
| SWRCB | State Water Resources Control Board |
| SWP | State Water Project |
| TAA | Trade Adjustment Assistance |
| TAP | Technical Assistance Program |



ABBREVIATIONS

| | |
|--------|---|
| TCC | Transformative Climate Communities Program |
| TCU | Transportation, Communications and Utilities |
| TIRCP | Transit and Intercity Rail Capital Program |
| TNC | Transportation Network Company |
| TOC | Transit-Oriented Communities |
| TPP | Transit Priority Project |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UPCT | Utility Pre-Craft Trainee Program |
| USDA | U.S. Department of Agriculture |
| VMT | Vehicle miles traveled |
| VTA | Santa Clara Valley Transportation Authority |
| WAV | Water Audit Validator |
| WBMLA | Women Build Metro LA |
| WE&T | Workforce Education & Training |
| WINTER | Women in Non-Traditional Employment Roles |
| WIOA | Workforce Innovation and Opportunity Act |
| WWTP | Waste water treatment plant |
| ZEV | Zero-Emission Vehicle |



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

edited by Carol Zabin • June 2020

Executive Summary

by Carol Zabin

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I. Introduction

Over the last 15 years, California has emerged as a national and world leader in the fight to avoid climate disaster, passing a comprehensive and evolving suite of climate measures to accelerate the transition to a carbon-neutral economy. The state has also emerged as a national leader in embracing economic equity as a goal for state policy, charting a path towards a new social compact for shared prosperity in a rapidly changing world.¹ Meaningful commitment to both of these goals—ensuring that all Californians thrive in the transition to a carbon-neutral economy—requires the development and implementation of a bold agenda that aligns California’s ambitious climate and workforce action plans. This report presents a framework for California to advance that agenda.

Assembly Bill 398 (E. Garcia, Chapter 135, Statutes of 2017) required that the California Workforce Development Board (CWDB) present a report to the Legislature on strategies “to help industry, workers, and communities transition to economic and labor-market changes related to statewide greenhouse gas emissions reduction goals.”² To fulfill this mandate, the CWDB commissioned the Center for Labor Research and Education at the University of California, Berkeley, to review the existing research in the field and prepare this report. The summary presented here describes the key concepts, findings, and recommendations contained in UC Berkeley’s full work.

The statutory language of AB 398 makes clear that this report should address workforce interventions to ensure that the transition to a carbon-neutral economy:

- **Creates high-quality jobs;**
- **Prepares workers with the skills needed to adapt to and master new, zero- and low-emission technologies;**
- **Broadens career opportunities for workers from disadvantaged communities; and**
- **Supports workers whose jobs may be at risk.**³

This report presents a comprehensive strategy that identifies roles for state and local climate, economic development, and workforce development agencies in achieving these goals, alongside key partners such as business, labor, community, and education and training institutions. All recommendations align with the CWDB’s Unified Strategic Workforce Development Plan, which has put forth a set of actions to leverage and coordinate the state’s myriad workforce and education programs to support high-quality careers for Californians.⁴ In keeping with the statutory directive, the report discussion is further enriched by comments provided to the CWDB through a series of stakeholder meetings held in July and August 2018.⁵



This report builds upon the framework established in California’s 2017 Climate Change Scoping Plan (Scoping Plan),⁶ which presents a roadmap of policies and programs to reach the climate protection target in Senate Bill 32 (Pavley, Chapter 42, Statutes of 2016) of a 40 percent reduction in greenhouse gas emissions by 2030 from 1990 levels. The Scoping Plan is organized into sectors based on the state’s major sources of greenhouse gas emissions and corresponding climate action measures: Transportation, Industry, Energy, Natural and Working Lands (including Agricultural Lands), Waste, and Water.⁷

This report organizes the available information from existing academic research, economic models, and industry studies for the Scoping Plan sectors and presents for each of them:

- Information about current labor conditions and the impact on jobs of the major climate measures;
- Guidance for policymakers, agencies, and institutions that implement climate and/or workforce policy on how to best generate family-supporting jobs, broaden career opportunities for disadvantaged workers, deliver the skilled workforce that employers need to achieve California’s climate targets, and protect workers in declining industries; and
- Examples of concrete, scalable strategies that have connected effective climate action with workforce interventions to produce good outcomes for workers.

II. The High-Road Framework

California has demonstrated that it is viable to reduce greenhouse gas emissions and have economic growth concurrently.⁸ The California Air Resources Board (CARB) used economic modeling to estimate that in 2030 there will be at most a 0.3 percent difference in job growth when comparing scenarios with or without climate policy—essentially, no net job loss.⁹ This cost is minuscule compared to recent projections of the cost of not mitigating climate change, reported in the federal government’s Fourth National Climate Assessment, which predicts severe disruptions to the economy if climate action is not taken.¹⁰

However, maximizing **shared** prosperity for California’s working families from these transformations requires specific and intentional labor policy.¹¹ Workers will experience changes unequally; some good jobs will disappear, and, without policy intervention, they could be replaced by low-wage jobs.¹² This outcome has implications not only for the broader economy, but also for the climate policies themselves. Research shows a strong relationship between the quality of work done on renewable energy system installation,



for instance, and the ability of those systems to perform at a level where they actually reduce greenhouse gas emissions.¹³ In energy efficiency projects, this relationship is especially clear, as the energy savings from efficiency projects come largely from the operation of those systems, not simply from their installation. As a result, skilled, trained workers involved in system installation, maintenance, and operations are a key part of the state’s overall greenhouse gas emission reduction strategy.¹⁴

In addition, absent deliberate efforts to incorporate workforce goals, the economic changes produced by climate policy may simply replicate—or even exacerbate—deep-seated economy-wide trends of persistent wage inequality and disparities by race and gender.¹⁵ This report starts with the premise that California climate policy can and should generate safe, family-supporting career-track jobs; broaden job opportunities for workers from disadvantaged communities; and contain supports for workers and communities in carbon-intensive industries at risk of decline due to climate policy. This premise is consistent with the Scoping Plan, which notes that “the implementation of California’s climate change goals provides great opportunity to not only improve the habitability of the planet, but also to increase economic vitality [and] employ historically disadvantaged people in secure jobs.”¹⁶

As the report shows, there already exist feasible, road-tested workforce and economic development mechanisms that are complementary to climate policy, and that can be utilized to improve outcomes for workers. Successful examples from the workforce policy arena make clear that achieving strong workforce goals requires going beyond job numbers, and to focus as well on job quality and job access.

Job Quality

While the specifics will vary by sector and occupation, there is general agreement that a good, family-supporting job pays a living wage; offers a stable schedule; provides benefits such as health care, retirement, paid sick days, and paid family leave; offers wage increases as skills are acquired; provides safe and healthy working conditions; and complies with all workplace laws (e.g., wage and hour, employee classification, health and safety, anti-discrimination, workers’ compensation, and right to organize laws).¹⁷

Job Access

Historical patterns of discrimination and institutional racism have led to concentrations of people of color and women in low-wage and often unhealthy or dangerous jobs.¹⁸ Job access and inclusion entails ensuring that the job opportunities generated from the growth of the carbon-neutral economy are accessible to workers who reflect the diversity of the state’s population. Efforts to broaden inclusion must always be coupled with attention to job quality, and vice versa, or they will simply maintain the status quo, with



workers of color concentrated in the bottom of the labor market. California uses a variety of criteria to identify and include disadvantaged workers, including the CalEnviroScreen tool,¹⁹ which has been developed to identify communities at the census tract level that bear disproportionate burdens of environmental degradation and economic marginalization.

Job Numbers

This report uses available information from economic models and industry studies for each of the critical sectors identified in the Scoping Plan to assess relative job growth in sectors affected by climate policy. It is not, however, a quantitative analysis of the job impacts of the 2030 Scoping Plan or of the over 100 climate policies and programs on which it is based. As mandated in AB 398, this a strategy document with concrete recommendations for the legislature and the administration on labor policies and actions that can complement climate policy. Effective labor market analysis that informs planning for workforce development—and identifies opportunities to improve job quality and job access—requires combining labor market information with deep on-the-ground knowledge for each sector, industry, and set of occupations, and is most effectively carried out within the context of industry training partnerships at the regional level.

What is the High Road and How Do We Build It?

Optimizing climate policy outcomes while supporting the creation of and access to family-supporting jobs is a “high-road” approach to economic development. As the term is used here, a high-road economy supports businesses that compete on the basis of the quality of their products and services by investing in their workforces; these businesses pay the wages and benefits necessary to attract and retain skilled workers, who in turn perform high-quality work.²⁰ Building the high road requires interventions on both the demand side and the supply side of the labor market. Supply indicates workers and the institutions that train them; demand refers to jobs and the firms or institutions that offer them.

Demand-Side Strategies

Demand-side strategies affect the demand for labor, including the kinds of jobs that are generated, the skills that are needed, the wages and benefits employers provide, and who employers hire.²¹ Public policy can encourage improvements in job quality through industry-specific or economy-wide wage and benefit standards, such as prevailing, living, and minimum wages; skill certification requirements; enforcement of all labor and employment laws, including proper classification of employees; and collective bargaining



rights. Better wages, benefits, working conditions, and career ladders support a more skilled workforce, which in turns leads to better design, installation, operation, and maintenance of technologies.²² These policies support the high-road employers within an industry and help them attract and retain a skilled workforce by limiting competition based on low wages.²³ Demand-side policies also include interventions to increase hiring of qualified workers from disadvantaged communities and to ensure that labor standards do not create barriers for historically excluded groups. Finally, public policy can support industry and business growth that will lead to high-road job availability, so that workers are trained for jobs that actually exist.

Demand-side strategies, like wage standards, skill certification requirements, or community workforce agreements, can be incorporated into climate measures through policy, regulatory action, or program design. Agencies responsible for implementing climate investments and other measures play a key role here because they direct public investment and influence private investments in lower carbon economic activity.

AB 398 specifically calls for this report to focus on opportunities to use project labor agreements (PLAs), community workforce agreements (CWAs), and community benefits agreements (CBAs).²⁴ These are all well-tested demand-side strategies that have been used in particular instances but have not yet been systematically applied across low-carbon investments.²⁵ PLAs are pre-hire collective bargaining agreements unique to the construction industry that set wage and benefit standards.²⁶ Although terminology varies, CWAs, as defined in this report, are PLAs that also include goals and processes for hiring from local communities or targeted disadvantaged groups.²⁷ CBAs are legally enforceable agreements negotiated between community groups and a developer or employer, and require specified local benefits, in some cases related to job quality and hiring goals, to maximize the economic development benefits of public assets and/or investments.²⁸

Supply-Side Strategies

Supply-side strategies focus on preparing the workforce for current and future changes in the labor market that are the expected result of climate policy and the overall transition to a carbon-neutral economy. Supply-side strategies are the traditional purview of the state's workforce development community, which is made up of an interconnected set of institutions including the community college and four-year college systems, certified apprenticeship programs, nonprofit training organizations, labor-management partnerships, public workforce development agencies, and multiple state, county and municipal agency partners. This system of education and training is funded through a variety of state and federal funding sources.²⁹

For workers, training is valuable if it leads to skill development, job placement, and wage and career advancement; for employers, training is valuable if it leads to improved



productivity and work quality.³⁰ Public funding for training will be effective only if trained workers are hired and retained, making it critical to target public training investments toward high-road employers who see their workforce as a worthwhile investment rather than a cost to be minimized.³¹

Workforce development is essential to building economic opportunity for those who have been marginalized, disadvantaged, and otherwise denied opportunities. Programs targeted to disadvantaged workers can secure more equality in the distribution of job opportunities, but the shortage of good jobs is an ongoing challenge for these pipeline programs. *To improve outcomes for workers in low-wage jobs, the most effective strategies are those that build skills, respond to employer needs, and improve job quality, simultaneously.*³²

In line with the CWDB's strategic plan, best-practice workforce development emphasizes training that:³³

- Responds to actual labor market demand by partnering closely with industry;
- Supports the state's high-road employers and pays attention to job quality;
- Emphasizes broad skill training for an occupation rather than just for one technology;
- Leverages the state's existing workforce education and training infrastructure rather than creating boutique programs unconnected to workers' education and career trajectories; and
- Assesses success of training based on outcomes, including job placement rates and improvements in wages and benefits improvements, higher worker productivity, and ongoing commitments by employers.

Just Transition Strategies

"Just Transition" refers to integrated policy approaches offering protection, support, and compensation for displaced workers and communities in specific industries or regions. This issue often arises in resource-intensive regions that lack overall economic diversity, when the region's major industry is or is projected to be in decline due to the resource itself running out, or more broadly due to global trends in automation, globalization, and climate change. Just transition programs can offer resources for both immediate short-term assistance to workers and communities directly affected by these trends, and long-term assistance to communities and workers as they "retool" and adapt to a carbon-neutral economy.³⁴ These strategies can also incorporate economic development planning, to help regions better identify the most promising emerging new industries based on regional assets including geography, educational and research institutions, and existing workforce skills.



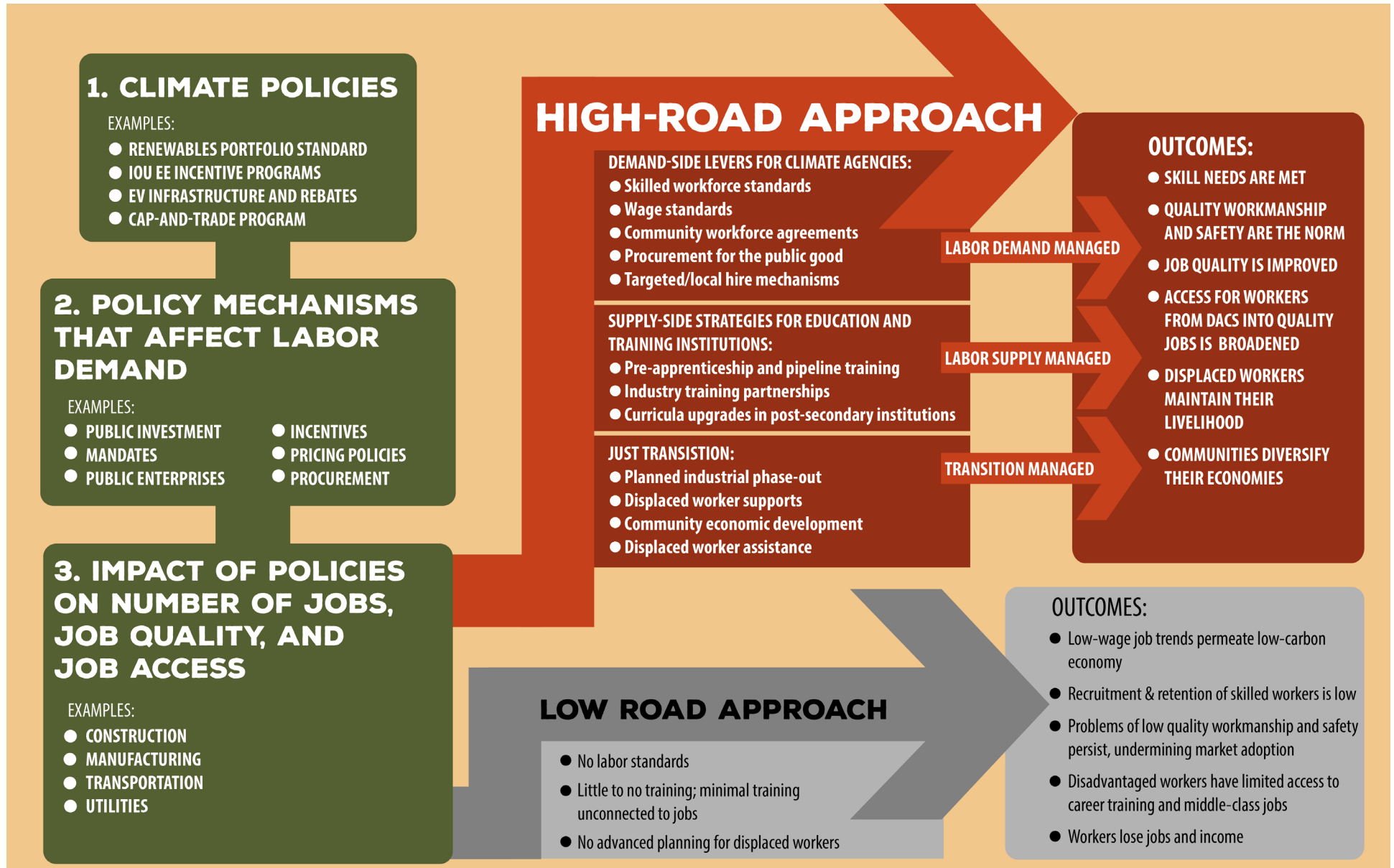
Choosing the High-Road Approach

The comprehensive and proactive supply-side and demand-side approach described above differs significantly from the standard approach to delivering skills to meet the needs of the climate transition. This more conventional approach relies *only* on supply-side strategies and assumes that as long as there are good training programs for new low-emission technologies, and that these have sufficient funding, the problem is solved. Proponents of this view have supported funding new short-term training programs aimed at new “green jobs,” or specific clean energy technologies or sectors. However, research has shown that simply funding more training—particularly short-term, technology-specific training—does not necessarily help workers.³⁵ Training does not create jobs or ensure job placement for graduates.³⁶ To be effective, training strategies must connect directly to the labor market, explicitly addressing industry needs and connecting participants to actual jobs.³⁷ The CWDB’s comprehensive approach to workforce development—as exemplified by its High Road Construction Careers and High Road Training Partnership initiatives—integrates demand- and supply-side strategies, avoiding the pitfalls of niche “green jobs” training and ensuring that California workers are prepared for long-term careers in a rapidly-evolving, carbon-constrained economy.

Exhibit ES.1 presents the conceptual framework illustrating the alignment of climate and workforce action plans. It starts with (1) examples of climate measures that use (2) a variety of specific policy mechanisms, and have (3) impacts on the number of jobs, job quality, and who is hired in the key industries affected by each climate measure. Without specific demand-side and supply-side labor interventions, these job impacts will replicate current trends and practices in the labor market, which in some sectors will simply reproduce low wages and ethnic and gender disparities. The graphic illustrates two distinct choices: a low-road approach that does not incorporate workforce strategies (in gray), and a high-road approach that manages changes in the labor market using the strategies recommended in this document (in red).



Exhibit ES.1. Conceptual Framework



III. Scoping Plan Sectors

The California Air Resources Board maintains an inventory of greenhouse gas emissions. Using 2017 data and following the Scoping Plan categorization, the descriptions below address the main sources of greenhouse gas emissions for each Scoping Plan sector and the primary strategies aimed at reducing those emissions.³⁸

❖ **Transportation (40.1 percent of California’s greenhouse gas emissions)**

This sector covers the greenhouse gas emissions from a wide range of vehicles and equipment used to move people and freight, including on- and off-road mobile sources of pollution (e.g., cars, trucks, locomotives, ships, aircraft, and other cargo-handling equipment). The three primary strategies to reduce greenhouse gas emissions from the transportation sector are: replacing conventional vehicles and equipment with zero- and near-zero-emission options; lowering the carbon intensity of transportation fuels; and reducing the number of vehicle miles traveled.

❖ **Industrial (25.8 percent of California’s greenhouse gas emissions)**

This sector covers the emissions from major emission-intensive production facilities, including oil refineries, cement, food processing, paper products, metals, and others; the sector includes oil and gas production. A key strategy is the Cap-and-Trade Program, which puts a price on greenhouse gas emissions and allows industry to determine the least cost method of reducing emissions. Other strategies include regulations to require fuel switching, energy efficiency improvements, and modifying industrial processes, as well as incentives. The manufacturing of lower-carbon products that can substitute for emission-intensive products is also addressed in the chapter of this report about the industrial sector. Emissions of high global warming potential (high-GWP) gases, like refrigerants, are mostly counted in the industrial sector. High-GWP gases are a growing emission source and can be lowered by reducing leaks and by shifting to alternatives with lower global warming potential.

❖ **Energy (24.4 percent of California’s greenhouse gas emissions)**

This sector covers the greenhouse gas emissions from the generation of electricity (in-state and imported) and the consumption of electricity and thermal energy in residential and commercial buildings. The primary strategies to reduce greenhouse gas emissions from the energy sector are: switching from fossil fuels to renewable



energy sources, and conserving energy and improving efficiency in residential and commercial buildings (industrial energy efficiency and water efficiency are addressed in the industry and water chapters, respectively).

❖ **Natural and Working Lands (7.6 percent of California’s greenhouse gas emissions, Agriculture only)**

This sector includes emissions from livestock, crop growing and harvesting, and other general fuel use by agriculture. Strategies and initiatives are in place to capture methane from dairies and other animal husbandry, improve crop production techniques and soil health for carbon capture, and reduce emissions from farm operations. This sector also covers California’s forests and other wildlands, as well as urban parks and greenspace; these emissions have not yet been quantified and are not included in the 7.6 percent above. Forest management and fire protection strategies to minimize black carbon emissions and increase carbon capture and sequestration are currently in development, as are incentives to promote healthy soils, rehabilitate wetlands and tidal environments, and promote greater adoption of land conservation practices.

❖ **Waste (2.1 percent of California’s greenhouse gas emissions)**

This sector covers the emissions from landfills and other waste treatment facilities. Strategies to reduce emissions from the waste sector involve: diverting waste from landfills to other types of facilities (recycling, composting, reuse, and re-manufacturing); reducing solid waste generation (through packaging reduction and edible food rescue/recovery efforts); and capturing methane emissions from waste facilities to generate energy.

❖ **Water (emissions accounted for within other sectors)**

This sector covers the emissions from the “water-energy nexus”—power consumed to heat and cool water in residential and commercial buildings and for industrial processes, and power needed for water conveyance, treatment, and distribution. Strategies to reduce emissions from the water sector include: water conservation and efficiency; use of renewable energy in major water operations; and deployment of lower carbon technologies for water treatment and groundwater remediation and recharge.



IV. Findings: The Impact of Climate Policy on Job Quality and Job Access

❖ Analysis of climate policy implementation shows the outsized importance of the construction industry and the predominance of blue-collar work.

Exhibit ES.2 is a summary table of the industries and occupations associated with each Scoping Plan sector. It illustrates two findings that shape the analysis and recommendations: the predominance of blue-collar work and the importance of the construction industry in the Scoping Plan sectors.

The information in **Exhibit ES.2** is derived by identifying the main activities impacted by climate policy, linking them to industries as defined by the Bureau of Labor Statistics (BLS) at the most disaggregated level possible, and identifying the occupational distribution of each industry. Some Scoping Plan sectors, like waste and water, are narrowly focused on one industry as defined by the BLS, but others, like sustainable transportation, affect multiple industries, e.g., manufacturing, trucking, transit, and construction.

Exhibit ES.2. Scoping Plan Sector, Subsector, Industry, and Percent Blue-Collar Employment

| Scoping Plan Sector | Subsector | Industry by NAICS | % Blue-Collar Jobs |
|---------------------|---------------------------------------|--|--------------------|
| Energy | Utility-Scale Renewables—Construction | Utility System Construction | 78% |
| | Utility-Scale Renewables—Operations | Electric Power Generation, Transmission and Distribution | 38% |
| | Distributed Generation | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |
| | Energy Efficiency | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |
| | Natural Gas Leakage Abatement | Natural Gas Distribution* | 42% |



| Scoping Plan Sector | Subsector | Industry by NAICS | % Blue-Collar Jobs |
|---------------------|---|--|--------------------|
| Transportation | Cleaner Vehicles | Motor Vehicle Manufacturing | 87% |
| | | Automotive Repair and Maintenance | 78% |
| | Trucking | Truck Transportation | 77% |
| | Public Transit | Transit and Ground Passenger Transportation | 83% |
| | Clean Fuel Infrastructure | Electrical Contractors and Other Wiring Installation | 75% |
| | Transit Infrastructure | Other Heavy and Civil Engineering Construction | 76% |
| | Infill and Transit-Oriented Development | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |
| Industry | Emissions Intensive Manufacturing | Various* | 58%** |
| | Fossil Fuel Production, Refining, and Distribution | Oil and Gas Extraction | 41% |
| | | Petroleum and Coal Products Manufacturing | 55% |
| | | Pipeline Transportation | 63% |
| | Emissions and Leakage Abatement | Other Specialty Contractors | 79% |
| Electrification | Electrical Contractors and Other Wiring Installation | 75% | |
| Waste | Waste Diversion and Methane Capture | Waste Management and Remediation Services | 76% |
| Water | Water Conservation in Drinking Water, Stormwater, Waste Water, Efficient Water Infrastructure | Water, Sewage and Other Systems | 58% |
| | | Utility System Construction | 78% |
| | | Remediation and Other Waste Management Services | 72% |



| Scoping Plan Sector | Subsector | Industry by NAICS | % Blue-Collar Jobs |
|---------------------------|---|--|--------------------|
| Natural and Working Lands | Forestry Services, Fire Prevention and Suppression | Forestry and Logging | 90% |
| | Lower Carbon Soil Management and Crop Production; Manure Management for Methane Capture | Agriculture, Forestry, Fishing and Hunting | 96% |
| | Wetlands Restoration, Urban Greening, etc. | Various* | N/A |

Notes:

* Detailed occupation profile of this industry is not available.

** Employment-weighted average of proportions of blue-collar workers within the NAICS industries listed as eligible for receiving allowances under the Cap-and-Trade Program Vintage 2018 Allowance Allocation. See California Air Resources Board, “Cap-and-Trade Program: Vintage 2018 Allowance Allocation,” December 5, 2017, <https://ww3.arb.ca.gov/cc/capandtrade/allowanceallocation/v2018allocation.pdf>.

Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]

Construction is the most significant industry in the expansion of utility-scale and distributed renewable energy generation, energy and water efficiency retrofits in the built environment, cleaner fuels infrastructure, infill and transit-oriented development, water infrastructure, infrastructure for waste energy capture, and the installation of emissions reductions technologies in refineries and leakage abatement in oil and gas production and distribution. Construction constitutes 54 percent of the expenditures from the Greenhouse Gas Reduction Fund (GGRF) to California Climate Investments (CCI) due to investments in high-speed rail, public transit system infrastructure, and affordable multi-unit housing.³⁹ Other key industries in **Exhibit ES.2**, such as manufacturing, utilities, and forestry services, are also critical; still, collectively, they comprise a limited slice of the California economy. The largest employment sectors of our economy—including healthcare, education, hospitality, and retail—make little appearance in the Scoping Plan, except as the subject of energy efficiency measures (carried out by construction and building operation activities) to lower energy and water use in the buildings they occupy. They are indirectly affected by changes in electricity and fuel prices but remain relatively untouched otherwise, showing that impacts of the climate policy explored in this report are concentrated in a limited number of industries and jobs.



Exhibit ES.2 also illustrates the predominance of blue-collar work—defined as occupations in construction, production, transportation, maintenance, repair, and similar occupations—in the industries that are most directly affected by climate policy.⁴⁰ The jobs tied to the production of fossil fuels, which are most likely to decline with the long-term transition to a carbon-neutral economy, are also largely blue collar. In contrast, the share of blue-collar occupations in the California economy as a whole is only 23 percent.⁴¹

The term “blue collar” does not mean low-skilled. Many blue-collar workers must gain sophisticated skills to carry out their jobs, and these workers increasingly perform technical and computer-related tasks.⁴² The predominance of these occupations among the industries affected by climate policy highlights the importance of workplace-based training and industry partnerships, since many of these workers are not required to have postsecondary education.⁴³

The predominance of blue-collar workers also underscores the importance of marrying climate investments to workforce strategies that promote job quality. The quality of blue-collar jobs varies tremendously, even within the same industry, depending on the degree of subcontracting and outsourcing, ease of employment law enforcement, unionization rates, and other factors.⁴⁴ These differences in job quality within industries and between high and low road employers are often difficult to discern from government data, which also is not able to capture wage theft and other employment violations.⁴⁵

Professional occupations, defined here as engineering and other technical occupations that mostly require a four-year college degree, are also critical for the design and planning of low-emission technologies. Jobs requiring a college degree generally pay family-supporting wages and provide workers with a return on their investment in education.⁴⁶ These can provide important career mobility paths for workers from disadvantaged communities, but they are much more limited in number than blue-collar jobs.

❖ Lowering greenhouse gas emissions involves traditional occupations that incorporate new tasks, rather than new and different jobs.

Research and practice have confirmed that it is more accurate to talk about “greening” existing jobs, rather than new and different “green jobs.” The vast majority of the jobs that will be involved in work to lower greenhouse gas emissions across the economy are in traditional occupations where specific “low carbon” knowledge and skills are only one component of a broader occupational skill set.⁴⁷ A comprehensive study of energy efficiency programs found that approximately two-thirds of the jobs generated directly by energy efficiency investments in California are in traditional building and construction trades—e.g., electricians, sheet metal workers, plumbers, carpenters, stationary



engineers, and others. Only around one-sixth are in professional occupations, and only 2 percent are specialized energy efficiency occupations like energy auditor (and even then, auditors often perform other tasks unrelated to energy savings).⁴⁸ Likewise, mechanics for zero-emissions vehicles are still motor vehicle mechanics and workers who manufacture electric cars are still autoworkers, even though they incorporate new skills and tasks for engines that do not run on fossil fuels. In other words, there are very few new occupations created by climate mitigation activities, but instead new aspects to old occupations. This finding helps confirm that niche training programs targeting a particular low-emission technology, such as training for solar panel installation, are less effective than broader training that helps workers gain mastery in an occupation and provides them with skills to continually adopt improved and cleaner technologies.⁴⁹

❖ **Many activities that reduce greenhouse gas emissions are creating good jobs and broadening opportunities for disadvantaged workers.**

➤ **Utility-Scale Renewable Energy Generation**

A major success story is the build-out of utility-scale renewable energy generation (solar energy primarily) facilities in California, driven in large part by the state's Renewables Portfolio Standard (RPS).⁵⁰ The RPS has resulted in steep declines in greenhouse gas emissions in the electricity sector—which accounts for most of the greenhouse gas reductions to date⁵¹—and has produced family-supporting jobs and employed workers from some of the poorest counties in the state.⁵²

Almost all utility-scale renewable generation projects have been built under project labor agreements (PLAs), and some have been built under community workforce agreements (CWAs).⁵³ Under both PLAs and CWAs, the construction of utility-scale renewables in California has produced family-supporting, union scale wages and benefits while also appreciably boosting the inclusion of workers from disadvantaged communities. The use of apprentices, a key feature of PLAs and CWAs, ensures training and a career ladder.⁵⁴

➤ **High Speed Rail and Major Transit Capital Projects**

The proceeds from state auctions of greenhouse gas emission allowances under the Cap-and-Trade Program are deposited into the Greenhouse Gas Reduction Fund (GGRF) and appropriated by the Legislature to California Climate Investments (CCI) programs that reduce greenhouse gas emissions and advance additional environmental, economic, and public health benefits. In some cases, CCI programs produce good jobs and create opportunities for disadvantaged workers. This is especially true of large-scale construction projects, but never happens automatically.



Because the GGRF is a state fund, most construction activities are covered by prevailing wages, ensuring family-supporting jobs, and the High Speed Rail project and many transit infrastructure investments are built under CWAs, which create access to employment opportunities for targeted populations of workers (e.g., workers from specific locales and/or socioeconomic backgrounds).⁵⁵ In addition, the GGRF-funded Transformative Climate Communities program, which allocated \$140 million for FY 2016-17 for comprehensive, community-guided infrastructure programs in disadvantaged communities in Fresno, Los Angeles, and Ontario, has made a commitment to expanding the use of CWAs.⁵⁶

➤ **Public Transit and Utilities**

Public transit authorities, public water agencies, and both public and investor-owned energy utilities, each with key roles in reducing greenhouse gas emissions, have traditionally provided family-supporting jobs for their workforces.⁵⁷ Public transit has been particularly successful in hiring a diverse workforce.⁵⁸ The blue-collar workforce in public water utilities is still largely white and male,⁵⁹ although some utilities have implemented a full suite of inclusion programs, including paid work-based learning opportunities and internships for local youth, and internal pre-apprenticeship pipeline programs, which have cultivated a diverse workforce.⁶⁰

❖ **Some activities that lower greenhouse gas emissions can produce lower quality jobs.**

➤ **Distributed Renewable Energy Generation and Energy Efficiency Retrofits**

Mandates and incentives to encourage both distributed renewable energy generation (e.g., customer-sited, or rooftop solar energy systems) and energy savings through retrofitting of residential and commercial buildings have resulted in mixed outcomes for workers. Particularly in the residential and small commercial sectors, some rooftop solar and energy efficiency jobs are characterized by low wages, minimal benefits and lack of career ladders.⁶¹ These jobs are in the residential and small commercial construction market, where low wages and few benefits are common and workers are sometimes subject to employee misclassification, high injury rates, and even wage theft.⁶² In contrast, distributed renewable energy generation and energy efficiency retrofits in public and some large commercial buildings tend to pay prevailing wages and benefits and use apprentices enrolled in state-certified apprenticeship programs.⁶³



➤ **Clean Vehicle Manufacturing**

Manufacturing was once a reliable source of family-supporting wages, but low-wage jobs in manufacturing have grown in recent decades.⁶⁴ Job quality within the clean vehicle manufacturing sector appears mixed in California. Concerns about the labor practices of zero-emission vehicle (ZEV) manufacturers, in both light- and heavy-duty segments, have been raised based on violations of wage, health and safety, and worker protection rules.⁶⁵ On the other hand, some zero-emission bus and rail manufacturers in the state have unionized workforces, which generally indicates higher job quality (including higher average earnings) compared to nonunionized workforces.⁶⁶ Two of these heavy-duty ZEV manufacturers in California have also committed to inclusive hiring goals and practices.⁶⁷

❖ **Several prominent industries that are critical targets for climate policy have some of the lowest wage jobs in the economy, and low-road practices impede efforts to reduce emissions.**

➤ **Trucking**

Short-haul trucking between seaports, railyards, warehouses, and other major freight hubs (port trucking or drayage, in industry parlance) is a critical part of the logistics chain and presents a significant opportunity for the adoption of zero-emission trucks. However, the prevalence of worker misclassification in trucking is not only a concern about job quality, but also with respect to achieving the environmental outcomes intended by climate policy. That is, when port truck drivers are misclassified as independent contractors instead of employees, drivers, rather than the trucking companies they work for, become responsible for the costs of switching to cleaner trucks. Clean truck mandates may not achieve, or be able to sustain, the expected reductions in air and climate pollution when misclassification is prevalent, because port truck drivers—a very low-income and largely immigrant workforce—have limited resources for purchasing and maintaining low-emission trucks.⁶⁸

➤ **Waste**

Many local governments in California contract out waste collection services and establish systems in which customers arrange services directly with authorized private waste haulers. A race to the bottom ensues under these types of systems (viz., non-exclusive franchising and open permitting systems), which results in low wages and unsafe working conditions,⁶⁹ creates obstacles for municipalities to meet state-mandated waste diversion targets and enforce other performance standards,



and contributes to problems affecting quality of life (e.g., traffic congestion and damaged local streets and roads).⁷⁰ Centralized “best value” contracting—where bidding processes include standards for contractor performance, job quality, and job access, not just cost—help prevent a race to the bottom on wages. This makes it easier to both enforce the state’s waste diversion mandates and to attract, train, and retain a qualified workforce to handle multiple waste streams.⁷¹ San Francisco and Oakland offer examples of a high-road approach to contracted waste collection services, and efforts to improve diversion and labor conditions through responsible contracting policies are underway in Los Angeles.⁷²

In the recycling industry, wage and hour violations and relatively high rates of workplace injury and illness contribute to poor job quality.⁷³

➤ **Wildfire Prevention and Forestry Services**

CAL FIRE employees spend part of their time carrying out wildfire prevention and forestry services work, and receive rigorous skills and safety training as well as family-supporting wages and benefits.⁷⁴ However, Forest and Conservation Workers overall—including tree-planters, thinners, and other vegetation management workers—have some of the lowest median hourly wages (\$10.66/hour) of all occupations in California.⁷⁵ In addition to low pay and various forms of wage theft, illegal labor practices (e.g., setting unrealistic pace of work and insufficient rest breaks) are fairly common among forestry services contractors operating on forest lands despite federal laws that prohibit such actions by employers.⁷⁶ Poor job quality and the inadequate enforcement of labor and employment law is especially problematic for vulnerable populations working in this sector, namely foreign guest workers (with H 2-B visas) and undocumented immigrants.⁷⁷ While employment data does not make it possible to disaggregate the forestry services workforce in terms of employers (i.e., public sector versus private contractors) or workers’ nativity, close attention to job quality will nonetheless be necessary to put industry expansion on the high road, as growth in the size of this workforce is critical to reducing the threat and impacts of catastrophic wildfire.

❖ **Climate policy creates the risk of future job loss in fossil fuel industries.**

➤ **Oil and Gas Production, Refining, and Distribution**

As the state transitions to a carbon-neutral economy, and as other states and countries begin to price carbon—and ramp up complementary policies like vehicle and building electrification—more aggressively, fossil fuel industries will face job losses. In fact, this is already happening due to automation in many parts of the oil



and gas industry. However, the fossil fuel sector is still an important part of the job and economic mix of California, especially in specific counties. In 2016 there were approximately 57,000 workers in these industries, including approximately 10,000 employed in refineries, 9,000 in oil and gas extraction, 2,000 in oil and gas pipeline work, and about 32,000 in natural gas distribution.⁷⁸ Fossil fuel-intensive regions of the state are already looking at economic diversification, which needs to include targeted strategies to help workers maintain their livelihood.

V. Recommendations

The following recommendations, supported by the findings in the report, begin to align the state's comprehensive climate and workforce action plans, and can help overcome a significant number of the problems identified above. Many of the recommendations can be applied in all of the six sectors in the 2017 Climate Change Scoping Plan. The state has the opportunity to explicitly incorporate the goals of job quality and job access in the next iteration of the Scoping Plan, which already embeds a commitment to equity through its support for environmental justice.

Demand-Side Strategies for Agencies Implementing Climate Measures

California's state government can use its power not only to drive low-carbon economic growth but also to support equitable development. The following recommendations are key to encouraging the generation of family-supporting jobs and access to them for workers from disadvantaged communities. Each recommendation includes an example of a current application which could be scaled and/or incorporated into climate strategies in the future.

1. Expand the use of Community Workforce Agreements (CWAs) on climate investments involving large-scale construction projects.

The predominance of the construction industry in the implementation of climate policy highlights the importance of expanding the use of the high-road strategies unique to construction, such as CWAs, which have a proven track record of ensuring job quality and job access, and securing robust training pathways through the use of state-certified apprenticeship programs in the construction trades.



Current Application

In climate policy, CWAs are currently used in the construction of utility-scale renewable energy projects, public transit and high-speed rail infrastructure, and some other large-scale construction projects funded by the GGRF.

Expansion Possibilities

Agencies or entities administering public or ratepayer funds can use CWAs on large construction projects for infrastructure investment in renewable energy, energy efficiency retrofits, EV charging infrastructure and transit infrastructure projects, installation of emission controls in refineries, leakage abatement in oil and gas distribution, and waste and water infrastructure. The typical minimum threshold for a stand-alone CWA is \$1 million in contract value, because sufficient scale is necessary to create enough jobs to successfully implement targeted hire requirements aimed at increasing economic equity.

2. Use inclusive procurement policies for public procurement of large capital equipment, contracts for public services, and in grant programs.

Government procurement policies can include requirements such as a floor on wages, skill standards, and other workforce standards in their contracts with businesses that supply capital equipment or other goods and services. Procurement language that gives bidders an opportunity to disclose additional detailed information about their commitments to high-road labor practices allows awarding agencies to identify the “best-in-class” employer as a component of bid evaluation. This incentivizes bidders to address job quality and access.

Current Application

Public agencies in California, including the High Speed Rail Authority and Los Angeles County Metropolitan Transportation Authority (LA Metro), have successfully used inclusive procurement language to ensure family-supporting jobs, substantial investments in training, and commitments to hiring disadvantaged and under-represented workers in the manufacturing of rail cars and transit buses.⁷⁹

Expansion Possibilities

In all competitive solicitations for climate mitigation, agencies or entities administering climate investment funds can use inclusive procurement policies to incorporate workforce commitments as one component of the criteria they use to rank bidders. Awarding agencies can insert this language in solicitations for the procurement of large capital equipment like buses or other fleet vehicles, for contracts for public services like waste collection and fire prevention, and in the myriad of grant programs funded by the GGRF, ratepayer funds, and other sources.



3. Include responsible employer standards in all climate incentive programs.

Responsible employer standards for incentive programs (e.g., rebates, vouchers, grants, and loan assistance) financed with public or ratepayer funds are a powerful tool to ensure adequate work quality and to prevent public funds from supporting low-wage jobs or unfair and illegal labor practices. Because incentive programs only partially subsidize private investments, the comprehensive strategies described in the first two recommendations above are not always feasible. Instead, responsible employer standards *can* screen out unwanted behavior and close off the low road by setting minimum requirements for incentive program eligibility or basic terms and conditions of program implementation. Responsible employer standards can include skill standards, a floor on wages and benefits, and labor law compliance, as addressed in the next two recommendations.⁸⁰

3a. Include skill standards to ensure safe and proper performance in programs receiving public or ratepayer funds.

Skill certifications are a way to ensure safety and high performance. Persistent quality problems have emerged in the installation, operation, and maintenance of some key technologies that are critical to lowering emissions, including HVAC and advanced lighting controls in energy retrofits.⁸¹ Safety concerns are paramount in EV-charging stations and battery storage.

Current Application

The California Public Utilities Commission (CPUC) recently mandated the use of specialized certifications for advanced lighting controls and commercial HVAC installation and maintenance in energy efficiency incentive programs.⁸² The CPUC also requires investor-owned utilities (IOUs) to utilize certified electricians who have acquired a specialized upgrade certification for the installation of IOU-owned electric vehicle supply equipment.⁸³

It is noteworthy that skill certification standards have now been established for certain major projects within the fossil fuel industry. When contracting for construction, repair, maintenance, or demolition services, owners of petroleum refining and hydrocarbon manufacturing facilities are required to ensure that contractors and subcontractors use a skilled and trained workforce, which includes active registered apprentices and skilled journey-level workers in the building and construction trades; the state law mandating a skilled and trained workforce (Senate Bill 54, Hancock, Chapter 795, Statutes of 2013) also established a prevailing wage standard for this contracted work.⁸⁴



Expansion Possibilities

Skill standards can be adopted for public and ratepayer climate investments involving skilled work, particularly for emerging technologies, technologies with safety risks, and/or climate measures with persistent performance problems. Upgrade certifications can be incorporated into program requirements for rebates, incentives, loan assistance, and more. Agencies administering programs can consult with subject matter experts, the CWDB, community colleges, the Division of Apprenticeship Standards, and high-road employers to help identify the most appropriate advanced certifications.

3b. Incorporate wage and benefits standards and verification of compliance with all employment and labor law, including health and safety standards, into incentive program requirements.

A floor on wages and benefits, as well as verification of compliance with the full range of California labor, employment, and environmental regulations can be incorporated into the terms and conditions of implementation or eligibility criteria for all climate incentive programs (e.g., rebates, vouchers, grants, and loan assistance). These standards would be especially useful for incentive programs in industries or sectors characterized by low wages, health and safety violations, worker misclassification, and other low-road labor practices. At minimum, such requirements can prevent public or ratepayer funds from benefiting low-road employers; they could also help ensure climate incentive programs deliver decent job quality outcomes.

Current Applications

The Los Angeles Department of Water and Power (LADWP) set a wage and benefits floor of \$16 per hour plus full medical and pension benefits for its weatherization workers enrolled in pre-apprenticeship (i.e., the Utility Pre-Craft Trainee (UPCT) program).⁸⁵ These workers also benefit from membership in the International Brotherhood of Electric Workers (IBEW) Local 18, a founding partner of the UPCT program.

The South Coast Air Quality Management District (SCAQMD, or the district) added new rules regarding labor law compliance to its district-funded truck replacement projects. The district assesses a company's record of labor law violations when reviewing applications for clean truck incentives, and has a disclosure and certification process regarding ongoing labor law compliance for those awarded funding. SCAQMD also prohibits trucking firms to use lease-to-own arrangements with their drivers in contracts involving district-funded trucks.⁸⁶



Expansion Possibilities

Agencies implementing climate incentive programs can use responsible employer standards to ensure that public funds do not support low-wage jobs, or firms with repeated and/or egregious violations of labor and employment laws. This practice would be especially useful in industries or sectors in which low-road working conditions are common, including residential and small commercial construction, trucking, forest and wildlands management, agriculture, some manufacturing, and subcontracted waste services.

4. Identify and focus incentives on win-win strategies that meet both climate and workforce goals.

Climate programs can be designed and phased strategically to support high-road rather than low-road employers. One strategy is to design programs to increase project scale, even within the same general market segment (e.g., multifamily residential vs. single-family homes). In construction, increased project size can facilitate the incorporation of local and targeted hire. Often, larger projects can capture economies of scale and thus also increase emissions reductions per dollar invested. Phasing incentives for emerging technologies and practices for energy savings or distributed generation in buildings, so that they first target the municipal, university, schools and hospital (MUSH) sector where labor standards usually already exist, provides an opportunity to encourage high-road employers. These employers will develop expertise and efficiency, and this can help them be competitive in more challenging sectors where low road practices are more common.

Current Application

LADWP is initiating a shared community solar pilot project that includes a wage floor and inclusionary hiring.⁸⁷

Expansion Possibilities

Community shared solar; district energy electrification (systems that provide heating and cooling from renewable sources to neighborhoods, rather than single homes).

5. Use insourcing or exclusive franchise contracting models to support labor and environmental standards for public services or ratepayer-funded subcontracts.

State and local jurisdictions and other public entities can use their own employees instead of subcontracting, or use exclusive franchise systems for services that are currently “open market.” Subcontracting in some weatherization programs has led



to low wages and lack of career ladders for workers. Open markets in waste, where customers contract with private waste providers, have impeded enforcement of state waste-diversion mandates and produced low-road labor practices. An exclusive franchise system, where local governments set contract terms and conditions, along with inclusive procurement policies, facilitate the establishment and enforcement of environmental and labor standards.

Current Application

The City of Los Angeles adopted the exclusive franchising model for its waste system. The LADWP insourced its previously subcontracted weatherization program, allowing the creation of career ladders for entry-level weatherization workers into permanent jobs in the utility.

Expansion Possibilities

Municipal waste contracting throughout the state, contracting of low-income weatherization measures, urban greening and many other public services.

6. Use metrics to measure the impact of climate policies on job growth, job quality, and job access.

Tracking and reporting on the job impacts of climate policy is necessary to measure progress over time. Measuring economic and workforce development across Scoping Plan sectors involves complex inquiries into job creation, job quality, employment of targeted groups, employment in given industries and occupations, advancement in the labor market, wages and benefits, and apprenticeship utilization. To identify, capture, analyze, and report on related metrics requires dedicated resources and considerable expertise beyond the scope of traditional labor market intelligence.

Current Application

CARB has explored methods and metrics for tracking job numbers, job quality, and job access, and is deploying a related tool for GGRF-funded projects.⁸⁸ In the construction sector, many public entities that implement CWAs for contracted projects use commercial software for prevailing wage and local hire compliance.⁸⁹

Expansion Possibilities

Technology is now available to accurately track jobs with online software programs that confidentially extract data from payroll records; these can track numbers of workers, their wages and benefits, and residence zip codes.⁹⁰ The software used in CWAs could be adopted for climate investments in construction, including GGRF expenditures and IOU contracts for energy efficiency retrofits.



7. Incorporate workforce analysis into emerging-technology support programs.

Agencies that are tasked with promoting the accelerated market adoption of emerging low-emission technologies can help ensure that technology and skill development are coordinated by requiring that workforce analysis be incorporated into emerging-technology programs. Entities that are receiving state support could be asked to identify: 1) the occupations that are critical to the planning, installation, maintenance, and operation of the technology; 2) any performance problems that were related to skill gaps; and 3) the relevant training and skill requirements that the business uses to engage qualified workers.

Workforce development agencies currently have very limited access to information on skill needs for new technologies that come to market. Workforce analysis can help fill this information gap and help training organizations identify priorities for training investments.

Current Application

One example is the collaboration between the UC Davis California Lighting Technology Center and the state-certified electrical apprenticeship programs, which supported the identification of skill gaps for the installation of advanced lighting controls and the creation of the model California Advanced Lighting Controls Training Program (CALCTP) certification for electricians.⁹¹

Expansion Possibilities

Agencies administering grants for research and development, demonstration projects, and pilot programs for emerging technologies can request that grantees identify key occupations that need to be engaged for successful performance of the emerging technologies and needs for skill upgrades, if they exist.

8. Provide technical assistance to agencies implementing climate policy on the application of demand-side tools.

The CWDB should develop a technical assistance team to advise other state agencies seeking to make high-road labor and workforce interventions through climate policies and programs. Agencies administering climate measures typically have limited experience with the job quality and job access strategies and tools outlined in this report. There is considerable relevant expertise within the CWDB that can be systematically engaged to help other public entities determine when, where, and how to implement this report's demand-side recommendations, including, for example, community workforce agreements and inclusive procurement.



Supply-Side Strategies for Workforce Development Agencies and Training Institutions

California’s robust workforce training and education infrastructure can prepare workers for the changes in the labor market that will occur as the state makes the transition to a carbon-neutral economy, particularly when combined with the demand-side actions listed above. The following summarizes key recommendations for a coordinated statewide strategy built upon partnerships with the state’s key training and education institutions, including the community colleges, the state-certified apprenticeship system, and the UC/CSU public universities, along with high-road employers, unions, and community based organizations. Crucially, investments in training should:

- Support and enhance existing programs in California’s key workforce development institutions, so that they can respond to the needed changes, instead of building new training programs specifically for emerging lower carbon technologies.
- Fund comprehensive training that prepares workers for careers, rather than niche programs that train on one particular “green” skill or “green” technology that may become outdated as technology advances.

Funding already exists for many of the initiatives recommended below, including ratepayer funds for the Electric Program Investment Charge (EPIC), and IOU energy efficiency programs. Pipeline training for the skilled construction trades has been available from Prop. 39 and now is also available from the Road Repair & Accountability Act (Senate Bill 1, Beall, Chapter 5, Statutes of 2017) as the CWDB launches its High Road Construction Careers (HRCC) initiative as an integrated statewide network of pre-apprenticeship partnerships. The challenge with existing and new investments—especially where climate agencies and CCI programs are running their own training programs—is to align the work, avoiding duplication and further fragmentation of training for California’s workers. Specific recommendations fall into four broad categories:

1. Redirect and align funding for industry-led incumbent worker training.

State investments stand to make the greatest immediate impact by focusing on training workers already employed in the key occupations critical to the transition to a carbon-neutral economy. Employer engagement in training of incumbent workers is essential. For the professional occupations, continuing education that already is embedded in licensing or credential renewal may be sufficient. For blue-collar and technical workers, high-road industry training partnerships provide a model for successful incumbent worker training, with training institutions such as the community colleges, apprenticeship programs, and others providing training *in response* to industry partnership needs.



1a. Support high-road industry training partnerships.

Industry partnerships are essential for training incumbent workers and also can serve efforts to improve inclusion of disadvantaged workers into entry-level jobs. There should continue to be expanded funding for industry partnerships in key industries in each of the Scoping Plan sectors.⁹² The CWDB's High Road Training Partnership (H RTP) initiative can serve as a model for an expanded effort that could include new apprenticeship programs and enhancements of existing programs, other labor-management partnerships, and other employer-led training initiatives in nonunionized high-road businesses. These initiatives can partner with community colleges and other training organizations to deliver skills to accelerate the adoption of clean technologies. In addition, they can provide a structure in which to engage and protect workers and find collaborative solutions as technological change and/or climate policies cause large disruptions or even elimination of certain jobs.

Current Application

H RTPs have been developed in critical industries, including transit, warehousing, logistics, transportation, water, building services, health care, and hospitality.

Expansion Possibilities

There are numerous opportunities for expansion of high-road training partnerships in industries critical to climate policies, and significant new funding for the H RTP initiative was appropriated by the Legislature during the Fiscal Year (FY) 2019/20 budget process. The report identifies opportunities in: fire prevention jobs in California's forests and wildlands, where an expanded workforce is needed because of increased fire risk; occupations engaged in pollution abatement and process improvements in refineries that are required under Assembly Bill 617 (C. Garcia, Chapter 136, Statutes of 2017) and other laws; occupations involved in waste diversion activities, which are required due to more stringent waste diversion mandates; emerging water conservation programs in the state's water utilities; and occupations involved in methane capture in dairies and waste facilities due to new mandates on emissions with high global warming potential.

1b. Support existing apprenticeship programs and, where conditions are favorable, create new apprenticeship programs.

State-certified apprenticeship is one critical approach embraced by high-road industry training partnerships and is the gold standard in training for occupations that do not require a four-year college degree. Apprenticeship has the following advantages: it is industry driven and funded, provides high returns and no debt to workers through its earn-while-you-learn model, delivers broad skills needed by employers that lead to



mastery of a trade or occupation, uses both classroom and on-the-job training, leads to wage increases as skills are acquired, and calibrates the number of training slots to the number of available jobs.⁹³ Developed in the context of an HRTP, multiple employers can identify the shared advantage of skill delivery via apprenticeship, and work to develop a common pathway; this model may be more sustainable than one in which training institutions try to convince employers from a single firm to invest in such a structure.

Current Application

The skilled construction trades all have well-developed apprenticeships and have incorporated some emerging low-emission technologies in their curricula with funding from the Employment Training Panel; firefighters also are trained through apprenticeship. Apprenticeships have also been developed in transit operations (one of the HRTP programs) and zero-emissions bus manufacturing.

Expansion Possibilities

Forestry services, waste diversion, water conservation, and other climate critical industries offer opportunities for expanding apprenticeship, as one path for the HRTPs described above. Expanding skill upgrades for emerging technologies in the skilled trades presents another key opportunity, as illustrated by model programs such as the Electric Vehicle Infrastructure Training Program.

2. Redirect and align funding for a statewide strategy for pipeline programs to expand inclusion of disadvantaged workers into family-supporting career-track jobs in the carbon-neutral economy.

A commitment to inclusion requires specific interventions that can reach all occupations critical to the transition to a carbon-neutral economy. All inclusion programs should include the following elements: 1) comprehensive services that include entry-level skills training and a suite of supports, mentoring, and wrap-around services tailored to targeted populations; and 2) explicit connections to family-supporting jobs through specific commitments from employers or other proven avenues to job placement, or entry into further career training that leads to placement in family-supporting careers.⁹⁴ In a “start with the jobs” approach as modeled by the CWDB’s HRTP and its High Road Construction Careers (HRCC) initiative, pipeline programs are designed in response to the specific needs of employers in a region, rather than starting with a training program for a given population and trying to then win employer support or commitment. Inclusion programs should not be developed for low-wage jobs unless coupled with strategies to improve job quality or create ladders from low-wage to good jobs.



2a. Support a statewide initiative for pre-apprenticeship for construction careers.

Support for pre-apprenticeship is critical to improving equity and inclusion in the skilled construction trades. Therefore, any climate investments that involve a significant amount of construction trades work and seek to increase disadvantaged and/or under-represented workers' access to employment in this industry should connect to, align with, or feed into the emerging statewide system of quality pre-apprenticeship that the CWDB is building through its HRCC initiative. The HRCC initiative builds upon CWDB's successful pilots that have helped to develop and diversify California's construction workforce industry-wide.⁹⁵ These pre-apprenticeship pilots have modeled a strategy for increasing access to state-certified apprenticeship, the highest-quality career pathway in the construction trades, rather than serving as stand-alone training programs for individual climate investment projects or programs. To support additional investment in high-road pre-apprenticeship, the CWDB has established standards for construction pre-apprenticeship ("SB 1 Workforce Guidelines") that are applicable industry-wide.⁹⁶

Funding from disparate sources, currently administered by a variety of agencies, can be consolidated to support and expand the set of coordinated pre-apprenticeship partnerships that the CWDB has invested in under the California Clean Energy Jobs Act (Prop. 39, 2012), and will bring to scale through the HRCC.

Current Application

The CWDB has been piloting its high-road construction pre-apprenticeship strategy under Prop. 39, which funded clean energy (i.e., energy efficiency and renewable energy) retrofits to K-12 schools. The same strategy, but at a larger, regional scale, will direct future workforce investments with funding from Senate Bill 1 (Beall, Chapter 5, Statutes of 2017) and the Greenhouse Gas Reduction Fund (Budget Act of 2019). In both cases, the CWDB's approach focuses on increasing access to quality construction career pathways rather than short-term training for particular construction projects or climate investment programs.

Expansion Possibilities

The state has the opportunity to work towards funding regional consortia of pre-apprenticeship programs and training partnerships to ensure calibration between the number of pre-apprenticeship training slots and the number of job openings at a regional level. The High Road Construction Careers initiative is thus suited to any sector or climate investment for which construction work represents a component of program or project implementation activities.



2b. Support inclusion programs for technical and blue-collar jobs via high-road training partnerships.

Outside of the construction sector, some jobs critical to the transition to a carbon-neutral economy that do not require a four-year college degree offer family-supporting careers and provide important opportunities for disadvantaged workers. The high-road training partnerships described above for incumbent worker training can also integrate pipeline programs. This entails close collaboration with community-based organizations and the public workforce system to provide the comprehensive supports needed to prepare under-served populations for apprenticeships or other pathways into occupations critical to the state's climate future.

Current Application

The San Francisco Public Utilities Commission and the Alameda County Waste Management both have very strong inclusion programs that provide training for career jobs to disadvantaged workers through collaborations with community organizations. In addition, in a variety of industries with growing sustainability practices, HRTPs are preparing and connecting disadvantaged workers to good jobs: the Worker Education and Resource Center for county careers in Los Angeles, the West Oakland Job Resource Center for transportation careers at the port; and the California Transit Works! for public transit careers.

Expansion Possibilities

A significant opportunity for creating inclusive pipelines is in water and energy utilities, where the existence of good jobs and an aging workforce present ideal conditions for such policies. Other strategies designed to improve jobs while reducing emissions, such as initiatives to reform contracting processes so that they include strong labor and environmental standards, can also incorporate inclusion programs to ensure that as wages rise, opportunities for historically excluded groups are expanded. A key industry in this category is waste, where reform of the contracting models is necessary to achieve the more stringent targets for waste diversion. Jobs in fire prevention and forest management in the Department of Forestry and Fire Protection also offer opportunities for inclusion through insourcing of work that is now contracted out and through the expansion of pipeline programs.

2c. Support inclusion programs for professional clean economy jobs.

A commitment to broaden access to economic opportunities that emerge from the growth of low-emission technologies and industries should also focus on inclusion into jobs that require bachelor's or graduate degrees, such as engineers, architects, and



other professional and technical workers. For these jobs, inclusion efforts are most successful when linked to preparation in high school, as it is much more difficult to create such pathways after workers leave school. Students must first gain their foundational knowledge before getting specialized training, and should be exposed to as wide a variety of viable career paths as feasible during this phase of their education. Funding to improve inclusion into professional and technical occupations related to the transition to a carbon-neutral economy is therefore most effective if it contributes to existing initiatives, rather than initiating new ones that focus only on climate-critical occupations.

Current Application

The California Partnership Academies, the California Linked Learning Initiative, and the California Career Pathways Trust all are recent initiatives linked to community colleges that are designed to build successful high-school-to-college transitions for California's many underserved youth, which can eventually lead into occupations related to climate policy implementation. The community college system, via its transfer programs, is itself a pipeline for many disadvantaged Californians into professional occupations.⁹⁷

Expansion Possibilities

Private employers and public agencies in all six Scoping Plan sectors who hire professional workers can participate in existing initiatives that expose young people to professional pathways through paid internships and other programming for inclusion.

3. Support curriculum upgrades and teacher training for emerging technologies in occupations critical to the transition to a carbon-neutral economy.

To prepare the next generation of energy engineers, electricians, zero-emission bus mechanics, transportation planners, and **all** the other occupations that are necessary to develop, design, plan, build, operate, and maintain new technologies that lower greenhouse gas emissions, the state should support the incorporation of new relevant skills and knowledge in the existing key postsecondary institutions that already provide foundational training for priority occupations. The state can accomplish this by supporting curriculum upgrades and instructor professional development in community colleges, apprenticeship programs, and four-year colleges.

Current Application

The community colleges have developed the Advanced Transportation and Logistics Initiative and the Energy Construction and Utilities Initiative, which use staff trained as "sector navigators" to work with industry to identify skill gaps and incorporate relevant skills and knowledge into curricula of programs of study for key occupations.



Apprenticeships in the trades continually incorporate needed new skills through employers' participation on curriculum committees.

Expansion Possibilities

There is an opportunity to more systematically support curricula upgrades related to climate in community colleges, apprenticeship, and four-year universities, by transferring information derived from emerging technology programs to appropriate institutional venues for curricula upgrades, as described in demand-side recommendation #7, above.

4. Track outcomes of all training programs.

To evaluate and improve training investments over time, all training programs should track workforce outcomes for participants. Key metrics include not only number of enrollees and number of graduates, but also attainment of industry-recognized credential, job placement, job retention, initial wages, and wage mobility over time. In addition, resources could be devoted to the challenging but valuable work of tracking benefits to employers in terms of increased productivity and quality. This critical work is time-consuming and expensive, and where mandated should include appropriate staff, technological, and financial resources. Requiring tracking at any level of training, from entry level to incumbent worker training, is essential to improve training over time and direct training investments towards programs that produce the best outcomes for workers. Finally, the state should continue to invest in third-party studies and evaluations that assess the broad, integrated, social and economic impact of workforce partnerships, considering the costs and value of building a high-road training infrastructure that addresses both climate and equity concerns, and measuring broader community outcomes that go beyond individual labor market advancement.

Just Transition for Workers and Communities Facing Industry Decline

California can and should build an inclusive carbon-neutral economy based on high quality jobs. At the same time, the state must acknowledge those industries and jobs that have been part of its economic foundation for generations, and that may experience decline as California and many other jurisdictions (within and outside the U.S.) begin a steady decrease in fossil fuel use. Specific regions of California have long depended on jobs in the oil and gas sector, and in other sectors that have traditionally depended on fossil fuels for heat, power, or raw material inputs. It is imperative for the state to develop strong policies to help diversify the economies of these regions, as well as to identify transition strategies for workers and communities dependent on fossil fuel or emissions-intensive industries. Transition assistance programs that focus on securing comparable jobs or incomes provide some models to consider.⁹⁸



The following recommendations reflect a phased approach that aims to prepare and support at-risk workers and communities, at the same time the state considers broader and more comprehensive strategies to help strengthen and diversify key regional economies.

1. Short term: Fully explore alternatives to plant closures when there are other strategies available that will achieve greenhouse gas emissions reductions *and* local pollution abatement.

In specific communities, immediate plant closure may not be the best and most equitable way to achieve the state’s carbon emission goals. It is important to explore whether in the short term, continued investments in emissions abatement and targeted enforcement of pollution mandates for heavy emitting industries could ensure maximum job retention concurrent with decreasing emissions and pollution. This includes deploying Best Available Retrofit Technology as required in AB 617, fugitive methane emissions capture mandates, and industrial energy efficiency incentive programs. Targeted investments in pollution abatement can create jobs, many in sectors where skilled workforce standards already speak to job quality.

2. Longer term: Convene an interagency task force to develop concrete, specific plans for short-term and long-term transition.

2a. Identify priority transition assistance needs.

The state could work to identify the most vulnerable industries, firms, and localities through research and engagement of a diverse set of business, labor, and community interests, and develop a set of the most likely job disruption scenarios through 2030. At the same time, the state could work to support regions in an economic analysis of the most promising emerging high-road industries and jobs based on specific regional assets including geography, educational and research institutions, and existing workforce skills. For each scenario, the task force could develop cost estimates for a transition plan, incorporating a variety of assistance packages. Such estimates should examine options for retraining and job placement, considerations regarding the speed of industry transition, and firm and worker characteristics such as the health of pension plans and the age of workforce. This work could be facilitated by the High Road Training Partnerships described above, which would provide a framework for stakeholder discussion and planning.



2b. Facilitate a planning process for transition assistance.

Based on the identification of priorities, the state could work with at risk communities, labor, and business—again, ideally through regional industry partnerships such as the H RTPs—to develop and propose a set of key criteria for transition programs that include a combination of income and benefits support, skills training, and job creation. Ultimately, any program will need to be directly beneficial to the specific region and industry affected. Potential benefits could include income support; continued pension accrual and health care benefits; a bridge to retirement for older workers; sizable job training, retraining, or education allowances and case management to improve the likelihood of re-employment at comparable wages; consideration of guaranteed employment in public works or first source privilege in hiring; and even outside the box ideas such as college aid for the children of displaced workers.

VI. Conclusion

California’s ambitious path towards a carbon-neutral economy is complex, involves and affects different industries and occupations in multiple ways, and holds both promise and challenges for the state’s working families. The analysis and recommendations here present actions that show a high road to climate policy is both valuable and feasible.



Endnotes

1 Ian Perry, “California Is Working: The Effects of California’s Public Policy on Jobs and the Economy Since 2011” (UC Berkeley Center for Labor Research and Education, November 14, 2017), <http://laborcenter.berkeley.edu/california-is-working/>.

2 Eduardo Garcia, “AB-398 California Global Warming Solutions Act of 2006: Market-Based Compliance Mechanisms: Fire Prevention Fees: Sales and Use Tax Manufacturing Exemption,” Chapter 135, Statutes of 2017 § (2017), [https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398](https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398). The bill adds Section 38591.3 to the Health and Safety Code, specifying:

(a) No later than January 1, 2019, the California Workforce Development Board, in consultation with the state board, shall report to the Legislature on the need for increased education, career technical education, job training, and workforce development resources or capacity to help industry, workers, and communities transition to economic and labor-market changes related to statewide greenhouse gas emissions reduction goals, pursuant to Sections 38550 and 38566, and the scoping plan, adopted pursuant to Section 38561. The California Workforce Development Board shall ensure that the report aligns, as appropriate, with California’s Unified Strategic Workforce Development Plan, developed by the California Workforce Development Board. The California Workforce Development Board and the state board shall work in consultation with all of the following:

(1) State Department of Education.

(2) California Community Colleges.

(3) Trustees of the California State University.

(4) Regents of the University of California.

(5) Governor’s Office of Business and Economic Development.

(6) Interested stakeholders.

(b) The report to the Legislature shall address all of the following:

(1) Creating and retaining jobs and stimulating economic activity in the state.

(2) Imbedding workforce training and employment services in infrastructure investments so that services more directly connect to the jobs created.

(3) The use of community benefits agreements, community workforce agreements, and project labor agreements that connect workforce services and job training directly to jobs impacted or jobs created.



- (4) Preparing the state’s students with relevant career technical education that responds to business and industry demands.
 - (5) Developing worker retraining programs to assist the existing workforce with the necessary tools to upgrade their skills.
 - (6) Responding to the job creation and workforce needs of the state’s new and emerging industries, including emerging technologies that will result in greater greenhouse gas emissions reductions.
 - (7) Developing job training programs to assist specific populations, such as at-risk youth, displaced workers, veterans, the formerly incarcerated, and others facing barriers to employment.
 - (8) Opportunities for community-based organizations to partner with local workforce agencies to improve the labor-market outcomes of targeted disadvantaged populations.
 - (9) Targeting workforce development programs and activities in disadvantaged communities, as identified pursuant to Section 39711, and communities that are located near entities regulated by the state board pursuant to this division.
 - (10) Identifying and leveraging state and federal funding resources to implement the recommendations made in the report consistent with the regulatory purposes of this division.
- (c) This section shall remain in effect only until January 1, 2031, and as of that date is repealed.

3 Garcia.

4 California Workforce Development Board, “Skills Attainment for Upward Mobility; Aligned Services for Shared Prosperity: California’s Unified Strategic Workforce Development Plan Under the Workforce Innovation and Opportunity Act (WIOA) for Program Years 2016-2019,” December 2018, https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/01/Unified-State-Plan-modifications.Final_.12.27.18.1.pdf.

5 A summary of these meetings is included as Appendix B to this report.

6 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.

7 California Air Resources Board, 62–95.

8 California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2016: Trends of Emissions and Other Indicators,” 2018, https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf; Chris Busch, “How



Do Ambitious Climate Pledges Impact Economic Growth? For Insight, Compare Texas And California.,” *Forbes*, September 10, 2018, <https://www.forbes.com/sites/energyinnovation/2018/09/10/how-do-ambitious-climate-pledges-impact-economic-growth-for-insight-compare-texas-and-california/>.

9 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 62–95.

10 U.S. Global Change Research Program, “Climate Science Special Report: Fourth National Climate Assessment, Volume 1” (Washington, D.C.: U.S. Global Change Research Program, 2017), <https://science2017.globalchange.gov/>; see also: California Governor’s Office of Planning and Research, California Natural Resources Agency, and California Energy Commission, “California’s Fourth Climate Change Assessment,” accessed June 12, 2019, <http://www.climateassessment.ca.gov/>. CARB economic modeling estimates that by 2030, California climate policy will result in lowering GDP by 0.3-0.6 percent compared to GDP with no climate policy costs.

11 Carol Zabin et al., “Advancing Equity in California Climate Policy: A New Social Contract for Low-Carbon Transition” (UC Berkeley Donald Vial Center on Employment in the Green Economy, September 13, 2016), <http://laborcenter.berkeley.edu/advancing-equity/>.

12 Josh Bivens, “A Comprehensive Analysis of the Employment Impacts of the EPA’s Proposed Clean Power Plan,” Briefing Paper (Economic Policy Institute, 2015), <http://www.epi.org/publication/employment-analysis-epa-clean-power-plan/>.

13 J. C. Wiles, B. Brooks, and B.- Schultze, “PV Installations, a Progress Report,” in *Conference Record of the Twenty-Ninth IEEE Photovoltaic Specialists Conference, 2002.*, 2002, 1461–64, <https://ieeexplore.ieee.org/document/1190885>. “Using the mature PV module technology and proven balance-of-systems (BOS) equipment, well-trained and experienced PV designers and installers following the best available information and codes are providing PV electrical power systems that are safe, durable, reliable, and well performing. About 50% of the surveyed installations met this goal. However, the remaining 50% of the installed systems had deficiencies in these same areas of safety, reliability, durability, and performance.”

14 Guillermo Escrivá-Escrivá, “Basic Actions to Improve Energy Efficiency in Commercial Buildings in Operation,” *Energy and Buildings* 43, no. 11 (November 1, 2011): 3106–11, <https://doi.org/10.1016/j.enbuild.2011.08.006>.

15 Ian Perry, “Low-Wage Work in California Data Explorer,” UC Berkeley Center for Labor Research and Education, August 16, 2018, <http://laborcenter.berkeley.edu/low-wage-work-in-california-data-explorer/>.

16 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 59–60.



- 17 California Workforce Development Board, “High Road Framework,” June 2018, https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/09/High-Road-ECJ-Brief_UPDATED-BRANDING.pdf; Paul Osterman, “In Search of the High Road: Meaning and Evidence,” *ILR Review* 71, no. 1 (January 1, 2018): 3–34, <https://doi.org/10.1177/0019793917738757>.
- 18 Annette Bernhardt, “Low-Wage Work in California: 2014 Chartbook” (UC Berkeley Center for Labor Research and Education, April 30, 2015), <http://laborcenter.berkeley.edu/lowwageca/>.
- 19 California Office of Environmental Health Hazard Assessment (OEHHA), “CalEnviroScreen,” Text, OEHHA, November 27, 2014, <https://oehha.ca.gov/calenviroscreen>.
- 20 Osterman, “In Search of the High Road”; Daniel Luria and Joel Rogers, *Metro Futures: Economic Solutions for the Cities and Their Suburbs* (Boston, MA: Beacon Press, 1999), https://www.cows.org/_data/files/1999_Metro_Futures_complete_book.pdf.
- 21 Carol Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014), <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>.
- 22 Carol Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response” (UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011), chap. 4, <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.
- 23 Luria and Rogers, *Metro Futures: Economic Solutions for the Cities and Their Suburbs*.
- 24 Garcia, AB-398 California Global Warming Solutions Act of 2006: market-based compliance mechanisms: fire prevention fees: sales and use tax manufacturing exemption, sec. 38591.3.b.
- 25 Art Lujan, Lyle A. Balistreri, and Loree K. Soggs, “Community Workforce Agreements: Pathway to Career Opportunities” (Jobs for the Future, March 2013), <https://www.jff.org/resources/community-workforce-agreements-pathway-career-opportunities/>; Maria Figueroa, Jeff Grabelsky, and J. Ryan Lamare, “Community Workforce Agreements: A Tool to Grow the Union Market and to Expand Access to Lifetime Careers in the Unionized Building Trades,” *Labor Studies Journal* 38, no. 1 (March 2013): 7–31, <https://doi.org/10.1177/0160449X13490408>.



- 26 Daniel Villao et al., *Beyond Green Jobs: Building Lasting Opportunities in Energy Efficiency* (Los Angeles, CA: UCLA Labor Center, 2012), <https://books.labor.ucla.edu/p/77/beyondgreenjobs>.
- 27 Partnership for Working Families, “Policy & Tools: Community Benefits Agreements and Policies In Effect,” accessed May 9, 2016, <http://www.forworking-families.org/page/policy-tools-community-benefits-agreements-and-policies-effect>.
- 28 Partnership for Working Families.
- 29 California Budget & Policy Center, “2009 Mapping California’s Workforce Development System: A Guide to Workforce Development Programs in California,” May 2009, <https://calbudgetcenter.org/resources/2009-mapping-californias-workforce-development-system-a-guide-to-workforce-development-programs-in-california/>; Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”
- 30 Zeynep Ton, *The Good Jobs Strategy: How the Smartest Companies Invest in Employees to Lower Costs and Boost Profits* (Boston, MA: New Harvest, 2013).
- 31 Laura Dresser, Hannah Halbert, and Stephen Herzenberg, “High Road WIOA: Building Higher Job Quality into Workforce Development” (Economic Analysis Research Network (EARN), COWS, Policy Matters Ohio, Keystone Research Center, December 2015), https://www.keystoneresearch.org/sites/default/files/KRC_WIOA.pdf.
- 32 COWS, “Equity in Apprenticeship,” August 17, 2018, <https://www.cows.org/equity-in-apprenticeship>.
- 33 Sarah White, Laura Dresser, and Joel Rogers, “Greener Skills: How Credentials Create Value in the Clean Energy Economy” (COWS, March 25, 2010), <https://www.cows.org/greener-skills-how-credentials-create-value-in-the-clean-energy-economy>.
- 34 Elena Foshay, Jill Kubit, and Lara Skinner, “Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy” (Apollo Alliance & Cornell University, ILR School Global Labor Institute, 2009), http://www.climatechange.ca.gov/eaac/comments/2009-12-11_California_Labor_Federation_attachment_2.pdf.
- 35 Foshay, Kubit, and Skinner.
- 36 Sarah White and Jason Walsh, “Jobs and Workforce Development in the Clean Energy Economy” (COWS, Workforce Alliance, Apollo Alliance, 2008), https://www.cows.org/_data/documents/1226.pdf.
- 37 Robert P. Giloth, “Workforce Intermediaries: Partnerships for the Future,” *Economic Development Quarterly* 17, no. 3 (August 1, 2003): 215–19, <https://doi.org/10.1177/0891242403255222>.



38 California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019, https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf. See also California Air Resources Board, “California’s 2017 Climate Change Scoping Plan.”

39 J.R. DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments” (UCLA Luskin Center for Innovation, August 14, 2018), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Employment_Benefits_from_CA_Climate_Investments_and_Co-investments.pdf; California Air Resources Board, “California’s 2017 Climate Change Scoping Plan Appendix E Economic Analysis,” November 2017, https://ww3.arb.ca.gov/cc/scopingplan/2030sp_app_econ_final.pdf.

40 Blue-collar occupations are defined here as: construction and extraction occupations; production occupations; transportation and material moving occupations; installation, maintenance, and repair occupations; building and grounds cleaning and maintenance occupations; and farming, fishing, and forestry occupations. See Appendix A, Mapping Sectors to Industries and Occupations, for details on occupational categories.

41 U.S. Department of Labor, Bureau of Labor Statistics, “May 2017 OES National Industry-Specific Occupational Employment and Wage Estimates,” May 2017, <https://www.bls.gov/oes/2017/may/oessrci.htm>.

42 White and Walsh, “Jobs and Workforce Development in the Clean Energy Economy.”

43 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Outlook Handbook,” accessed January 2, 2019, <https://www.bls.gov/ooh/home.htm>; Joel Rogers et al., “High Performance Partnerships: Winning Solutions for Employers and Workers” (State of Wisconsin Department of Workforce Development, 1999), <https://www.cows.org/high-performance-partnerships-winning-solutions-for-employers-and-workers>.

44 Sara Hinkley, Annette Bernhardt, and Sarah Thomason, “Race to the Bottom: How Low-Road Subcontracting Affects Working Conditions in California’s Property Services Industry” (UC Berkeley Center for Labor Research and Education, March 8, 2016), <http://laborcenter.berkeley.edu/race-to-the-bottom/>.

45 Ruth Milkman, Ana Luz Gonzalez, and Victor Narro, “Wage Theft and Workplace Violations in Los Angeles: The Failure of Employment and Labor Law for Low-Wage Workers” (UCLA Institute for Research on Labor and Employment, 2010), <https://escholarship.org/uc/item/5jt7n9gx>; Annette Bernhardt, “Labor Standards and the Reorganization of Work: Gaps in Data and Research,” IRLE Working Paper (UC Berkeley Institute for Research on Labor and Employment, January 2014), <https://escholarship.org/uc/item/3hc6t3d5>.



- 46 David Autor, “The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings” (Center for American Progress and The Hamilton Project, April 2010), <https://economics.mit.edu/files/5554>.
- 47 Rogers et al., “High Performance Partnerships: Winning Solutions for Employers and Workers.”
- 48 DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments.”
- 49 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”
- 50 Peter Philips, “Environmental and Economic Benefits of Building Solar in California: Quality Careers—Cleaner Lives” (UC Berkeley Donald Vial Center on Employment in the Green Economy, November 10, 2014), <http://laborcenter.berkeley.edu/environmental-and-economic-benefits-of-building-solar-in-california-quality-careers-cleaner-lives/>; Betony Jones, Peter Philips, and Carol Zabin, “The Link Between Good Jobs and a Low Carbon Future” (UC Berkeley Donald Vial Center on Employment in the Green Economy, July 2016), <http://laborcenter.berkeley.edu/the-link-between-good-jobs-and-a-low-carbon-future/>.
- 51 Guido Franco, “Greenhouse Gas Emission Reductions - Tracking Progress” (California Energy Commission, December 2017), https://ww2.energy.ca.gov/renewables/tracking_progress/documents/%20%20_%20%20duplicate:old%20files%20here/Greenhouse_Gas_Emissions_Reductions.pdf.
- 52 Nikki Luke et al., “Diversity in California’s Clean Energy Workforce: Access to Jobs for Disadvantaged Workers in Renewable Energy Construction” (UC Berkeley Center for Labor Research and Education, August 31, 2017), <http://laborcenter.berkeley.edu/diversity-in-californias-clean-energy-workforce/>; Jones, Philips, and Zabin, “The Link Between Good Jobs and a Low Carbon Future.”
- 53 Luke et al., “Diversity in California’s Clean Energy Workforce.”
- 54 Jones, Philips, and Zabin, “The Link Between Good Jobs and a Low Carbon Future.”
- 55 California High-Speed Rail Authority, “Community Benefits Agreement,” August 13, 2013, https://www.hsr.ca.gov/Programs/Construction/community_benefits_agreement.html.
- 56 California Strategic Growth Council, “Transformative Climate Communities (TCC),” California Strategic Growth Council, accessed August 28, 2018, <http://sgc.ca.gov/programs/tcc/>.



57 Pew Research Center, “America’s Shrinking Middle Class: A Close Look at Changes Within Metropolitan Areas,” May 11, 2016, <http://www.pewsocialtrends.org/2016/05/11/americas-shrinking-middle-class-a-close-look-at-changes-within-metropolitan-areas/>.

58 Beverly G. Ward and Eric T. Hill, “Women in Transit: Findings from African-Americans, Other Minorities, and Women in the Transit Industry,” *Women’s Travel Issues: Proceedings from the Second National Conference* FHWA-PL-97-02 (October 1996), <https://www.fhwa.dot.gov/ohim/womens/chap32.pdf>.

59 Joseph Kane and Adie Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity” (The Metropolitan Policy Program at Brookings, June 2018), <https://www.brookings.edu/research/water-workforce/>.

60 San Francisco Public Utilities Commission, “Internships, Apprenticeships and Youth Employment,” accessed February 12, 2018, <http://sfwater.org/index.aspx?page=888>. Ellen Avis and Carol Zabin, “Training for the Future, Workforce Development for a 21st Century Utility Los Angeles’s Utility Pre-Craft Trainee Program” (UC Berkeley Donald Vial Center on Employment in the Green Economy, 2013), http://laborcenter.berkeley.edu/pdf/2013/training_future13.pdf.

61 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)”; Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response”; Betony Jones and Carol Zabin, “Are Solar Energy Jobs Good Jobs?,” *Raising the Bar: UC Berkeley Labor Center Blog* (blog), July 2, 2015, <http://laborcenter.berkeley.edu/are-solar-energy-jobs-good-jobs/>; Jones, Philips, and Zabin, “The Link Between Good Jobs and a Low Carbon Future.”

62 Thomas Moehrle, “Compensation of Residential and Nonresidential Construction Workers,” *Monthly Labor Review*, April 2010, 15.; Yvonne Yen Liu and Daniel Flaming, “Sinking Underground: The Growing Informal Economy in California Construction” (Economic Roundtable, September 1, 2014), <https://economicrt.org/publication/sinking-underground/>; Milkman, Gonzalez, and Narro, “Wage Theft and Workplace Violations in Los Angeles: The Failure of Employment and Labor Law for Low-Wage Workers.”

63 Carol Zabin and Megan Emiko Scott, “Proposition 39: Jobs and Training for California’s Workforce” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2013), <http://laborcenter.berkeley.edu/proposition-39-jobs-and-training-for-californias-workforce/>. Carol Zabin, Kevin Duncan, and Erica Paul, “Proposition 39 Job Creation & Quality, 2014-2018: A Report to the Citizens Oversight Board of the California Clean Energy Jobs Act” (California Workforce Development Board, 2019), <http://laborcenter.berkeley.edu/proposition-39-job-creation-quality-2014-2018/>.



64 Lawrence Mishel, “Yes, Manufacturing Still Provides a Pay Advantage, but Staffing Firm Outsourcing Is Eroding It” (Economic Policy Institute, March 12, 2018), <https://www.epi.org/files/pdf/141193.pdf>; Ken Jacobs et al., “Producing Poverty: The Public Cost of Low-Wage Production Jobs in Manufacturing” (UC Berkeley Center for Labor Research and Education, 2016), <http://laborcenter.berkeley.edu/pdf/2016/Producing-Poverty.pdf>.

65 This is based on review of the California Department of Industrial Relations (Division of Occupational Safety & Health and Division of Labor Standards Enforcement) inspections and investigations since 2011 of zero-emission vehicle manufacturers that have received state funding for workforce and capital/production investments.

66 Ann C. Foster, “Differences in Union and Nonunion Earnings in Blue-Collar and Service Occupations” (U.S. Department of Labor, Bureau of Labor Statistics, June 25, 2003), <https://www.bls.gov/opub/mlr/cwc/differences-in-union-and-nonunion-earnings-in-blue-collar-and-service-occupations.pdf>.

67 Jobs to Move America, “Victories,” accessed November 21, 2018, <https://jobstomoveamerica.org/about/california-jobs-move-america/victories/>; Jobs to Move America, “Labor and Community Groups Sign Landmark Agreement with Electric Bus Manufacturer BYD in Los Angeles,” July 17, 2017, <https://en.byd.com/news-posts/press-release-labor-and-community-groups-sign-landmark-agreement-with-electric-bus-manufacturer-byd-in-los-angeles/>; Steven Greenhouse, “Connecting Public Transit to Great Manufacturing Jobs,” *The American Prospect*, April 9, 2018, <http://prospect.org/article/connecting-public-transit-great-manufacturing-jobs>.

68 Ricardo Lara, “SB-1402 Labor Contracting: Customer Liability,” Chapter 702, Statutes of 2018 § (2018), https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1402; Rebecca Smith, David Bensman, and Paul Alexander Marvy, “The Big Rig: Poverty, Pollution, and the Misclassification of Truck Drivers at America’s Ports” (National Employment Law Project and Change to Win, December 2010), <https://s27147.pcdn.co/wp-content/uploads/2015/03/PovertyPollutionandMisclassification.pdf>; Brett Murphy, “Rigged. Forced into Debt. Worked Past Exhaustion. Left with Nothing.,” *USA TODAY*, June 16, 2017, <https://www.usatoday.com/pages/interactives/news/rigged-forced-into-debt-worked-past-exhaustion-left-with-nothing/>.

69 California Department of Industrial Relations, “Cal/OSHA Issues Citations for Fatal Waste Collection Truck Accident (News Release No. 2018-77),” September 20, 2018, <https://www.dir.ca.gov/DIRNews/2018/2018-77.pdf>.

70 Lauren Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities” (LAANE: A New Economy For All, July 2015), <http://laane.org/wp-content/uploads/2017/06/Cleaning-Up-Waste-1.pdf>; U.S. Department of Labor, Occupational Safety & Health Administration, “Green Job Hazards: Waste



Management and Recycling,” accessed September 21, 2018, <https://www.osha.gov/dep/greenjobs/recycling.html>; Recycling Today, “CalRecycle Targets Wage Violators,” March 16, 2015, <https://www.recyclingtoday.com/article/calrecycle-targets-wage-violators/>.

71 Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities.”

72 Ahkiam.

73 Recycling Today, “CalRecycle Targets Wage Violators”; Cole Rosengren, “Crackdown on Wage Violations Continues in California Recycling Industry,” *Waste Dive*, May 20, 2016, <https://www.wastedive.com/news/crackdown-on-wage-violations-continues-in-california-recycling-industry/419538/>; U.S. Department of Labor, Occupational Safety & Health Administration, “Green Job Hazards: Waste Management and Recycling”; California Department of Industrial Relations, “Cal/OSHA Issues Citations for Fatal Waste Collection Truck Accident (News Release No. 2018-77).”

74 Cal Fire, “CAL FIRE Firefighter Training,” October 2009, http://calfire.ca.gov/communications/downloads/fact_sheets/Firefightertraining.pdf.

75 U.S. Department of Labor, Bureau of Labor Statistics, “May 2018 OES State Occupational Employment and Wage Estimates - California (45-4011 - Forest and Conservation Workers),” accessed April 2, 2019, https://www.bls.gov/oes/current/oes_ca.htm#45-0000.

76 Alliance of Forest Workers and Harvesters, “A Guide to Job Quality and Remaining Competitive in Forest Ecosystem Restoration,” June 2010, <https://firebasestorage.googleapis.com/v0/b/nwforestworkers-f633c.appspot.com/o/PDF%2FHandbook.pdf?alt=media&token=77aacec1-9b77-4c87-bb9b-b9a17eeaccb2>.

77 Alliance of Forest Workers and Harvesters; “Forest Service Workers,” Pub. L. No. S. Hrg. 109-427, § Subcommittee on Public Lands and Forests of the Committee on Energy and Natural Resources (2006), <https://www.gpo.gov/fdsys/pkg/CHRG-109shrg28144/html/CHRG-109shrg28144.htm>.

78 California Employment Development Department, “Quarterly Census of Employment and Wages (QCEW) - Industry Detail,” 2016, https://www.labormarketinfo.edd.ca.gov/qcew/CEW-Detail_NAICS.asp?MajorIndustryCode=1021&Geo-Code=06000000&Year=2016&OwnCode=50&Qtr=00.; natural gas distribution jobs were not available in the QCEW, and are reported for the less reliable Current Employment Statistics Survey, California Employment Development Department, “Labor Market Information for the State of California (Statewide Summary),” accessed December 4, 2018, <https://www.labormarketinfo.edd.ca.gov/geography/california-statewide.html>.

79 Jobs to Move America, “Victories.”



- 80 U.S. Environmental Protection Agency, “General Risk Management Program Guidance - Chapter 2: Applicability of Program Levels,” April 2004, <https://www.epa.gov/rmp/general-rmp-guidance-chapter-2-applicability-program-levels>.
- 81 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”
- 82 California Public Utilities Commission, “Decision Addressing Energy Efficiency Business Plans,” May 31, 2018, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K706/215706139.PDF>.
- 83 California Public Utilities Commission, “Decision on the Transportation Electrification Priority Review Projects,” January 11, 2018, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K655/204655240.PDF>.
- 84 Loni Hancock, “SB-54 Hazardous Materials Management: Stationary Sources: Skilled and Trained Workforce,” Chapter 795, Statutes of 2013 § (2013), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB54.
- 85 Avis and Zabin, “Training for the Future, Workforce Development for a 21st Century Utility Los Angeles’s Utility Pre-Craft Trainee Program.”
- 86 South Coast Air Quality Management District, “Board Meeting Minutes, Agenda No. 29 (Report of the Technology Committee Meeting Held September 21, 2018),” October 5, 2018, <http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2018/2018-oct5-029.pdf?sfvrsn=2>.
- 87 Los Angeles Department of Water and Power, “LADWP Approves New Community Solar Power Program for Renters,” September 26, 2018, <http://www.ladwpnews.com/ladwp-approves-new-community-solar-power-program-for-renters/>.
- 88 David Roland-Holst et al., “Methods to Assess Co-Benefits of California Climate Investments” (UC Berkeley Center for Resource Efficient Communities, November 2, 2017), https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/ucb_lit_rev_on_jobs.pdf.
- 89 Partnership for Working Families, “Policy & Tools: Community Benefits Agreements and Policies In Effect.”
- 90 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan),” Appendix 5B.
- 91 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”
- 92 California Workforce Development Board, “High Road Training Partnerships,” accessed September 11, 2019, <https://cwdb.ca.gov/initiatives/high-road-training-partnerships/>.



- 93 Luke et al., “Diversity in California’s Clean Energy Workforce.”
- 94 Luke et al.
- 95 California Workforce Development Board, “High Road Partnerships for Construction Careers,” accessed October 12, 2018, <https://cwdb.ca.gov/initiatives/hrcc/>.
- 96 California Workforce Development Board, “SB 1 Workforce Guidelines,” January 2019, <https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/02/SB1-Workforce-Guidelines-1.18.2019.pdf>.
- 97 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”
- 98 Jeremy Brecher, “Climate, Jobs, and Justice: A Plan for a Just Transition to a Climate-Safe Economy,” *Labor Network for Sustainability* (blog), accessed December 4, 2018, <http://www.labor4sustainability.org/articles/climate-jobs-and-justice-a-plan-for-a-just-transition-to-a-climate-safe-economy/>.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

edited by Carol Zabin • June 2020

Chapter 1: Introduction

by Carol Zabin

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I. Background

Over the last 15 years, California has emerged as a national and world leader in the fight to avoid climate disaster, passing a comprehensive and evolving suite of climate measures to accelerate the transition to a carbon-neutral economy. The state has also emerged as a national leader in embracing economic equity as a goal for state policy, charting a path towards a new social compact for shared prosperity in a rapidly changing world.¹ Meaningful commitment to both of these goals requires the development and implementation of a bold agenda that aligns California's ambitious climate and workforce action plans. This report presents a framework for California to advance that agenda in order to simultaneously improve equity, mobility, and job quality for workers, deliver skills and a level playing field for the state's best employers, and address the challenges of climate change across the economy.

Assembly Bill 398 (E. Garcia, Chapter 135, Statutes of 2017) required that the California Workforce Development Board (CWDB) present a report to the Legislature on strategies “to help industry, workers, and communities transition to economic and labor-market changes related to statewide greenhouse gas emissions reduction goals.”² To fulfill this mandate, the CWDB contracted with the Center for Labor Research and Education at the University of California to review the existing research from leading experts in the field and prepare this report.

The legislation³ specifically requires that the report address:

- Creating and retaining jobs and stimulating economic activity in the state;
- Embedding workforce training and employment services in infrastructure investments so that services more directly connect to the jobs created;
- The use of community benefits agreements, community workforce agreements, and project labor agreements that connect workforce services and job training directly to jobs impacted or created;
- Preparing the state's students with relevant career technical education that responds to business and industry demands;
- Developing worker retraining programs to assist the existing workforce with the necessary tools to upgrade their skills;
- Responding to the job creation and workforce needs of the state's new and emerging industries, including emerging technologies that will result in greater greenhouse gas emission reductions;



- Developing job training programs to assist specific populations, such as at-risk youth, displaced workers, veterans, the formerly incarcerated, and others facing barriers to employment;
- Opportunities for community-based organizations to partner with local workforce agencies to improve the labor-market outcomes of targeted disadvantaged populations;
- Targeting workforce development programs and activities in disadvantaged communities, as identified pursuant to Section 39711, and communities that are located near entities regulated by the CWDB pursuant to this division; and
- Identifying and leveraging state and federal funding resources to implement the recommendations made in the report consistent with the regulatory purposes of this division.

The directive in AB 398 makes clear that this report should address workforce interventions that affect both job creation and worker training and should highlight the importance of diverse actors inside and outside of government. This report presents a comprehensive strategy that identifies roles for agencies implementing climate policy and those implementing workforce policy, as well as key partners such as business, labor, community, and education and training institutions. As mandated in the legislation, all recommendations align with the CWDB's Unified Strategic Workforce Development Plan, which has put forth a set of actions to leverage and coordinate the state's myriad workforce and education programs to support high-quality careers for Californians.⁴

California's 2017 Climate Change Scoping Plan (Scoping Plan)⁵ presents a roadmap of policies and programs to reach the climate protection target in Senate Bill 32 (Pavley, Chapter 42, Statutes of 2016), which is a 40-percent reduction in greenhouse gas emissions from 1990 levels by 2030. The Scoping Plan is organized into six sectors based on sources of greenhouse gas emissions and corresponding climate action measures, as follows: Transportation, Industrial, Energy; Natural and Working Lands (including Agricultural Lands); Waste; and Water.⁶

The report organizes the available information from existing academic research, economic models, and industry studies for the six sectors identified in the Scoping Plan and presents for each of them:

- The available information about current labor conditions and major climate measures' impact on jobs;
- How to best generate family-supporting jobs, broaden job and career opportunities for workers from disadvantaged communities, deliver the skilled workforce that employers need to achieve California's climate targets, and protect workers in declining industries; and



- Guidance for policymakers, agencies, and institutions that implement climate and/or workforce policy, offering examples of concrete, scalable strategies that have connected effective climate action with workforce interventions to produce good outcomes for workers.

In keeping with the statutory directive, the report’s discussion was further enriched by comments provided to the CWDB through a series of stakeholder meetings organized by Scoping Plan sector and constituency held in July and August 2018.⁷

All the recommendations in this report have been successfully implemented by state and/or local government bodies. The report provides guidance on how the state can build on these successes to systematically embed job quality and job access strategies in all climate legislation, regulation, and program design.

II. The High-Road Framework

As the state advances toward its clean energy goals for 2030 and beyond, climate policy will drive far-reaching changes in the state economy as it adapts to a new, low-carbon paradigm. Climate policy creates both disruptions and opportunities for businesses in California as well as for the workers they employ. This report starts with the premise that California climate policy can and should provide multiple benefits: it should generate family-sustaining, career-track jobs; create pipelines to these jobs for workers from disadvantaged communities; and contain supports for workers and communities in carbon-intensive industries at risk of decline.⁸ This premise is consistent with the Scoping Plan as well, which notes that “the implementation of California’s climate change goals provides great opportunity to not only improve the habitability of the planet, but also to increase economic vitality [and] employ historically disadvantaged people in secure jobs.”⁹

Optimizing climate policy outcomes while supporting the creation of and access to family-supporting jobs is the “high-road” approach to economic development—and, it should be noted, the vision of equity, climate and jobs advanced by the CWDB. As the term is used here, a high-road economy supports businesses that compete on the basis of the quality of their products and services by investing in their workforce, paying the wages and benefits necessary to attract and retain skilled workers, who in turn perform high-quality work. Building the high road requires interventions on both the demand side and the supply side of the labor market.

Demand-side strategies are those that affect the demand for labor, including the kinds of jobs that are generated, the skills that are needed, the wages and benefits employers provide, and who employers hire.¹⁰ Public policy can encourage



improvements in job quality through industry-specific or economy-wide wage and benefit standards, such as prevailing, living, and minimum wages; skill certification requirements; enforcement of all labor and employment laws including proper classification of employees (vs. independent contractor arrangements); and collective bargaining rights. These types of policies support the high-road employers within an industry and help them attract and retain a skilled workforce by limiting competition based on low wages. Demand-side policies also include interventions to increase hiring of qualified workers from disadvantaged communities and to ensure that standards do not create barriers for historically excluded groups.

AB 398 specifically calls for the report to focus on opportunities to use project labor agreements (PLAs), community workforce agreements (CWAs), and community benefits agreements (CBAs), which are all well-tested demand-side strategies.¹¹ PLAs are pre-hire collective bargaining agreements unique to the construction industry that set wage and benefit standards. Although terminology varies, CWAs, as defined in this report, are PLAs that also include goals and processes for hiring from local communities or targeted disadvantaged groups. CBAs are legally enforceable agreements negotiated between community groups and a developer and require specified local benefits, in some cases related to job quality and hiring goals, in exchange for community support.

Demand-side strategies can be incorporated into climate measures through either policy or program design. Agencies responsible for implementing climate investments and other measures play a key role here and are essential to the alignment of climate and workforce actions.

Supply-side strategies are also critical. They focus on preparing the workforce for changes in the labor market due to climate policy and on delivering a skilled workforce to businesses involved in the transition to a carbon-neutral economy. For workers, training is valuable if it leads to job placement and wage and career advancement as they acquire skills; for employers, training is valuable if it leads to increased productivity and improved work quality. Public funding will only benefit both workers and employers if skilled workers are hired and retained, making it critical to target public training investments for high-road employers who see their workforce as a worthwhile investment rather than a cost to be minimized.

Workforce development is essential to building economic opportunity for those who have been marginalized, disadvantaged, and/or denied opportunities. Programs targeted to disadvantaged workers can secure more equality in the distribution of job opportunities, but the shortage of good jobs is an ongoing challenge for these pipeline programs. For low-wage jobs, the most effective strategies are those that build skills, respond to employer needs, and improve job quality, simultaneously.



Supply-side strategies are the traditional purview of the state’s workforce development community, which is made up of a complex web of institutions providing adult basic and postsecondary education, skill building, job matching, and other employment support and services. The workforce development community includes the community college and four-year college systems, certified apprenticeship programs, nonprofit training organizations, labor-management partnerships, the public workforce development system, and a host of state, county and municipal agency partners, as well as intermediaries who may align these systems and/or provide training themselves.

Best practice workforce development emphasizes training that:¹²

- Responds to actual labor market demand by partnering closely with industry;
- Supports the state’s high-road employers and pays attention to job quality;
- Emphasizes broad skill training for an occupation rather than just for one technology;
- Leverages the state’s existing workforce education and training infrastructure rather than creating boutique programs unconnected to workers’ education and career trajectories; and
- Assesses success of training based on outcomes, including job placement rates and improvements in wages and benefits improvements, higher worker productivity, and ongoing commitments by employers.

The comprehensive and proactive supply-side and demand-side approach described above—in which state climate investments intentionally improve job quality, while workforce investments broaden access to those jobs, and in which training focuses on broad occupations rather than narrow technologies—differs significantly from a common but incomplete view of how to deliver skills for the climate transition. The conventional approach relies primarily on a supply-side strategy: fund training programs that identify perceived skill gaps. The result is a rush to fund new short-term training programs aimed at new “green jobs.”

However, research and practice have confirmed that it is more accurate to talk about “greening jobs,” rather than new and different “green jobs.” The vast majority of the jobs that will be involved in work to lower greenhouse gas emissions across the economy are in traditional occupations where specific knowledge and skills related to emission reduction are only one component of a broader occupational skill set. A comprehensive study of energy efficiency programs found that approximately two-thirds of the jobs generated directly by energy efficiency investments in California are in traditional building and construction trades—e.g., electricians, sheet metal workers, plumbers, carpenters, stationary engineers, and others. Only around one-sixth are in professional occupations, and only 2 percent are specialized energy efficiency occupations like energy auditor



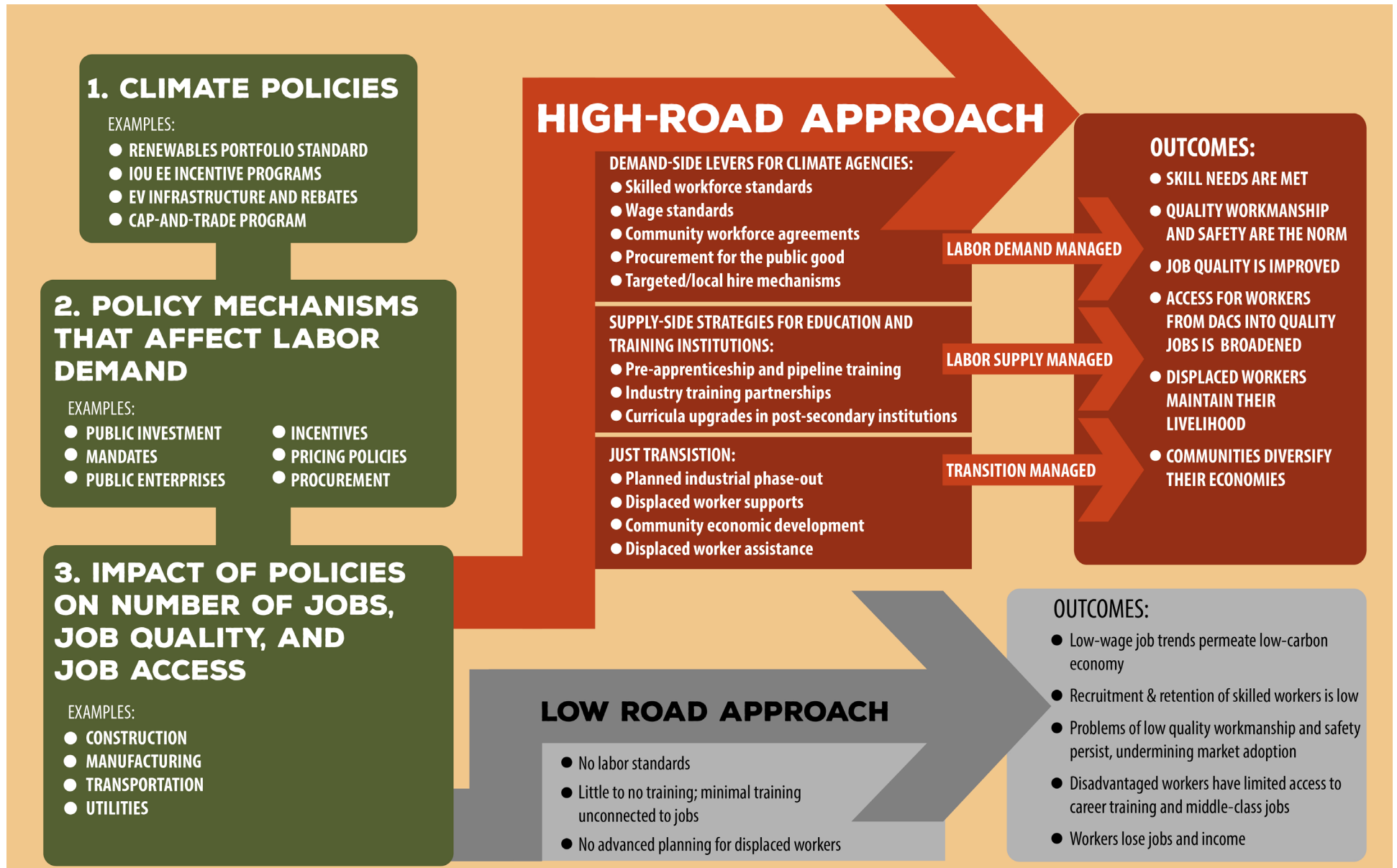
(and even then, auditors often perform other tasks unrelated to energy savings).¹³ Likewise, mechanics for zero-emission vehicles are still motor vehicle mechanics, and workers who manufacture electric cars are still autoworkers, even though their skill sets continually evolve. In other words, there are very few new occupations created by climate mitigation activities, but instead new aspects to old occupations.

Moreover, simply funding more training—particularly short-term, technology-specific training—does not necessarily help workers. Training neither creates jobs nor ensures job placement for graduates. To be effective, training strategies must connect directly to the labor market, explicitly addressing industry needs and connecting participants to actual jobs. The CWDB’s comprehensive approach—as exemplified by its High Road Construction Careers and High Road Training Partnership initiatives—integrates demand- and supply-side strategies, avoiding the pitfalls of niche “green jobs” training and ensuring that California workers are prepared for long-term careers in a rapidly-evolving, carbon-constrained economy.

Exhibit 1.1 presents the high road conceptual framework illustrating the alignment of climate and workforce action plans. It starts with (1) examples of climate measures that use (2) a variety of specific policy mechanisms, and have (3) impacts on the number of jobs, job quality, and who is hired in the key industries affected by each climate measure. Without specific demand-side and supply-side labor interventions, these job impacts will replicate current trends and practices in the labor market, which in some sectors will simply reproduce low wages and ethnic and gender disparities. The graphic illustrates two distinct choices: a low-road approach that does not incorporate workforce strategies (in gray), and a high-road approach that manages changes in the labor market using the strategies recommended in this document (in red).



Exhibit 1.1. Conceptual Framework



III. Rethinking How to Assess the Job Impacts of Climate Policy

Attention to skill delivery and equity issues requires going beyond the most common method of assessing job impacts of climate policy, which looks at job numbers only. Numbers alone do not tell the full story. This report also focuses on job quality (wages, benefits, etc.) and access (who gets the jobs).

1. Job Quality

Climate policy cannot be the “silver bullet” that solves the state’s low-wage job problem, but it does not have to exacerbate the problem and, in fact, can and should be implemented in ways that promote development of good, accessible jobs.

While the specifics will vary, there is general agreement that a good, family-supporting job pays a living wage; offers a stable schedule; provides benefits such as health care, retirement, paid sick days, and paid family leave; offers wage increases as skills are acquired; and complies with all workplace laws (e.g., laws on wage and hours, employee classification, health and safety, anti-discrimination, workers’ compensation, and the right to organize).¹⁴ Additional elements of job quality include respect for and inclusion of worker voice, and opportunities for training and advancement.

2. Job Access

To ensure that the benefits of the emerging carbon-neutral economy reach all Californians, the job opportunities generated from the growth of this economy must be shared across a workforce that reflects the diversity of the state’s population. Historical patterns of discrimination and institutional racism have led to concentrations of people of color and women in low-wage jobs. As a consequence, efforts to improve job quality must be coupled with efforts to promote inclusion (and vice versa). If not, we will simply replicate and reinforce the existing disproportionate concentration of African Americans, Latinos, and women in low-wage jobs.¹⁵

California uses a variety of criteria to identify disadvantaged workers, including measures for identifying workers with specific barriers to employment, such as at-risk youth, veterans, single mothers, and workers with criminal records. In the climate arena, the CalEnviroScreen tool¹⁶ is used to identify communities at the census tract level that bear disproportionate burdens of environmental degradation and social and economic disadvantage. This place-based ranking of disadvantage can complement criteria



measuring an individual's disadvantage, such as employment status, ethnicity, history of incarceration, etc. The identification of these workers and communities can inform decisions concerning the allocation of public investment and training funds and the development of hiring strategies to promote inclusion.

3. Job Numbers

Of course, it is also critical to examine job numbers. This report uses available information from economic models and industry studies for each of the critical sectors identified in the Scoping Plan to assess relative job growth in sectors affected by climate policy. The California Air Resources Board (CARB) has produced economic modeling of jobs with and without climate policy.¹⁷ CARB economic modeling estimates that when comparing scenarios with or without climate policy in 2030, there will be no net job loss: at most job growth could be 0.3-percent lower by 2030 than job growth without climate policy, but there will be more jobs than in 2020.¹⁸ Even as the state has reached its 2020 targets four years ahead of schedule,¹⁹ California's diverse and booming economy and historically low dependence on coal have facilitated rapid economic growth concurrent with greenhouse gas emission reductions. With an economy made up of 18 million jobs and a state GDP of \$2.7 trillion, the cost of reducing greenhouse gas emissions is small, and climate policy is not expected to change growth trajectories to any significant degree.²⁰

However, macroeconomic modeling does not provide the detailed information needed for workforce planning, nor does it provide information on job quality or job access. Effective labor market analysis that informs planning for workforce development and identifies opportunities to improve job quality and job access requires combining labor market information with deep on-the-ground knowledge for each detailed sector, industry, and set of occupations and is most effectively carried out within the context of industry training partnerships at the regional level.

In assessing job growth or loss, it is important to understand the following:

❖ Net vs. Gross

The overall health of an economy depends on net growth (growth minus loss) in jobs, and job creation and destruction is a continual feature of all market economies. In terms of net growth, CARB models suggest positive growth but at a slightly lower rate than without climate policy. It is also critical to assess the risk of absolute job loss where previously employed workers are displaced, so as to avoid a disproportionate burden of transition on a particular group of workers.



❖ Direct, Indirect, and Induced

Most job impact studies use economic models to capture the entire effect of a policy as its impact ripples through the economy by counting direct, indirect, and induced jobs (the so-called multiplier effect).²¹ The policies and training strategies presented here are most able to influence direct jobs, which are the focus of this report.

“Direct jobs” are those generated in firms that directly benefit from public or private investment that occurs due to climate policy. “Indirect jobs” are those generated by the supply chain (i.e., the purchase of equipment, materials, fuels, and other inputs needed for the activities of the recipient firms). There are limited circumstances, discussed in this report under procurement strategies, in which the alignment of climate and labor policies can impact some jobs in the supply chain, particularly when the supply chain involves large equipment or other capital inputs. “Induced jobs”—those generated as wage and business income from the direct and indirect investments is spent on a wide variety of goods and services in the economy—are not addressed in this report, which is limited to sectors most directly affected by climate policy.

❖ Sector, Industry, and Occupation

In this report, we follow CARB’s use of the term “sector,” which is a clustering and categorization of similar economic activities that create greenhouse gas emissions and that are subject to Scoping Plan policies to reduce emissions. For CARB, the term “sector” includes both production and consumption (end use) activities. For example, CARB’s Low-Carbon Energy Sector includes both generation of renewable electricity and energy efficiency activities that reduce energy consumption. For the terms “industry” and “occupation,” we follow the Bureau of Labor Statistics (BLS) which defines industry as a group of establishments that produce similar goods and services (a production rather than a consumption category); and occupation as a set of activities that employees carry out in their jobs. The BLS definitions allow us to utilize BLS data on jobs in industries and occupations, using the North American Industry Classification System (NAICS) for industry and the Standard Occupational Classification (SOC) for occupation.

❖ Job Tracking vs. Job Modeling

Most job impact studies use modeling techniques to estimate job impacts, often using government data to derive estimates of the number of jobs per million dollars of investment. While this is useful for some planning purposes, it is not the same as actual tracking of the number, quality and workforce characteristics of jobs that are generated or lost due to climate policy. Tracking and reporting on the job impacts of climate policy is necessary to measure progress over time. The CARB is currently



developing methods and metrics for tracking job numbers, job quality, and job access. Local jurisdictions commonly use commercial software that processes certified payroll records to track compliance with prevailing wage and local/targeted hire rules (while maintaining confidentiality of worker information).

IV. Organization of Report

The report is organized into two sections: Chapters 2 through 4 address labor policy tools and Chapters 5 through 11 address each Scoping Plan sector. The three chapters on policy tools consist of:

- **Chapter 2.** Demand-side tools that can ensure good jobs for workers and support for employers who invest in a skilled workforce;
- **Chapter 3.** Supply-side tools that can prepare the workforce for the low-carbon transition and ensure skill delivery to employers; and
- **Chapter 4.** Just transition policies to protect workers and communities at risk of displacement and disruption due to climate policy. These include both demand-side and supply-side tools to create a comprehensive planning process to address job loss.

Chapters 5 through 11 of the report address the six Scoping Plan sectors: Energy, Transportation, Industry, Waste, Water, and Land. First, Chapter 5 provides an overview of the sectors' importance in terms of emissions and emissions reduction efforts, the industries and occupations that are affected by climate policies, and an explanation of this report's approach to analyzing job impacts and developing workforce recommendations. The report's recommendations are first explained in the three chapters on policy tools and then applied where relevant in the Scoping Plan sector chapters.



Endnotes

- 1 Ian Perry, “California Is Working: The Effects of California’s Public Policy on Jobs and the Economy Since 2011” (UC Berkeley Center for Labor Research and Education, November 14, 2017), <http://laborcenter.berkeley.edu/california-is-working/>.
- 2 Eduardo Garcia, “AB-398 California Global Warming Solutions Act of 2006: Market-Based Compliance Mechanisms: Fire Prevention Fees: Sales and Use Tax Manufacturing Exemption,” Chapter 135, Statutes of 2017 § (2017), 38591.3.a, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398.
- 3 Garcia, Sec. 38591.3.b.
- 4 California Workforce Development Board, “Skills Attainment for Upward Mobility; Aligned Services for Shared Prosperity: California’s Unified Strategic Workforce Development Plan 2016-2020,” 2016, <https://cwdb.ca.gov/wp-content/uploads/sites/43/2016/08/Unified-State-Plan-With-Appendices.pdf>.
- 5 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- 6 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, 62–95, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- 7 A summary of these meetings is included as Appendix B to this report.
- 8 Danielle Beavers, “Diversity, Equity and Inclusion Framework: Reclaiming Diversity, Equity and Inclusion for Racial Justice” (The Greenlining Institute, March 2018), <http://greenlining.org/wp-content/uploads/2018/05/Racial-Equity-Framework.pdf>.
- 9 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, 59–60.
- 10 Carol Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014), chapter 2, <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>.
- 11 Garcia, AB-398 California Global Warming Solutions Act of 2006: market-based compliance mechanisms: fire prevention fees: sales and use tax manufacturing exemption, 38591.3.b.
- 12 Sarah White, Laura Dresser, and Joel Rogers, “Greener Skills: How Credentials Create Value in the Clean Energy Economy” (COWS, March 25, 2010), <https://www.cows.org/greener-skills-how-credentials-create-value-in-the-clean-energy-economy>.



- 13 Carol Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response” (UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011), <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.
- 14 California Workforce Development Board, “High Road Overview,” June 2018, https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/09/High-Road-ECJ-Brief_UPDATED-BRANDING.pdf; Paul Osterman, “In Search of the High Road: Meaning and Evidence,” *ILR Review* 71, no. 1 (January 1, 2018): 3–34, <https://doi.org/10.1177/0019793917738757>.
- 15 Annette Bernhardt, “Low-Wage Work in California: 2014 Chartbook” (UC Berkeley Center for Labor Research and Education, April 30, 2015), <http://laborcenter.berkeley.edu/lowwageca/>.
- 16 California Office of Environmental Health Hazard Assessment (OEHHA), “CalEnviroScreen,” Text, OEHHA, November 27, 2014, <https://oehha.ca.gov/calenviroscreen>.
- 17 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan Appendix E Economic Analysis,” November 2017, https://ww3.arb.ca.gov/cc/scopingplan/2030sp_appe_econ_final.pdf.
- 18 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, 55.
- 19 Christopher Weber, “California Meets Greenhouse Gas Reduction Goal Years Early,” AP News, July 12, 2018, <https://www.apnews.com/942b5a251fac413a84fc4eb93a67c46c>.
- 20 U.S. Department of Commerce, Bureau of Economic Analysis, “Bearfacts: Personal Income for California,” March 26, 2019, <https://apps.bea.gov/regional/bearfacts/pdf.cfm?fips=06000&areatype=STATE&geotype=3>; U.S. Department of Labor, Bureau of Labor Statistics, “California Economy at a Glance,” accessed June 24, 2019, <https://www.bls.gov/eag/eag.ca.htm>.
- 21 Alan W. Hodges, “Understanding and Using Economic Multipliers,” <https://ageconsearch.umn.edu/bitstream/43793/2/HodgesMultipliers.pdf>.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 2: Demand-Side Workforce Policy Levers

by Carol Zabin and Jenifer MacGillvary

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I. Introduction

Climate policy creates both disruptions and new opportunities for businesses in California and for the workers they employ. Minimizing the disruptions and maximizing shared prosperity as new opportunities arise requires specific and intentional labor policy.

A low-carbon economy with broadly shared benefits will not happen automatically. Not all jobs that are commonly considered “green jobs” are good jobs nor are they automatically accessible to workers from disadvantaged communities. Intentionally or not, the agencies in charge of implementing climate policy—including the California Air Resources Board (CARB), the California Energy Commission (CEC), and the California Public Utilities Commission (CPUC), among others—affect the types of jobs that are created whenever they make public investments, provide incentives to encourage market development, set standards for technologies and the built environment, mandate caps on pollution, and apply other policy tools. Without deliberate efforts, the economic changes produced by climate policy may simply replicate deep-seated economy-wide trends of persistent wage inequality and disparities by race and gender. Climate policy obviously cannot solve all the challenges of inequality, but the alignment of the state’s climate and workforce action plans can contribute to solutions. The good news is that there are feasible, road-tested policy mechanisms that are complementary to and can be carried out in conjunction with climate policy. These mechanisms can be utilized to promote the generation of good jobs and pipelines into them for workers from historically excluded groups and communities.

Moreover, policies that result in better outcomes for workers can also fortify efforts to achieve the state’s climate goals. There is a relationship between job quality and work quality: better wages, benefits, working conditions, and career ladders lead to better design, installation, operation, and maintenance of technologies, which in turn lead to maximized reductions in greenhouse gas emissions. As the sector chapters show, concerns about work quality and the sluggish adoption of emission-reducing technologies appear in industries (or segments thereof) where businesses pay low wages and do not invest in a skilled workforce. In energy efficiency (Chapter 6), studies show that work quality problems have impeded the adoption of advanced technologies for deeper energy savings and that quality problems were reduced when performed by workers with skill certifications. In some sectors, such as trucking, low-road labor practices impede implementation of climate measures by imposing cost burdens on very poor workers who cannot afford them, as discussed in Chapter 7. In several sectors, such as waste (Chapter 9) and forest fire prevention (Chapter 11), lowest bid and decentralized contracting processes lead to low-road labor practices and make it very difficult to either upgrade skills or enforce environmental standards.



This chapter provides policymakers and agencies responsible for climate policy implementation with guidance on how to ensure better workforce outcomes through “demand-side” policies and practices. Demand-side policies affect the demand for labor, including what kinds of jobs are generated, what skills are needed, what wages employers pay, and who employers hire. On the other hand, “supply-side strategies,” addressed in Chapter 3, focus on the supply of labor and the strategies needed to prepare the workforce for changes in the labor market due to climate policy.

The following section presents an inventory of labor standards and other good jobs strategies that are high impact and feasible. When attached to appropriate climate measures, these workforce policies can be used as levers to improve job quality and access and ensure that workers with appropriate skills are engaged the critical work of building a carbon-neutral economy. These demand-side policies can be incorporated into climate measures through a variety of authorizing mechanisms, including legislation, executive orders, agency regulations, and agreements among private parties that can sometimes be encouraged by state government. They provide concrete ways to promote a high-road economy, in which employers pay family-supporting wages and compete based on the quality of their services and products.¹

Labor standards and other demand-side workforce policies raise wages but do not necessarily raise total costs of production. As discussed in more detail at the end of the chapter, studies have found that benefits generally outweigh or at least equal costs. This favorable balance is because higher wages, better training, and safer workplaces lead to increased workforce productivity and performance. For very low-skilled activities—for example, replacing incandescent lightbulbs with more efficient ones—high-performance labor standards are less critical. With more complex technologies, proper installation and maintenance does depend on high performance, not only for professional workers, but also for blue-collar workers, as has been well documented in energy efficiency innovations such as advanced HVAC and lighting controls.²

This chapter explains the role of labor standards in general, and then identifies specific policy levers. Some of these apply only to the construction industry, which has a uniquely well-developed set of high-road standards codified in federal and state labor code. A recent study showed that about 54 percent of the expenditures of the Greenhouse Gas Reduction Fund (GGRF) flow into the construction industry, and it is also the predominant industry involved in renewable energy, energy efficiency, transportation capital projects, and other key infrastructure projects for the low-carbon economy. Combined with the fact that the construction industry has developed tried and true strategies for improving outcomes for workers while helping reach climate goals, construction is a key area of opportunity and is highlighted in the recommendations of this report.



II. What Are Labor Standards and Related Workforce Policy Levers?

The demand-side policy levers discussed in this report can be organized into four general categories:

❖ Labor Standards

Labor standards include compensation standards (such as minimum wages, living wages, prevailing wages, and requirements to provide health insurance), workplace safety standards, and any other requirement intended primarily to improve conditions for workers, including such things as fair scheduling rules, sick leave, union neutrality, and whistleblower protections. The establishment and enforcement of strict labor standards and worker protections comprises one type of workforce policy lever.

❖ Skill Standards

A second type of labor policy lever focuses on worker qualifications and is intended primarily to ensure high-quality work products. Specific policy levers to this end include skill standards such as requirements for licensing, skills certifications, educational credentials, and similar requirements for employees.

❖ Access and Inclusion Policies

Another type of workforce policy lever is concerned with inclusion, diversity, and local community benefits. Here, specific policies include requirements to increase hiring from historically disadvantaged communities and/or local community members.

❖ Comprehensive Strategies

Individual policy levers are often combined into a comprehensive “umbrella” policy lever. Community workforce agreements (CWAs) and community benefits agreements (CBAs), for example, can include wage and skill standards as well as local or targeted hire goals. Responsible contractor requirements often embed labor and skill requirements along with other minimum insurance and performance standards.

There can be a great deal of overlap and interaction among various policy levers. For instance, skill certification requirements promote high-quality work as well as higher wages.³ Similarly, wage floors lower worker turnover and improve work quality and productivity.⁴



Labor standards change the competitive environment for businesses, favoring high-road employers that compete on quality rather than price alone. High-performing contractors hire skilled workers and compensate them for their skills and investment in training. Likewise, higher wages attract more highly skilled workers. Standards help screen out unqualified contractors, thus improving the quality of work in a given sector.

Collectively, labor standards and workforce policy levers are designed to maintain or improve job quality, job performance, and job access, thereby avoiding the growth of poverty-wage jobs and supporting the development of a skilled workforce able to secure a middle-class livelihood.

In so doing, these policies support high-road employers who compete on quality; focus on innovation, productivity, and value added; use well-paid workers as a force for greater production; and focus on the long-term prospects of the firm. These policies can and should be harnessed in service to California's visionary climate agenda.

Various mechanisms can be used to attach labor standards to climate measures. They can be mandated in legislation, in regulation, as a condition of participation in incentive programs, in competitive solicitations and procurement policies, and through a variety of other authorizing vehicles.

Labor standards can be economy-wide, such as minimum wages, or specific to an industry or set of employers, such as prevailing wages for the construction industry or living wages for government contractors.

A. Wage and Benefit Standards

1. Prevailing Wages (Construction Sector)

California's prevailing wage laws, like the federal government's Davis-Bacon Act, require that on public works projects, contractors and subcontractors must pay their workers not less than the wage rates and health and pension benefits "prevailing" in the local areas, based on the classification or type of work performed by each worker. While the federal law applies to federally funded or assisted projects with a value of more than \$2,000, the California version applies to state, municipal, or local projects with a value of more than \$1,000.⁵ Wage rates and the corresponding health and pension benefits, as well as the requisite contributions to the state-certified apprenticeship programs, are determined by the California Department of Industrial Relations.⁶ Under California law, minimum labor standard requirements apply to apprentices in state-certified apprenticeship programs; apprentice wage rates rise as workers progress in their program.



The purpose of prevailing wage laws is to ensure that public investments do not undermine local wages and do not provide an incentive for employers to recruit lower-wage workers from outside the area. Prevailing wage laws also create a level playing field in the bidding process for contractors that pay union-scale wages and benefits.

Examples in Low-Carbon Sectors

High-speed rail; public transit construction projects financed by the Greenhouse Gas Reduction Fund; and Prop. 39 of 2012, which provides state funding (\$431.4 million in 2017-18) to support energy efficiency projects in schools.

Authorizing Vehicles

Prevailing wage exists in state law and covers construction projects that are paid for in full or in part out of public funds. The prevailing wage requirement has recently been extended to cover certain private projects for which developers seek streamlined environmental review (see, e.g., Senate Bill 35 [Wiener, Chapter 366, Statutes of 2017]⁷). Prevailing wage requirements have also been mandated in power purchase agreements between both investor-owned and public utilities and power plant developers.⁸

2. Wage Floors for Occupations Not Covered by Prevailing Wage

A variety of wage standards exist in industries not covered by prevailing wage laws. Minimum wage standards are the most common; they place a wage floor that affects all jobs within a specific jurisdiction. Living wage ordinances, which have become common among local governments in recent decades, place a wage floor on contractors or companies doing business with or receiving subsidies or other benefits from the local government. While these measures use varying definitions of what constitutes a “living wage,” they typically calculate the income needed to support a family according to local costs, plus benefits. As of the writing of this report, living wage ordinances have been adopted by a total of 38 cities, counties, and other jurisdictions in California.⁹ Living wage laws have also been instituted for specific sectors. San Francisco and New York City have expanded wage standards beyond construction to cover a wide range of occupations including janitors, theatrical workers, workers in parking garages, solid waste haulers, moving services, trade show workers, and broadcast services.¹⁰

The state has the authority to set wage floors in programs they operate. Where there is no prevailing wage determination, the state could ask the Department of Industrial Relations (DIR) to make one, as the Obama administration did in determining a prevailing wage for weatherization during the American Recovery and Reinvestment Act (ARRA). Alternatively, programs could mandate a wage floor. Estimates from the 2014 Guidance Plan show that for the low-income weatherization programs administered



by the investor-owned utilities (IOUs), implementing a wage floor of \$15.00 per hour would increase total installation costs by about 2 percent, and a wage floor of \$16 would increase costs by less than 3 percent.¹¹

Examples in Low-Carbon Sectors

The Utility Pre-Craft Trainee (UPCT) program, an innovative low-income weatherization program operated by the Los Angeles Department of Water and Power (LADWP), created a wage floor for its workers.¹² Started in 2011, the UPCT program trainees received a starting wage of \$16 per hour plus health and retirement benefits, as well as opportunities to move into careers in the skilled trades with the utility. See **Promising Practice #6.3: LADWP Utility Pre-Craft Training Program** in Chapter 6 for more details.

Authorizing Vehicles

Wage mandates and other compensation standards can be enacted in state law, regulation, public investment and procurement policies, and incentives programs as a condition of participation.

B. Skill Standards

Skill certifications, educational credentials, licenses, and other skill standards for specific occupations or tasks comprise a second type of labor standard. Many industries require skill certifications to obtain a license in order to legally practice an occupation, from highly educated professionals like architects and engineers, to technical occupations requiring more limited postsecondary education, such as dental assistants and transit drivers. Because they are mandates, such licenses and state-required certifications are the most powerful form of skill certification.

In California's construction industry, most skilled trades do not require that workers have a certification to practice their craft, with the exception of electricians, who must have a state electrical certification. Even when not legally required, employers may require specific skill certifications for some construction jobs as a prerequisite for hiring or performing specific tasks. Such "industry-recognized" skill certifications demonstrate a worker's competence and value to their employer and usually command higher wages. When skill certifications are required or expected as a prerequisite for certain occupations or major tasks, it provides a signal to the training and education community about what skills are needed and valued in the labor market. As long as there are strong pipelines to facilitate inclusion of disadvantaged workers, these certifications serve to ensure quality workmanship, help ensure job quality, and provide steps in a career ladder. In addition to signifying competence in the tasks needed for performance, skill standards include proficiency in both consumer and occupational safety protocols.



It is critical to distinguish between a business or employer license, and a workforce skill certification. In construction, for example, a contractor license is intended to signify a contractor's management, administration, and construction competence in a particular construction activity, but in most cases places few or no skill requirements on the workers performing this work for the contractor. A combination of contractor licenses and worker qualifications can help ensure the safety and quality of work performed, which benefits workers and consumers. Such a combination of skill standards for employers and workers is advisable, particularly, but not exclusively, for work involving new low-carbon technologies or products in order to promote acceptance and facilitate widespread adoption.

1. Requirements for a Skilled and Trained Workforce (Construction Sector)

In the construction industry, a journey card from a state-certified apprenticeship program qualifies as the most recognized and most robust skill certification for a particular skilled trade occupation. Apprenticeships are industry-funded, “earn-as-you-learn” programs that combine classroom instruction and paid on-the-job training over three to five years. Wages are increased in accordance with skills acquisition, and apprentices receive an industry-recognized credential when they complete the program.¹³ See Chapter 3 for a more detailed description of apprenticeship.

a. Requirements Under Public Works Labor Code

State law recognizes the importance of requiring the use of apprentices and graduates of apprenticeship as a means to ensure that a qualified workforce is employed on public works projects. Under the decades-old state public works labor code, contractors and subcontractors on all public works contracts valued at \$30,000 or more must utilize a specified ratio of apprentices from state-certified apprenticeship programs to journey-level workers, usually requiring one apprentice for every five journey workers.¹⁴

b. Requirements Under Skilled and Trained Workforce Standard

California has recently expanded apprenticeship requirements for a subset of public works projects¹⁵ as well as for some private-sector construction through the “skilled and trained workforce” requirement. For construction projects where it applies, a percentage of all workers in apprenticeable occupations must be either skilled journeypersons or apprentices with a registered program. The law requires that, for some trades (e.g., electricians, iron workers), 60 percent of the workers must be skilled journeypersons by 2020; for other trades (e.g., operating engineers, cement masons, carpenters, pile drivers), the requirement is 30 percent. This standard is stronger than that used in



state public works law because it specifies: 1) that *all* workers in apprenticeable trades must meet certain standards; and 2) there must be an overall minimum percentage of journey-level workers on covered projects who have completed state-approved, registered apprenticeship programs, compared to the public works law that mandates a ratio of journey workers to apprentices. The skilled and trained standard was established by Senate Bill 54 (Hancock, Chapter 795, Statutes of 2013),¹⁶ and applies to the workforce contracted by owners of petroleum refining and hydrocarbon manufacturing facilities to perform construction, repair, maintenance, and demolition work. The skilled and trained standard is used to help ensure quality work and protect against accidents. It has also been incorporated in recent affordable housing bills, including SB 35 (Wiener, Chapter 366, Statutes of 2017) and Assembly Bill 73 (Chiu, Chapter 371, Statutes of 2017),¹⁷ both of which create streamlined approval processes for some housing developments. The “skilled and trained workforce” law is complicated and has been amended or “cleaned up” several times since passage of SB 54; for more information, including definitions of “skilled journeypersons” and an implementation timeline, see the United Contractors’ “Revised: Skilled and Trained Workforce Guide.”¹⁸

Examples in Low-Carbon Sectors

Under state prevailing wage law, all publicly funded clean energy projects—including Prop. 39 projects for clean energy upgrades and generation at public educational facilities,¹⁹ high-speed rail construction, and other public works construction financed by the GGFR—must use the apprenticeship standard required in all public works construction above the \$30,000 threshold. The stronger requirement for a trained and skilled workforce has not yet been incorporated into specific climate policies or funding streams. However, IOU-administered energy efficiency programs for commercial HVAC now require enrollment in or completion of a California or federal certified apprenticeship program (or proof of equivalent competency).²⁰

Authorizing Vehicles

Either the public works labor code standard or the skilled and trained standard could be inserted in regulations, procurement policy, incentive programs, and mandates on regulated entities such as the Renewables Portfolio Standard (RPS).

2. Requirements for Specialized Certifications (Construction Sector)

Specialized certifications have been developed for specific clean technologies, particularly emerging technologies that require skill upgrades. These certifications are most effective when they augment a broad occupational credential rather than serving as stand-alone programs for specific “green skills.” A model program is the California Advanced Lighting Controls Training Program (CALCTP), a skills-upgrade certificate for



licensed electricians. This third-party certification was developed as a collaboration of the UC Davis Lighting Center, the Lawrence Berkeley National Laboratory, the IOUs, the National Electrical Contractors Association (NECA), and the International Brotherhood of Electrical Workers (IBEW). These subject-matter experts and industry stakeholders developed the program to overcome skill gaps that were creating a major barrier to the successful adoption of technologies that have great promise to lower energy use from lighting. Similar programs have now been developed for electric vehicle (EV) charging infrastructure, battery storage, and micro-grid installation.²¹ See Chapter 3 on supply-side demands for more details.

Examples in Low-Carbon Sectors

Specialized skill certifications are required in a number of California low-carbon sectors, although to a much lesser extent than in Europe. The Title 24 Green Building Code now requires specific skill standards for “acceptance testing,” i.e., the specialized testing of building system technologies including advanced lighting controls. The Electric Vehicle Infrastructure Training Program (EVITP) certification is required for the installation of all IOU-owned charging stations; this requirement does not yet apply to state funding for EV supply equipment deployment. The CPUC recently issued a decision to require CALCTP and other specialized certifications for advanced lighting and HVAC incentive programs.²²

Authorizing Vehicles

Existing vehicles for specialized skill certifications are regulatory. These requirements could also be inserted in legislation, procurement policy, incentive programs, and mandates on regulated entities such as eligibility requirements for inclusion in the RPS.

3. Skill Standards Requirements in Non-Construction Sectors

California imposes licenses and skill certifications on a wide variety of occupations for reasons of quality, safety, and accountability.²³ State-regulated certification is common for many professional occupations, such as engineers (structural, civil, fire, chemical, control systems, traffic, etc.), architects, land surveyors, geologists, geophysicists,²⁴ physicians,²⁵ nurses,²⁶ pharmacists,²⁷ and attorneys.²⁸ In low-carbon sectors, apart from construction trades, transit operators and bus mechanics are examples of non-professional occupations that require a license or specific skill certification.

Examples in Low-Carbon Sectors

Transit operators are required to undergo training and obtain appropriate driving licenses. Certifications from state-approved apprenticeship are also expanding. BYD, the electric bus manufacturing company under contract with the Los Angeles County Metropolitan



Transportation Authority (LA Metro), has developed a certified joint apprenticeship program for their workforce. A number of transit agencies in California have or are developing apprenticeship programs for transit operators and bus mechanics.²⁹ Each program will follow the Division of Apprenticeship Standards regulations, which issue a journey card at completion of training that serves as an occupational certification for workers.

Authorizing Vehicles

Skill certifications can be required in legislation, regulation, by public agencies, in contract bidding, and in requirements for participation in incentive and subsidy programs.

C. Responsible Employer Standards

Another type of workforce policy lever involves placing pre-qualification requirements on businesses that seek government contracts or that benefit from public subsidy programs. This approach can be used to incorporate wage and skill standards, as well as to promote other high-road employment practices.

1. Responsible Contractor Standards (Construction Sector)

Contracts in some public works projects go beyond the legally mandated prevailing wage and apprenticeship utilization standards to include stronger language with the goal of ensuring quality and performance as well as good working conditions.

So-called “responsible contractor standards” generally require that firms meet pre-established, clearly defined minimum standards relating to contractor responsibility, including: all applicable licenses, bonding, and insurance (including workers’ compensation); wage and labor law compliance; no OSHA violations; and permitting that includes passing code inspections. They often include evidence of past performance, and may include the types of wage and skill standards discussed above. As with skills certifications, these standards help ensure high performance and promote good jobs. As with any minimum performance criteria, it is critical to take intentional steps to ensure equal access for historically marginalized groups, including in this case minority and women-owned small businesses.



Examples in Low-Carbon Sectors

Senate Bill 350 (de León, Chapter 547, Statutes of 2015)³⁰ requires the California Energy Commission to adopt a responsible contractor policy to ensure that building energy efficiency retrofits meet high-quality performance standards and reduce energy savings lost or forgone due to poor-quality workmanship.³¹ As of the writing of this report, this policy had not yet been implemented.

Authorizing Vehicles

Responsible employer standards are most common in public works contracting but can also be incorporated into legislation (as in SB 350), regulation, incentive program requirements, and mandates on regulated entities.

2. Responsible Employer Requirements in Non-Construction Industries

Responsible employer standards can be used to place pre-qualification requirements on firms that do business with, or receive economic benefits from, the government in non-construction industries. These standards, which could be specified in contracts with public agencies or eligibility criteria for participation in incentive and grant programs, mandate more than compliance with basic minimum wage and employment laws and include requirements or terms and conditions, with the aim of ensuring that public dollars support quality performance and good jobs. The requirements often include having no violations of employment regulations, evidence of past experience, and sometimes safety training or specialized skill standards.

Examples in Low-Carbon Sectors

The South Coast Air Quality Management District (SCAQMD) added new rules regarding labor law compliance to its district-funded truck replacement projects. The SCAQMD assesses a company's record of labor law violations when reviewing applications for clean truck incentives, and has a disclosure and certification process regarding ongoing labor law compliance for those awarded funding. SCAQMD also prohibits lease-to-own arrangements in contracts involving district-funded trucks.³²

Authorizing Vehicles

Responsible employer standards can be incorporated into legislation, regulation, incentive program requirements, and mandates on regulated entities.



D. Project Labor Agreements and Community Workforce Agreements

1. Project Labor Agreements (Construction Sector)

Common in large, complex construction projects, a Project Labor Agreement (PLA) is a pre-hire collective bargaining agreement with one or more labor unions setting the terms and protocols of project execution and worksite conditions and prohibiting work stoppages due to labor disputes. Each PLA is negotiated to meet the needs of a specific project owner/manager. By governing nearly all aspects of the project, PLAs maximize stability in terms of construction timelines and budget, and guarantee positive outcomes and they resolve labor disputes without recourse to strikes or lockouts. By requiring the use of state-certified apprenticeship programs, PLAs benefit both contractors and communities by engaging a workforce that is undergoing or has undergone rigorous training and that is paid family-sustaining wages. Compensation standards generally include prevailing wages and contributions to health, retirement, and training trust funds managed by a joint labor-management committee. PLAs have long been used for public works projects funded by the federal government and state, county, and municipal agencies. In California, they are also sometimes used by developers on large private projects.

Examples in Low-Carbon Sectors

Many of California's large public transit projects with state or local government funding have used PLAs, including LA Metro's Measure R projects.³³ PLAs have become the industry norm and are used on almost all utility-scale renewable energy construction projects, even though they are not required by state law (see Chapter 6).

Authorizing Vehicles

PLAs are not mandated in state law, but state law authorizes public agencies to use PLAs (see Public Contract Code 2500) and prohibits charter cities from adopting measures to ban PLAs on state-funded construction projects.³⁴ PLAs have recently been used on construction of state buildings. PLAs can be mandated by awarding agencies for construction projects.



2. Community Workforce Agreements (Construction Sector)

Community Workforce Agreements (CWAs) consist of a Project Labor Agreement that includes language to broaden access to good jobs in construction. These “targeted” or “local” hire provisions typically include requirements to hire a certain minimum percentage of workers from zip codes that are near the project (known as “local hire”) and/or from economically disadvantaged communities. Many CWAs also set hiring goals for underrepresented populations, veterans, and/or women, often by giving preference to graduates of pre-apprenticeship programs that target historically excluded groups. In California, because of Prop. 209, explicit targeting to improve hiring of workers from underrepresented racial/ethnic groups is prohibited, but local and targeted hiring policies and practices have proven effective at improving access and inclusion in many instances.

CWAs are most successful when there are strong pre-apprenticeship programs that work closely with the building trades unions, because these programs can ensure that there is a pool of qualified local or targeted entry-level workers who can be hired on the project. It is costly to build a pipeline of qualified entry-level workers from underrepresented groups, so CWAs are most practical on large-scale projects or an aggregation of smaller projects governed by the same CWA. The strength of this policy is that it increases the number of good jobs while ensuring inclusion of historically marginalized workers.

Examples in Low-Carbon Sectors

The California High-Speed Rail Authority’s Community Benefits Agreement,³⁵ which was finalized in 2013 stipulates that 30 percent of the hours will be performed by “National Targeted Workers,” which is defined in the agreement as those who reside in zip codes that include a census tract or portion thereof in which the median annual household income is less than \$40,000 per year.³⁶ The Transformative Climate Communities (TCC) program funds projects that develop and implement neighborhood-level plans for greenhouse gas emission reductions and provide local economic, environmental, and health benefits to disadvantaged communities; it encourages CWAs for these construction projects.³⁷ Some PLAs on utility-scale solar projects include local hire agreements, thereby turning them into CWAs and ensuring that the benefits of PLAs include job access for local and/or disadvantaged workers.

Authorizing Vehicles

Like PLAs, CWAs are not mandated in state law. For construction projects, CWAs are negotiated by many public awarding agencies, such as counties, cities, school districts, and ports.



E. Inclusive Procurement Policies for Purchases of Large Capital Equipment, Contracts for Public Services, and Grants

Public procurement by state, county, and municipal government entities enables a variety of measures that encourage businesses that contract with public entities to comply with high labor standards or provide other public benefits. Federal law preempts states from requiring bidders to negotiate Community Workforce Agreements (CWAs) or Community Benefits Agreements (CBAs) like those in the construction industry, but state procurement policies can include requirements for a floor on wages, skill standards, and more, and procurement can provide incentives for bidders to enter into a CBA. An agreement between community stakeholders and a business bidding for a public contract, a CBA provides a variety of local employment and community benefits in exchange for community support for the project. Many CBAs are negotiated with a developer by broad-based local coalitions that include community, environmental, and religious organizations as well as labor unions. Though legally binding, CBAs are not traditional collective bargaining agreements.

Procurement processes can determine wage and benefits standards in several ways. In some cases, service contractors are required to pay a living wage, as determined by local living wage ordinances. In other cases, particularly for services that are also carried out by public-sector workers, wage parity between public and private workers is required in order to discourage contracting out for the sole purpose of reducing wages and benefits.³⁸

One practical way to use procurement to ensure job quality is to seek the “best-in-class” employer, rather than predetermine labor standards. This approach is used by the U.S. Employment Plan (USEP), an initiative created by Jobs to Move America, a national organization advocating responsible use of public transit procurement. The USEP provides model language for procurement in competitive solicitations that gives bidders an opportunity to disclose detailed information about the location and number of new jobs that would be created or sustained as well as the number of disadvantaged and under-represented workers to be hired. The U.S. Employment Plan was designed to level the playing field for high-road manufacturers that supply buses, rail cars, and other large capital equipment to public transit agencies, and has been adopted by some of the nation’s largest urban transit authorities. The USEP has three components that agencies can incorporate into their procurement language:



- Proposal Guidelines that include pre-approved forms that capture the number and quality of U.S. jobs to which a proposer is committing on the contract, including details regarding expected wages, employer-provided benefits, and workforce training investments; plans to generate employment opportunities for disadvantaged and underrepresented workers through partnerships with community-based organizations; and plans to invest in domestic production facilities or sites;
- Evaluation Guidelines with scoring criteria to evaluate competing proposals and reward companies that demonstrate a commitment to creating good U.S. jobs, hiring disadvantaged and underrepresented workers, advancing workforce development, and investing in U.S. facilities; and
- Enforcement Language to be included in an awarded contract that legally obligates companies to meet the hiring, job quality, equity, and workforce investment commitments made in their winning proposals.

Example in Low-Carbon Sector

Various public agencies in California, including the High Speed Rail Authority and Los Angeles County Metropolitan Transportation Authority (LA Metro), have adopted and used the U.S. Employment Plan (USEP) in procurement of commuter rail cars and transit buses. In fact, LA Metro now has a Permanent U.S. Employment Plan policy, requiring the USEP in all future procurements of new manufactured vehicles and equipment above \$100 million. Likewise, the City of Los Angeles' Department of Transportation (LADOT) has committed to the USEP in procurements to meet the agency's planned transition to a fully zero-emission transit bus fleet. Accordingly, companies bidding on future LA Metro and LADOT contracts can now voluntarily commit to job quality, job access, and workforce investment targets to improve the competitiveness of their proposals. See **Promising Practice #7.1: Heavy-Duty Transit Vehicle Manufacturing—Procurement for the Public Good** in Chapter 7, Sustainable Transportation, for more information about LA Metro's 2016 procurement of zero-emission battery-electric buses that included the USEP.

Like CWAs, the strength of these policies is that they increase the number of good jobs while ensuring inclusion from historically marginalized workers.

Authorizing Vehicles

Community-benefiting procurement policies can be implemented through contract bidding language that requires them, or by adding points in the ranking of projects in a competitive solicitation.



F. Inclusive Hiring (All Sectors)

Inclusive hiring, sometimes called “first-source hiring,” “targeted hiring” or “local hiring,” focuses on improving job access for workers from disadvantaged groups or communities. Under an inclusive hiring system, community organizations or training programs serving disadvantaged workers refer local job applicants to employers; in turn, the employers agree to notify the referring organizations when there are job openings and to look at its referrals first in their review of job applicants.³⁹ To have impact, inclusive hiring should only target higher-wage jobs or jobs with structured career ladders, or be incorporated into CWAs or CBAs as part of the local or targeted hire agreements. If they are stand-alone programs that do not include a job-quality strategy, they serve only to funnel disadvantaged workers into low-wage jobs and to replicate existing inequality in the labor market.

Example in Low-Carbon Sector

The ratepayer-funded California Solar Initiative’s Multifamily Affordable Solar Housing (MASH) program requires that contractors provide temporary employment for graduates of training programs.⁴⁰ For each MASH project, contractors must provide at least one student or graduate of a job training program with at least one full paid day (eight-hour day) of work for each 10kW of system size up to 50kW. These job requirements are now being adopted in the CPUC rulemaking for the implementation of Assembly Bill 693 (Eggman, Chapter 582, Statutes of 2015).⁴¹

Authorizing Vehicles

Local or targeted hire requirements can be mandated in public procurement contract bidding, in program requirements for incentive programs, and in other programs where employers are receiving public or ratepayer funds. They are most effective when they are linked to the expansion of good jobs, as in CWAs and CBAs.

G. Retention of Work in Public-Sector or Regulated Entities (All Sectors)

Across a variety of industries, contracting out by the public sector or large private firms has been shown to lead to significant declines in job quality. While wage standards such as living wage ordinances can limit declines in job quality in the context of outsourcing, from a good-jobs perspective it is preferable to retain work in public enterprises or regulated firms like the IOUs. Since these entities are often unionized and/or already have internal wage floors, avoiding outsourcing can help ensure job quality. With more accountability than unregulated firms, they are also more likely to have job access strategies in place or be open to them.



Example in Low-Carbon Sector

The LADWP made a decision to insource weatherization jobs that had previously been contracted out. As described in Chapter 6, they then created a pre-craft job classification in the utility and a training program for weatherization that functions as a pre-apprenticeship program serving as a pipeline into career utility employment in a skilled trade. This approach has transformed weatherization from a low-wage, dead-end job to a job with a living wage floor (\$16 per hour and full benefits when the program started in 2011) and a career ladder.⁴² See **Promising Practice 6.3: LADWP Utility Pre-Craft Training Program** in Chapter 6.

Authorizing Vehicles

Public or regulated entities can authorize retention of public employment or insourcing of previously outsourced activities.

H. Enforcement of All Labor and Employment Law, Including Proper Classification of Employees vs. Independent Contractors

A company's incorrect designation of its employees as "independent contractors" strips workers of essential wage and other workplace rights under state and federal labor and employment law and generally lowers their net wages and benefits. It also drains tax revenues, and disadvantages employers that do comply with the rules, correctly classify workers, and pay for payroll taxes, workers' compensation insurance, and other employee protections. Many companies in transportation, janitorial, logistics, home care and domestic work, construction, tech, and other sectors have put workers outside of workplace protections by claiming that they are independent contractors instead of employees. Under the law, however, these arrangements are permissible only when the worker is running a separate business.⁴³ The misclassification problem greatly affects some occupations that are directly impacted by climate policy, including truck drivers, as described in Chapter 7. Climate policies can include requirements to help ensure workers are not misclassified.

Examples in Low-Carbon Sectors

The South Coast Air Quality Management District (SCAQMD, or the district), the air pollution control agency for all of Orange County and parts of Los Angeles and Riverside Counties, added new rules regarding labor law compliance to its district-funded truck replacement projects. The district assesses a company's record of labor law violations when reviewing applications for clean truck incentives, and has a disclosure and



certification process regarding ongoing labor law compliance for those awarded funding. SCAQMD also prohibits lease-to-own arrangements in contracts involving district-funded trucks.⁴⁴

Authorizing Vehicles

Just as with wage standards and responsible contractor policies, businesses contracting with public agencies or receiving public funds could be required to verify compliance with proper employee classification laws.

III. Costs and Benefits of Labor Standards

The workforce policy levers described above generally lead to higher wages and better benefits. A legitimate question is whether higher-quality jobs will increase the costs of climate measures, and if so, by how much. Simple economic theory would suggest that wage standards would negatively impact consumers through higher prices, and workers through fewer jobs. However, a substantial body of research shows that the benefits of labor standards implemented in a variety of industries in the United States outweigh the costs. Studies on the actual impacts of increases in minimum and living wages have found price and employment effects to be negligible, while worker incomes have been substantially improved.⁴⁵ In construction, numerous studies have shown that prevailing wages, project labor agreements, and other mandates for high-road labor standards have not raised costs where they have been implemented, as productivity improvements make up for higher wages and benefits.⁴⁶ For example, a 2017 research study by the UC Berkeley Labor Center analyzed 88 community college projects that were built with PLAs and 175 that were built without PLAs. This study found evidence suggesting that PLAs did not reduce the number of bidders or raise costs; on the contrary, the projects built under PLAs had slightly more bidders compared to non-PLA projects, and their low bids came in slightly lower than those of non-PLA projects.⁴⁷ Research has shown similar results in other industries: better wages and working conditions attract more highly skilled workers and lead to decreased turnover, which in turn improves productivity and performance of the workforce, thereby offsetting a portion of the higher compensation.⁴⁸

Moreover, cost increases due to higher compensation may lead to negligible or very small overall cost increases, since labor costs are often a small percentage of production costs. For example, an analysis of the impact of raising wages for weatherization workers estimated that a 20 percent rise in wages (from an average of \$12.50 per hour to a floor of \$15.00) would increase the cost of home weatherization by 2 percent.⁴⁹ Another consideration is the high public cost of low-wage work; a recent study estimates that low wages cost U.S. taxpayers \$153 billion each year in safety net programs for working families whose low income makes them eligible for public assistance.⁵⁰



Research has also provided evidence that requirements for skill certifications improve the quality of installation, maintenance, and operation of green technologies. For example, a North Carolina State University (NCSU) study demonstrates the link between skill standards and successful outcomes in implementing new green infrastructure (GI). The NCSU analysis found that prior to the launch of a GI worker certification program, roughly 95 percent of the 425 GI projects implemented in Cary, North Carolina, failed inspections because they were not properly maintained.⁵¹ However, “after owners better appreciated the value of maintenance and hired workers certified by NCSU, roughly 95 percent of BMPs *passed* a second inspection.”

In the HVAC sector, a study of the NATE (North American Technician Excellence) certification found that systems installed by certified technicians achieve 10 percent better field-adjusted energy efficiency compared to uncertified technicians.⁵² Another study showed that projects performed by a NATE-certified HVAC contractor generate 12.9 percent fewer callbacks than projects performed by an uncertified contractor and cost 6.8 percent less than projects performed by an uncertified contractor due to billing efficiency.⁵³ A study on contractor and technician behavior prepared by Energy Market Innovations, Inc., (EMI) showed worker certification helps ensure high-quality maintenance work. This study included a covert field study of 13 technicians performing maintenance duties and found that certified technicians performed more maintenance and service tasks than uncertified technicians and executed them correctly more often.⁵⁴

In lighting, evidence from six pilot studies indicates customer cost savings in the range of 10 to 30 percent for the installation of advanced lighting controls by CALCTP-certified contractors, who are required to employ CALCTP-certified electricians, versus non-certified contractors.⁵⁵ Lower costs are attributed to CALCTP training, which enables more accurate bids, faster installation, and higher initial system performance as a result of greater familiarity and expertise with advanced lighting controls.⁵⁶ Southern California Edison recognized the value of CALCTP in its Program Implementation Plans filed in July 2012, stating that “because CALCTP training translates into high-performance operation and maintenance, operational data on CALCTP-installed systems to date indicate an extremely low rate of installation difficulties, callbacks, changes, etc.”⁵⁷

Finally, there are serious downsides to the strategy of not requiring skill standards, which, inadvertent or not, is an explicit choice about the level of standards that should be provided. Research has shown evidence of poor work quality limiting the benefits of complex, emerging low-carbon technologies and slowing market adoption of new technologies where strong quality assurance mechanisms, including workforce standards, are not in place.



IV. Recommendations for Demand-Side Workforce Policy Levers

1. Expand the use of community workforce agreements (CWAs) on climate investments involving large-scale construction projects.

CWAs are agreements between construction employers and one or more unions that set wages and benefits, specify the use of apprentices, and include hiring language to promote the inclusion of workers from historically disadvantaged groups.

CWAs have a proven track record of ensuring job quality and job access in construction, a critical industry for many sectors in the Scoping Plan.

Agencies or entities administering public or ratepayer funds for low-carbon infrastructure can use CWAs on large projects for infrastructure investment in renewable energy, energy efficiency retrofits, EV charging infrastructure and transit infrastructure projects, installation of emission controls in refineries, leakage abatement in oil and gas distribution, and waste and water infrastructure. The typical minimum threshold for stand-alone CWAs is \$1 million in contract value, because sufficient scale is necessary to create enough jobs to successfully implement targeted or local hire requirements.

In climate policy, CWAs are currently used in utility-scale renewables construction, light rail, and high-speed rail construction, and other large-scale construction projects.

2. Use inclusive procurement policies for public procurement of large capital equipment, contracts for public services, and in grant programs.

Inclusive procurement policies by state, county, and municipal government entities require businesses that contract with public entities to comply with high labor standards, such as family-supporting wages, skill standards, investments in training, and inclusive hiring.

Agencies or entities administering climate investment funds can use inclusive procurement policies to incorporate anticipated workforce outcomes in the criteria they use to rank bidders in competitive solicitations. Awarding agencies can insert this language in solicitations for the procurement of large capital equipment like buses, for contracts for public services like waste collection and fire prevention, and in grant programs.



LA Metro has successfully used inclusive procurement language to ensure family-supporting jobs, substantial investments in training, and commitments to hiring veterans, women, and formerly incarcerated workers in a manufacturing facility that is providing zero-emission buses to the agency.

3. Include responsible employer standards in all climate-related incentive programs.

Responsible employer standards for publicly-funded incentive programs, including rebates, loan assistance, and other financial support, are a powerful tool to ensure adequate work quality and to avoid using public funds to support poverty-level jobs or the underground economy. Because incentive programs only partially subsidize private investments, the comprehensive strategies described in the first two recommendations above are not generally feasible. Responsible employer standards can include skill standards and living wage standards addressed in the next two recommendations.⁵⁸

3a. Use skill standards in incentive programs to ensure safe and proper performance in the installation, operation, and/or maintenance of low-carbon measures.

For emerging technologies, incumbent worker upgrade certifications can be incorporated into program requirements for rebates, incentives, loan assistance, and more. For commercial and industrial construction, agencies can employ the “skilled and trained workforce” standard currently required in some public works and in refinery upgrade work, which utilizes enrollees and graduates of state-certified apprenticeship programs.

For advanced technologies, use specialized skill certifications like CALCTP. These skill certifications are critical because persistent quality problems have emerged in the installation, operation, and maintenance of some key technologies that are critical to lowering emissions, including HVAC and advanced lighting controls in energy retrofits. Safety concerns are also paramount in EV charging stations and battery storage.

Agencies administering programs can consult with subject matter experts, the CWDB, community colleges, the Division of Apprenticeship Standards, and high-road employers to help identify the most appropriate advanced certifications.



3b. Use living wage standards and verification of compliance with all employment and labor law, including health and safety standards, in incentive program requirements.

For industries characterized by low wages, health and safety violations, and other indicators of low-road conditions, living wage standards and verification of compliance with the full range of California labor, employment, and environmental regulations can be incorporated into program requirements for rebates, incentives, loan assistance, and other assistance.

Without such requirements, incentives in these industries could end up supporting employers with low-road labor and workforce practices.

Sectors in which labor and employment violations are common include residential construction, trucking, forest and wildlands management, agriculture, some manufacturing, and subcontracted waste and water services. Agencies implementing climate measures in these sectors can use responsible employer policies to ensure that public funds do not support poverty-level jobs or violations of state labor and employment law.

4. Identify and focus incentives on win-win strategies that meet both climate and workforce goals.

Funding programs can be designed and phased strategically to support high-road rather than low-road employers.

4a. Identify program models that increase the scale of projects.

Agencies implementing climate measures may be able to design programs to increase project scale, even within the same general market segment, e.g., multifamily residential vs. single-family homes. In construction, increased project size can facilitate the incorporation of local and targeted hire. Often, larger projects can capture economies of scale and thus also increase the emission reduction per dollar invested.

For example, for the residential sector, where solar energy costs are generally the highest and subsidies have disproportionately benefited more-affluent homeowners, incentives can be concentrated on larger-scale community solar projects that focus on renters rather than on single-family rooftop installations and, in so doing, will lower the costs per MW even with higher wages.⁵⁹ Contracting models for energy efficiency and community solar that aggregate multiple small projects, all with the same contract terms, can more easily incorporate wage and skill standards.



4b. Phase incentives so they first target those segments of the industry that have both higher emission reduction per dollar invested and better workforce outcomes.

A sequenced approach to incentives can leverage their high-road impact. For example, programs to incentivize energy efficiency projects in the municipal, university, schools and hospital (MUSH) sector, where labor standards usually already exist, provide an opportunity for achieving energy savings while producing good jobs. Focusing on these sectors will encourage high-road employers with good labor practices that can then be transferred to more-challenging sectors, as businesses gain learning and efficiency over time.

5. Use public-sector insourcing or exclusive franchise contracting models to support labor and environmental standards for public services and some incentive and low-income programs.

State and local jurisdictions and other public entities can use their own employees instead of subcontracting, or use exclusive franchise systems for services that are currently “open market.” Subcontracting in some weatherization programs has led to low wages and lack of career ladders for workers. Open markets in waste, where customers contract with private waste providers, have impeded enforcement of state waste-diversion mandates and produced low-road labor practices.

In an exclusive franchise system, local governments set contract terms and conditions, and can more easily enforce environmental and labor standards. The City of Los Angeles adopted the exclusive franchising model for its waste system. The LADWP insourced its weatherization program that had been previously subcontracted, allowing the creation of career ladders for entry-level weatherization workers into permanent jobs in the utility.

6. Use metrics to measure the impact of climate policies on job numbers, job quality, and job access.

Tracking and reporting on the job impacts of climate policy is necessary to measure progress over time. The CARB is currently developing methods and metrics for tracking job numbers, job quality, and job access. Local jurisdictions commonly use commercial software that processes certified payroll records to track compliance with prevailing wage and local/targeted hire rules (while maintaining confidentiality of worker information). Agencies could contract for the adaptation of this software to assess job quality and job access in a wide variety of climate programs.



7. Incorporate workforce analysis into emerging-technology support programs.

Agencies that are tasked with promoting the accelerated market adoption of emerging low-carbon technologies can help ensure that technology and skill development are coordinated by requiring that workforce analysis be incorporated into emerging-technology programs.

Workforce development agencies currently have very limited access to information on skill needs for new technologies that come to market. Workforce analysis can help fill this information gap and help training organizations identify priorities for training investments.

Agencies administering grants for research and development, demonstration projects, and pilot programs for emerging technologies can request that grantees identify key occupations that need to be engaged for successful performance of the emerging technologies and needs for skill upgrades, if they exist. Businesses that are receiving state support could be asked to identify: 1) the occupations that are critical to the planning, installation, maintenance, and operation of the technology; 2) any performance problems that were related to skill gaps; and 3) the relevant training and skill requirements that the business uses to engage qualified workers. These three areas of workforce analysis are needed to anticipate skill upgrade needs and identify what part of the state's workforce development infrastructure can be leveraged to meet these needs.

8. Provide technical assistance to agencies implementing climate policy on how and when to apply these demand-side workforce interventions.

The California Workforce Development Board (CWDB) should develop a technical assistance team to help agencies responsible for implementing climate policy as they seek to incorporate high-road workforce interventions. Agencies administering climate investments and policies have limited experience and training to assess when, where, and how to incorporate the tools and approaches outlined in this report. There is considerable expertise within the CWDB and among their university and NGO partners, on community workforce agreements, responsible contractor language, and other demand-side interventions, which can be called upon to assist climate agency staff on how and when to implement these recommendations. The CWDB currently provides this technical assistance, and is working to secure the resources necessary to scale and expand these efforts through a dedicated team devoted to interagency collaboration on jobs and climate issues.



Endnotes

- 1 Sarah White, “CWDB Equity, Climate & Job Series, 2018” (California Workforce Development Board, 2018).
- 2 Carol Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014), <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>.
- 3 Maury Gittleman and Morris M. Kleiner, “Wage Effects of Unionization and Occupational Licensing Coverage in the United States,” *Industrial and Labor Relations Review*, January 2016, <http://journals.sagepub.com/doi/pdf/10.1177/0019793915601632>.
- 4 Michael Reich, Ken Jacobs, and Miranda Dietz, *When Mandates Work: Raising Labor Standards at the Local Level* (Berkeley and Los Angeles, California: University of California Press, 2014), <http://irle.berkeley.edu/when-mandates-work/>.
- 5 U.S. Department of Labor, Wage and Hour Division, “Davis-Bacon and Related Acts,” accessed February 26, 2018, <https://www.dol.gov/whd/govcontracts/dbra.htm>.
- 6 California Department of Industrial Relations, “California Prevailing Wage Laws,” February 1, 2016, <https://www.dir.ca.gov/public-works/CaliforniaPrevailingWageLaws.pdf>.
- 7 Scott Wiener, “SB-35: Planning and Zoning: Affordable Housing: Streamlined Approval Process,” Chapter 366, Statutes of 2017 § 65400, 65582.1 and 65913.4 (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB35.
- 8 Los Angeles Department of Water and Power, “Competitive Offer Power Purchase Agreement Between City of Los Angeles Acting by and Through the Department of Water and Power and Hecate Energy Fit ‘A’ LLC,” June 3, 2014, http://clkrep.lacity.org/onlinedocs/2014/14-0736_misc_06-05-14.pdf.
- 9 UC Berkeley Center for Labor Research and Education, “California City and County Living Wage Ordinances,” accessed September 26, 2018, <http://laborcenter.berkeley.edu/minimum-wage-living-wage-resources/california-city-and-county-living-wage-ordinances/>.
- 10 San Francisco Office of Labor Standards Enforcement, “Prevailing Wage: Construction,” City and County of San Francisco, accessed April 2, 2018, <http://sfgov.org/olse/prevailing-wage>.
- 11 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”



- 12 Megan Emiko Scott and Carol Zabin, “Training for the Future II: Los Angeles’s Utility Pre-Craft Trainee Program: Progress to Date” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2016), <http://laborcenter.berkeley.edu/training-for-the-future-ii/>.
- 13 California Department of Industrial Relations, “Public Works Apprentice Wage Sheets,” October 2016, <https://www.dir.ca.gov/OPRL/pwappwage/PWAppWageStart.asp>.
- 14 California Department of Industrial Relations, “Public Works Apprenticeship Requirements,” April 2017, <https://www.dir.ca.gov/das/publicworks.html>.
- 15 United Contractors, “Skilled and Trained Workforce Requirements: REVISED: Skilled and Trained Workforce Guide,” November 17, 2017, https://www.unitedcontractors.org/storage/documents/Contractor_Resource_Center/Master_Labor_Agreements/Skilled_and_Trained_Workforce_Guide_11.17.2017.pdf; Ben Hueso, “SB-693: Public Contracts: Skilled and Trained Workforce,” Education Code, Health and Safety Code, Public Contract Code § (2016), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB693.
- 16 Loni Hancock, “SB-54 Hazardous Materials Management: Stationary Sources: Skilled and Trained Workforce,” Chapter 795, Statutes of 2013 § (2013), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB54.
- 17 Wiener, SB-35: Planning and zoning: affordable housing: streamlined approval process; David Chiu, “AB-73: Planning and Zoning: Housing Sustainability Districts,” Chapter 371, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB73.
- 18 United Contractors, “Skilled and Trained Workforce Requirements: REVISED: Skilled and Trained Workforce Guide.”
- 19 Carol Zabin, Kevin Duncan, and Erica Paul, “Proposition 39 Job Creation and Quality, 2014-2017, A Report to the Citizens Oversight Board of the California Clean Energy Jobs Act” (UC Berkeley Center for Labor Research and Education Green Economy Program, 2017), https://ww2.energy.ca.gov/efficiency/proposition39/citizens_oversight_board/documents/3rd_annual_report/Appendix_E-CaliforniaWorkforceDevelopmentBoardJobsReportingReport.pdf.
- 20 California Public Utilities Commission, “Decision Addressing Workforce Requirements and Third-Party Contract Terms and Conditions (18-10-008),” October 22, 2018, https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/energy-efficiency-solicitations/Decision_Addressing_Workforce_Requirements_and_Third_Party_Contract_Terms_and_Conditions.pdf.



- 21 David Riley and Bernie Kotlier, “Energy Storage and Microgrid Training and Certification (ESAM-TAC)” (NECA 2017, Seattle, October 8, 2017), https://www.necanet.org/docs/default-source/17presentations/e-35_energy-storage-and-microgrid-training-and-certification_riley_kotlier_0900-0950_100817.pdf?sfvrsn=2.
- 22 California Public Utilities Commission, “Decision Addressing Workforce Requirements and Third-Party Contract Terms and Conditions (18-10-008).”
- 23 California Department of Industrial Relations, Labor Commissioner’s Office, “Electrician Certification Program,” 2017, <https://www.dir.ca.gov/dlse/ecu/ElectricalTrade.html>.
- 24 California Department of Consumer Affairs, Board for Professional Engineers, Land Surveyors, and Geologists, “Board for Professional Engineers, Land Surveyors, and Geologists,” Department of Consumer Affairs, accessed October 5, 2018, <https://www.bpelsg.ca.gov/>.
- 25 Medical Board of California, “The Mission of the Medical Board of California,” accessed October 5, 2018, <http://www.mbc.ca.gov/>.
- 26 California Board of Registered Nursing, “Welcome to the Board of Registered Nursing,” accessed October 5, 2018, <https://www.rn.ca.gov/index.shtml>.
- 27 California State Board of Pharmacy, “Welcome to the California State Board of Pharmacy,” accessed October 5, 2018, <https://www.pharmacy.ca.gov/>.
- 28 State Bar of California, “The State Bar of California,” accessed October 5, 2018, <http://www.calbar.ca.gov/>.
- 29 California Transit Works!, “CTW California Transit Works!,” accessed October 5, 2018, <http://californiatransitworks.org/>.
- 30 Kevin de León, “SB-350 Clean Energy and Pollution Reduction Act of 2015,” Chapter 547, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.
- 31 California Energy Commission, “Clean Energy & Pollution Reduction Act: SB 350 Overview,” accessed February 26, 2018, <http://www.energy.ca.gov/sb350/>.
- 32 South Coast Air Quality Management District, “Board Meeting Minutes, Agenda No. 29 (Report of the Technology Committee Meeting Held September 21, 2018),” October 5, 2018, <http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2018/2018-oct5-029.pdf?sfvrsn=2>.



- 33 Los Angeles County Metropolitan Transportation Authority and The Los Angeles/ Orange Counties Buildings and Construction Trades Council Affiliated with The Building and Construction Trade Department (AFL/CIO) And Signatory Craft Council and Local Unions, “Project Labor Agreement,” 2012, http://media.metro.net/about_us/pla/images/project_labor_agreement_2012.pdf.
- 34 California Code, “Project Labor Agreements,” Chapter 2.8 Public Contract Code - PCC § 2500-2503 (2012), https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PCC&division=2.&title=&part=1.&chapter=2.8.&article=.
- 35 This is technically a Community Workforce Agreement under the definitions we are using here. See California High-Speed Rail Authority, “Community Benefits Agreement: Putting Californians to Work,” May 2015, https://www.hsr.ca.gov/docs/newsroom/fact%20sheets/CBA_Factsheet_FINAL_0050415.pdf.
- 36 California High-Speed Rail Authority, “Community Benefits Agreement,” August 13, 2013, https://www.hsr.ca.gov/Programs/Construction/community_benefits_agreement.html.
- 37 California Strategic Growth Council, “Transformative Climate Communities (TCC),” California Strategic Growth Council, accessed August 28, 2018, <http://sgc.ca.gov/programs/tcc/>.
- 38 Eduardo Porter, “Harvard Is Vaulting Workers Into the Middle Class With High Pay. Can Anyone Else Follow Its Lead?,” *The New York Times*, September 8, 2018, sec. Economy, <https://www.nytimes.com/2018/09/08/business/economy/harvard-living-wage.html>.
- 39 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”
- 40 California Public Utilities Commission, “Multifamily Affordable Solar Housing Program Handbook, First Edition,” accessed August 1, 2018, http://www.gosolarcalifornia.ca.gov/documents/MASH_Handbook.pdf.
- 41 Susan Eggman, “AB-693 Multifamily Affordable Housing Solar Roofs Program.,” Chapter 582, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB693.
- 42 Ellen Avis and Carol Zabin, “Training for the Future, Workforce Development for a 21st Century Utility Los Angeles’s Utility Pre-Craft Trainee Program” (UC Berkeley Donald Vial Center on Employment in the Green Economy, 2013), http://laborcenter.berkeley.edu/pdf/2013/training_future13.pdf.



- 43 California Employment Development Department, “Employment Determination Guide (DE 38),” n.d., https://www.edd.ca.gov/pdf_pub_ctr/de38.pdf; California Department of Industrial Relations, Labor Commissioner’s Office, “Independent Contractor versus Employee,” accessed October 5, 2018, https://www.dir.ca.gov/dlse/faq_independentcontractor.htm.
- 44 South Coast Air Quality Management District, “Board Meeting Minutes, Agenda No. 29 (Report of the Technology Committee Meeting Held September 21, 2018).”
- 45 Reich, Jacobs, and Dietz, *When Mandates Work: Raising Labor Standards at the Local Level*.
- 46 Nooshin Mahalia, “Prevailing Wages and Government Contracting Costs: A Review of the Research,” Briefing Paper, July 3, 2008, <https://www.epi.org/publication/bp215/>.
- 47 Emma Waitzman and Peter Philips, “Project Labor Agreements and Bidding Outcomes: The Case of Community College Construction in California” (UC Berkeley Center for Labor Research and Education, January 9, 2017), <http://laborcenter.berkeley.edu/project-labor-agreements-and-bidding-outcomes/>.
- 48 Reich, Jacobs, and Dietz, *When Mandates Work: Raising Labor Standards at the Local Level*.
- 49 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” Appendix 5A. Another study estimates that requiring prevailing wages would add 0.25 to 0.5 cents to the cost per kWh, which ranges from 9.74 to 14.8 cents per kWh. The cheapest is a 3MW tracking ground mounted system, and the most expensive is small 100kW rooftop fixed axis system. Prevailing wage adds 0.25 to 0.5 cents and moving from ground to roof adds 5.0 cents per kWh. Clean Coalition, “East Bay Community Energy: Feed-in Tariff Design Recommendations,” prepared for East Bay Community Energy, August 2017, 15, https://ebce.org/wp-content/uploads/Task-3-EBCE-FIT-Design-Recommendations_DRAFT.pdf.
- 50 Ken Jacobs, Ian Perry, and Jenifer MacGillvary, “The High Public Cost of Low Wages” (UC Berkeley Center for Labor Research and Education, April 2015), <http://laborcenter.berkeley.edu/the-high-public-cost-of-low-wages/>.
- 51 Jon Zerolnick, “Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity” (LAANE: A New Economy For All, March 2018), http://laane.org/wp-content/uploads/2018/03/LAANE_Liquid-Assets_Stormwater-Report.pdf.
- 52 Michael Messenger, “Strategic Plan to Reduce the Energy Impact of Air Conditioners” (California Energy Commission, June 2008), <http://www.energy.ca.gov/2008publications/CEC-400-2008-010/CEC-400-2008-010.PDF>.



53 Matt Michel, “NATE Impact Study” (Service Roundtable, September 2016), <https://www.serviceroundtable.com/freebies/viewfreebie.asp?PCID=1469>.

54 Energy Market Innovations, Inc., Western Cooling Efficiency Center (WCEC), and Better Buildings, Inc. (BBI), “California HVAC Contractor & Technician Behavior Study: Final Report,” CALMAC Study, September 14, 2012, 62, http://www.calmac.org/publications/CA_HVAC_Behavior_Study_FinalReport_2012Sept14_FINAL.pdf.

55 Southern California Edison Design & Engineering Services, “Office of the Future - Landmark Square Building,” October 14, 2010, <https://www.etcc-ca.com/reports/office-future-landmark-square-building>; San Diego Gas & Electric Company, “Office of the Future 25% Solution Assessment, Stage One, Final Report,” December 15, 2010, <https://www.etcc-ca.com/reports/office-future-25-solution>; San Diego Gas & Electric Company, “Advanced Lighting Control System Assessment, Final Report,” December 15, 2010, <https://www.etcc-ca.com/reports/advanced-lighting-control-system-assessment>; Heschong Mahone Group, Inc, “Large Office (‘Ziggurat’ Building) Site Report: High Efficiency Office: Low Ambient/Task Lighting Pilot Project,” submitted to Pacific Gas and Electric Company, October 23, 2009, <https://www.etcc-ca.com/sites/default/files/OLD/images/pge0819.pdf>.

56 Southern California Gas Company, “Appendix B.1: Section A, Program Implementation Plans (Redline Versions) Statewide Programs,” May 29, 2013, [https://www.socalgas.com/regulatory/documents/A-12-07-003/SCG%20Appendix%20B.1%20Section%20A%20Statewide%20Program%20Implementation%20Plans%20\(Redline\).pdf](https://www.socalgas.com/regulatory/documents/A-12-07-003/SCG%20Appendix%20B.1%20Section%20A%20Statewide%20Program%20Implementation%20Plans%20(Redline).pdf); Cori Jackson, “California’s Advanced Lighting Controls Training Program: Building a Skilled Workforce in the Energy Efficiency Market,” *ACEEE Summer Study on Energy Efficiency in Buildings*, 2012, <http://cltc.ucdavis.edu/sites/default/files/files/publication/20120800-aceee-calctp-jackson-1.pdf>.

57 Southern California Gas Company, “Appendix B.1: Section A, Program Implementation Plans (Redline Versions) Statewide Programs,” 730.

58 U.S. Environmental Protection Agency, “General Risk Management Program Guidance - Chapter 2: Applicability of Program Levels,” April 2004, <https://www.epa.gov/rmp/general-rmp-guidance-chapter-2-applicability-program-levels>.

59 Carol Zabin et al., “Advancing Equity in California Climate Policy: A New Social Contract for Low-Carbon Transition” (UC Berkeley Donald Vial Center on Employment in the Green Economy, September 13, 2016), <http://laborcenter.berkeley.edu/advancing-equity/>.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 3: Supply-Side Workforce Development Strategies: Preparing Workers for the Low-Carbon Transition

by Carol Zabin

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I. Introduction

This chapter identifies priorities and provides recommendations for the best approaches to skill building for the transition to a carbon-neutral economy, while prioritizing middle-class careers and inclusion of disadvantaged workers. It outlines the roles that the state's existing workforce development infrastructure can play in preparing workers for changes in the labor market that will occur as the state undertakes the climate measures outlined in California's Climate Change Scoping Plan. It also presents recommendations for a coordinated statewide strategy built on California's robust education and training institutions in partnerships with high-road employers, unions, and community-based organizations.

The strategy is based on a fundamental principle for workforce development: training must serve the needs of both employers and workers to be successful. Public funding can add value but only if both workers and employers see the benefits of training. For workers, this means wage and career advancement as skills are acquired; for both public and private employers, this means increased productivity and quality performed by trained workers. Training programs should be designed to address the particular skill needs of an industry sector; in tune with hiring and promotion practices of employers in the industry; and calibrated to the number of actual jobs. More than simply paying attention to need, the state's workforce efforts must be grounded in an approach that is rooted in industry and starts with the jobs.

When combined with the strategies described in Chapter 2 on the demand side of the labor market, these recommendations for preparing workers (the supply of labor) can ensure that Californians are ready to contribute to and thrive in the transition to a carbon-neutral economy. The workforce development solutions presented here can equip workers with the skills they need to adapt to new technologies and meet the needs of businesses in energy, transportation, and other key industries as they reduce their greenhouse gas emissions. The recommendations can also ensure that the economic benefits arising from policies to mitigate climate change are more accessible to workers from disadvantaged communities. These recommendations are based on the current capacity of the state's workforce development infrastructure and identify gaps, areas to improve alignment and coordination, and opportunities to leverage existing funding.

With about 40 million people, and about 12 percent of the nation's population, California's workforce and education systems are tasked with serving more people than any other state. These services are provided through largely decentralized service delivery structures that include 11,000 K-12 Schools, over 1,000 School Districts, over 1,000 Charter Schools, 113 Community Colleges (in 72 Community College Districts), 58 County Welfare Departments, 58 County Offices of Education, 45 Local Workforce Boards, and various state departments and agencies, including the Labor and Workforce Development Agency (comprised of the California Workforce Development Board



(CWDB), Department of Industrial Relations-Division of Apprenticeship Standards (DIR-DAS), Employment Training Panel (ETP), and Employment Development Department (EDD)), the State Board of Education (SBE) and California Department of Education (CDE), the California Community Colleges Chancellor's Office (CCCCO), the Health and Human Services Agency, the Department of Rehabilitation, the California Department of Social Services, and the California Department of Corrections and Rehabilitation.

The foregoing institutions and organizations provide a variety of skill-building, job-matching, and educational and employment services and grant programs and are funded by both federal and state funding programs, including the federal Workforce Innovation and Opportunity Act (WIOA) program. Each workforce training program and funding stream plays a different role in this highly decentralized system, though CWDB works with the representatives of workforce, human service, and education programs to develop a common policy vision for the provision of workforce services in the state. This policy vision is articulated in the WIOA State Plan.¹

The vast majority of the jobs that can help lower greenhouse gas emissions across the economy are in traditional professional, technical, and blue-collar occupations related to the key industries producing energy and fuel, consuming energy and fuel, or other heavy-emitting activities. For these industries, specific knowledge and skills related to cleaner production are only one component of a much broader occupational skill set. Very few of these jobs are specialized jobs where the main skill set is focused exclusively on lowering greenhouse gas emissions. For example, the 2009 Needs Assessment commissioned by the California Public Utilities Commission (CPUC) showed that approximately two-thirds of the jobs generated directly by energy efficiency investments in California are in the building and construction trades—e.g., electricians, sheet metal workers, plumbers, laborers, carpenters, stationary engineers, and others.² Around one-sixth of the jobs created are for professionals such as architects and engineers. Only 2 percent are specialized energy efficiency occupations like energy auditor, and even then, auditors often perform other tasks unrelated to energy savings.³

Rather than creating any exclusively “green” jobs, the economy envisioned by the Scoping Plan will be built and run through existing occupations which may incorporate new skills or tasks that result in lower greenhouse gas emissions. Mechanics for zero-emission vehicles are still motor vehicle mechanics, workers who manufacture electric cars are still autoworkers, electricians who build solar farms are still electricians, and engineers who design methane digesters for dairies are still engineers, even though, in all cases, their skill sets continually evolve. In other words, very few new occupations are created by climate mitigation activities, but instead, new aspects to traditional occupations are developed. Accordingly, workforce preparation for the transition to a carbon-neutral economy can and should leverage the state's existing workforce training and education infrastructure that serves these occupations, rather than being treated as a new and separate initiative.



Moreover, as described in more detail in Chapter 5, an analysis of the principal industries and occupations affected by climate policy shows the predominance of blue-collar occupations in each of the Scoping Plan economic sectors. This finding does not negate the importance of professional occupations (those requiring a four-year degree), but does suggest that greater emphasis should be placed on skill and career development in blue-collar jobs.

II. Lessons for High-Road Workforce Training and Education for the Transition to a Carbon-Neutral Economy

Over the past 10 years, misconceptions about both the genesis and nature of “green jobs” and what made workforce development programs effective led to the creation of new short-term training programs for “green” occupations like rooftop solar installer or energy auditor. Many of these programs, some of which were funded by the American Recovery and Reinvestment Act (ARRA), had poor results for job placement and wage improvements for participants.⁴ The examples of the first wave of green jobs training during the ARRA era, when combined with best practices in workforce development, offer key lessons that shape the report’s recommendations on preparing workers for the transition to a carbon-neutral economy:

- The goal of training investments is to deliver skills for a broad set of workers who often are not specialized “green” workers, but whose actions impact greenhouse gas emissions. For example, architects and HVAC workers both have a significant impact on the energy use in buildings and need broad foundational training for their occupations as well as specialized training to incorporate energy efficiency best practices into their work. Broad occupational training is better for workers, who will not be locked into a narrow technological skillset as the economy changes, and at the same time provides employers with a workforce that can quickly adjust to rapidly evolving technologies.
- Training on its own is not sufficient to ensure that workers transition into good careers in the carbon-neutral economy. Jobs should drive training, and training programs, in turn, need to be evaluated on job placement outcomes—not just in any job, but career-track jobs with decent entry-level wages and pathways to advancement.
- For training institutions to be responsive to actual jobs, they need to know what skills are needed by employers. Skill and certification standards, addressed in Chapter 2 on demand-side policies, are critical to provide signals to training institutions on what to train for. Critical intelligence should also be gathered from



annual assessments conducted by industry partnerships. Indeed, in its new approach of “start with the jobs,” CWDB prioritizes industry-based partnerships that first organize workers and employers on the “demand side,” identifying jobs and skills before reaching out to training partners on the “supply” side.

- Benefits from investments in training will not be realized by either workers or employers in high-turnover, low-wage jobs. Training partnerships funded with public dollars should engage “best-in-class” employers in their specific industry: those who invest more in training, require greater skills, and offer higher wages than employers who compete on the basis of low wages.
- The inclusion of disadvantaged workers, a priority in state policy, requires that skill standards and certifications must always be coupled with intentional policies to bring these workers into the career pipeline. If disadvantaged workers are not supported to acquire the skills needed, standards and certifications can create barriers, rather than pathways into good jobs.
- Training funds committed by agencies responsible for climate policy implementation should be used to build on, rather than as a substitute for, the state’s existing workforce development infrastructure. Agencies in charge of climate policy implementation should not create independent workforce development programs, which would result in further fragmentation and lack of coordination of the state’s training infrastructure. Such fragmentation creates confusion for those seeking training.
- The primary role of agencies in charge of climate policy implementation with regard to workforce training and education should be to identify emerging technologies and changing production processes as these developments occur and mature. They should work with labor and education agencies to identify priority occupations and changes in skill sets that arise from technological innovation. As described in Chapter 2, they should then incorporate those skill standards in the requirements of programs that seek to encourage investments in emerging technologies and climate mitigation and adaptation activities, to ensure that there is demand for workers with the appropriate skills.

Industry training partnerships are key to successful workforce training for occupations not requiring a four-year degree. Sometimes known as sector strategies, industry partnerships bring together multiple employers, labor, community, education, and workforce partners to develop a strategy to address workforce issues within a particular industry. Business has to be at the table to identify specific skill and training needs and to commit to training their incumbent workers or new hires, or to interview training graduates as job openings occur. Sector strategies function best with an intermediary to convene the partners, coordinate the planning and implementation of the projects, develop agreements on skill standards and appropriate certifications, contract with



training providers (e.g., community colleges and apprenticeship programs), develop or update curricula, and design and carry out other implementation tasks. The intermediary can also help negotiate the exact nature of the commitments by the partners, particularly around sharing the costs of training, development of wage ladders or promotion opportunities for workers with upgraded skills, and other key mechanisms to assure sustainability and benefits for both employers and workers.

III. Understanding California's Existing Workforce Development Infrastructure

The transition to a carbon-neutral economy will impact workers in various occupations and industries, from architects and engineers to janitors and transit workers, from electricians and carpenters to mechanics and machinists. These and other occupations receive training and education through distinct pathways in the state's robust and complex network of core postsecondary education institutions. To understand how workers prepare to enter careers in the transition to carbon-neutrality, this analysis identifies three phases of training, four general occupation categories, and the skill development pathways and primary educational institutions for each. The overall system is illustrated in **Exhibit 3.1** and will be described in more detail below.

A. The Three Phases of Training

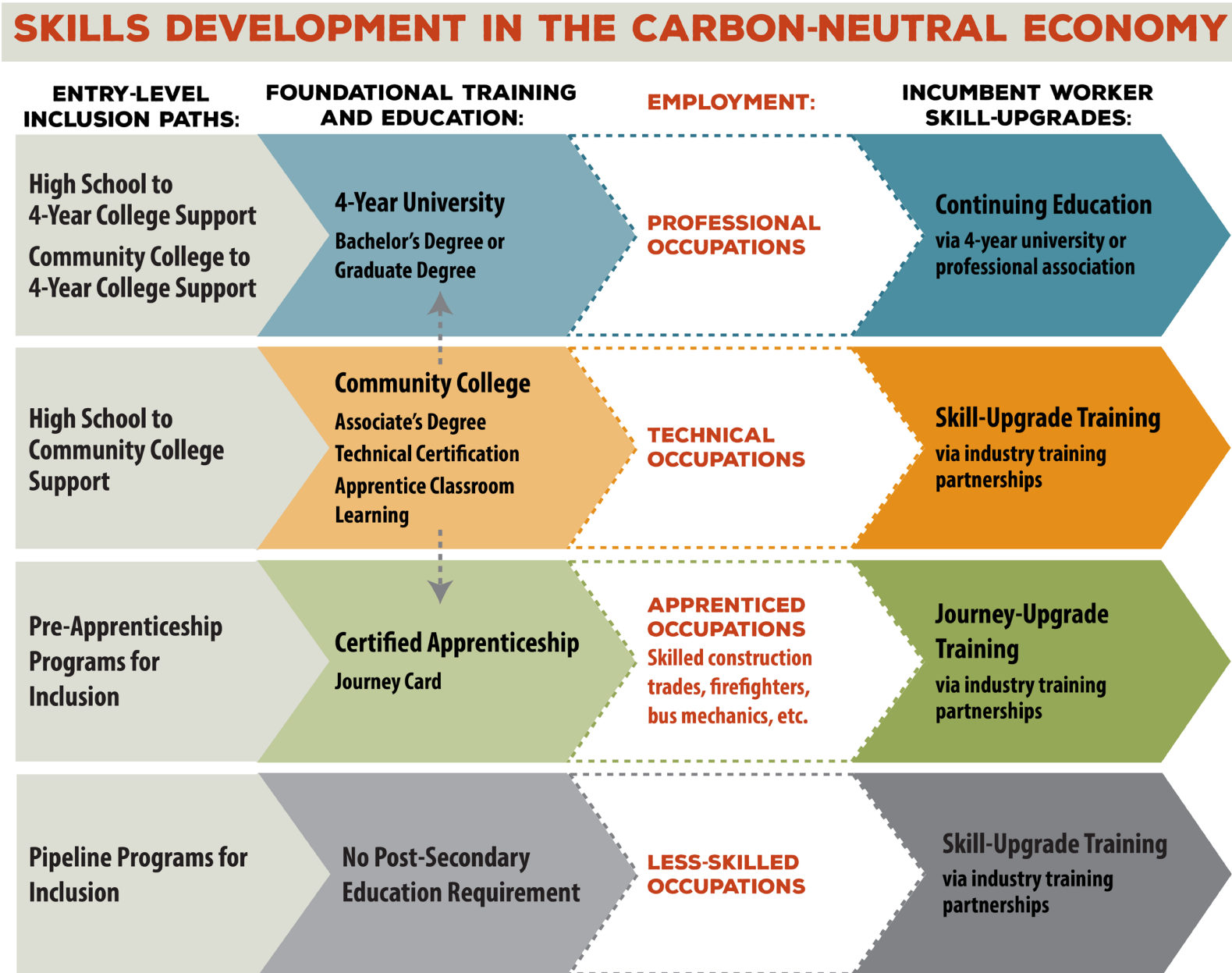
Ensuring that California's workforce is able to adapt to the transition to a carbon-neutral economy will require policy interventions at three distinct phases of training and education.

❖ Entry-Level Inclusion Paths

This phase of training is for the subset of workers coming from disadvantaged and historically marginalized communities. It requires investments in basic workforce preparation and a comprehensive set of supports that help workers overcome various barriers to employment. These programs are designed to help disadvantaged workers get access to the same opportunities as more-privileged Californians, putting them on a path into foundational training and education and, thereby, into career ladders across the spectrum of middle-class occupations, including blue-collar, white-collar, and professional occupations. Workers who are not disadvantaged typically have better access to pathways into the next phase of foundational training or access to entry-level positions in good career-track jobs.



Exhibit 3.1. Skills Development in the Carbon-Neutral Economy



❖ Foundational Training and Education

Workers entering skilled occupations in the carbon-neutral economy receive intensive training—usually before they enter the workforce—from the state’s core postsecondary education and training institutions: the state-certified apprenticeship system, the California community college system, and the state’s four-year colleges and universities. Programs that train for key occupations need to continually incorporate new technology-related knowledge and skills in curricula in relevant fields and occupations.

❖ Incumbent Worker Skill Upgrades

Most workers who will be faced by changes in jobs and skill needs due to the transition to a carbon-neutral economy are already in the workforce. Skill upgrades for incumbent workers are an essential component of a comprehensive strategy to prepare the workforce as employers introduce new technologies and processes in both old and new businesses.

The relevant institutions and best practices for these three phases of training differ by industry and occupation, and any workforce development strategy must take these differences into consideration.

B. Occupation Types and Typical Career Preparation Pathways

The three phases of training described above are carried out differently in different occupations and industries. This section describes the most important occupational categories below, with the caveat that the boundaries between these categories are blurry. This categorization is meant as a conceptual tool to distinguish among the major career pathways that exist in the labor market.

❖ Professional Occupations

Professional occupations key to the carbon neutrality transition, such as architects and engineers, generally require a bachelor’s or graduate degree and tend to receive training and education through the state’s **four-year colleges and universities**. In general, there are robust career training pathways for professional workers because there are clear educational credentials (bachelor’s and master’s degrees in engineering and other relevant professions) and usually a state professional license requirement based on education, work experience, continuing education, and a test of competency. Professional licenses are usually issued by a state agency or



state-sanctioned professional association. Two of the most common mandatory licenses related to the carbon-neutrality transition are for Professional Engineers (P.E.) and Registered Architects (R.A.). Because professional licenses are held to a high standard and are legally required, the return on investment for earning a professional degree and license is usually high in terms of compensation and employment opportunities. These requirements also ensure that licensed workers are continually maintaining and upgrading their skills.

❖ Technical Occupations

These occupations, which include a large variety of technical, mechanical, administrative, and other jobs across the Scoping Plan sectors, require postsecondary training and/or education but generally do not require four-year college degrees. Some examples of occupations include facility managers and energy data systems operators in energy efficiency, electrical systems operators, and water and waste technical occupations. The primary postsecondary institution to provide this type of training is the state's **community college system**. Training pathways here are multiple and various and not always as clearly defined as for the professional occupations or the occupations served mostly by apprenticeship programs. Training requirements range from short certificate programs to full two-year educational credentials. In some cases, employers have worked with community colleges or other training institutions to develop state-certified apprenticeship programs for these technical occupations; see below for a description of apprenticeship.

In the United States, for many technical occupations, there are no clear educational requirements for hiring. The exception is the healthcare profession, where many occupations have specific certification requirements, from the X-ray technicians to dental hygienists. But in many occupations where safety and accuracy are less urgent, qualifications are less systematized, and employers' hiring practices are not always transparent. This situation creates challenges not only for prospective workers, but also for training institutions like the community colleges, because there is no clear signal about what training is needed and valued by employers. Clearer certification frameworks, along with deeper industry partnerships, could provide more effective indicators for skill delivery.

❖ Skilled Construction Trades and other Apprenticed Occupations

The skilled construction trades are a subset of technical occupations where the predominant model of formal training is the **state-certified apprenticeship program**. The skilled trades are highlighted, because of the significance of construction work in all the Scoping Plan sectors and because the apprenticeship model for the skilled



trades is very well developed and a key asset that the state has for the transition to a carbon-neutral economy. State-certified and federally-registered apprenticeship programs are also available for other occupations with willing employers, and in fact, the use of the apprenticeship model is expanding and has strong support from the Newsom Administration. It is fair to say that apprenticeship is most highly developed and widespread in the skilled construction trades and is still less significant in most other occupations, with the exception of firefighters and a few other key occupations.

Previous research, including the *Needs Assessment and Guidance Plan*, has highlighted the particularly strong performance of certified apprenticeship in preparing workers for long-term careers in the construction trades. Certified apprenticeship is an earn-while-you-learn workforce training system that combines classroom and on-the-job training. Intended to prepare apprentices for a career in a particular trade, program graduates earn an industry-recognized credential and can progress to a journey-level position, which is the skill certification in the trades. For energy efficiency, the critical occupations are in building and industrial energy systems; they include electricians who work on lighting, plumbers, pipefitters, sheet metal workers, stationary engineers who work on heating ventilation and air conditioning, and related occupations.⁵ For renewable energy, depending on the specific technology, the critical occupations include electricians, ironworkers, boilermakers, and others. The basic trades—such as laborers, carpenters, and operating engineers—work on most construction projects, including renewables and energy efficiency.⁶ Transportation infrastructure—such as high-speed and light rail, smart roads, and other transportation projects—also include the full spectrum of the construction trades.

❖ **Less-Skilled Blue-Collar Occupations**

Many workers in key occupations for the carbon-neutrality transition are not expected to have any formal postsecondary education before they are hired but rather learn on the job, which creates challenges for any effort to upgrade these workers' skills *en masse*. These occupations include residential construction workers, truck drivers, manufacturing production workers, and forestry, waste, and agricultural workers.

Because of the lack of formal training programs in these occupations, skill upgrades can only be addressed through engagement of employers. Workforce development institutions can provide training resources, but employers' commitment and clear signals on what training is needed is essential. Where workers are represented by a union, labor-management partnerships can be developed, as in the state's High Road Training Partnerships initiative.



C. California's Core Postsecondary Education and Training Institutions

Most workers in middle-class careers must go through some form of foundational, postsecondary education. **Exhibit 3.1** shows how these training pathways differ by occupational groups. For professional workers, the pathway is by definition through a four-year college. For other technical jobs, this pathway may be through a two-year community college credential or associate degree. For the construction industry, at least the portion of it that provides workers with a middle-class career, that pathway is generally apprenticeship. Apprenticeship is also used in a limited number of other skilled occupations, and new efforts have been initiated to expand apprenticeship into non-traditional occupations such as transit workers, manufacturing workers, and others.

Exhibit 3.2, below, gives summary descriptions of the training and education services offered by the state's core postsecondary institutions, as well as the average time needed to complete the standard programming in each institution. As indicated in **Exhibit 3.2** and explained more fully below, each of these institutions provides education and training opportunities at all three phases of training—from entry-level inclusion programs, to foundational training, to incumbent worker skill upgrades. However, the majority of their training and educational opportunities address foundational training.

Exhibit 3.2. Institutional Overview

| Institution | Summary Description | Average Length of Training |
|--|---|----------------------------|
| State-Certified Apprenticeships | <ul style="list-style-type: none"> • Long-term training in the building and mechanical trades, and, increasingly, in other sectors and occupations. • Apprentices typically start with little or no experience and learn to be experts in their occupation while working full-time for an employer and receiving classroom instruction. • Wages increase with skill level. • Most joint apprenticeships in construction offer skill-upgrade training for journey workers to update or enhance their skills. | 3 to 5 years |



| Institution | Summary Description | Average Length of Training |
|---|---|--|
| <p>Community Colleges</p> | <ul style="list-style-type: none"> ● Postsecondary education that is open to those with limited resources and low basic skill levels. ● Students may obtain a terminal associate degree after two full-time years of study and/or receive a vocational certificate in a shorter amount of time, usually one year. ● Students can obtain industry-recognized certifications from accredited credentialing agencies that test for competencies based on well-established industry skill requirements, where they exist. ● Students may obtain an associate degree and transfer to a four-year college. ● Most apprentices receive the classroom portion of their learning through classes administered by the community colleges. Community colleges also provide pre-apprenticeship training to help disadvantaged students gain access to apprenticeship. Incumbent workers also access community college classes, primarily for reskilling or skill-upgrade training. | <p>6 months to 2 years</p> <p>(some custom programs as short as 4 weeks)</p> |
| <p>Four-Year Colleges and Universities</p> | <ul style="list-style-type: none"> ● Training for qualified high school graduates and community-college transfer students. ● Long-term pre-employment education for professional or managerial jobs that are linked to professional licenses and continuing education. | <p>4 years or more</p> |



1. State-Certified Apprenticeship

Apprenticeship is the core postsecondary training institution for the skilled construction trades and is increasingly the preferred model for other non-professional occupations. Registered apprenticeship—which can be either state or federally certified apprenticeship, or both—is an earn-while-you-learn workforce training system that combines classroom and on-the-job training. In California, registered apprenticeship programs are regulated by the state Division of Apprenticeship Standards (DAS), housed within the Department of Industrial Relations (DIR). DAS ensures that certified programs meet specific minimum training benchmarks and other criteria to ensure quality and accountability.⁷

In 2018, there were almost 80,000 apprentices in all occupations in California, ranging from firefighters to cosmetologists,⁸ including nearly 54,000 apprentices in more than 230 apprenticeship programs in the construction trades. California has invested \$15 million each year over the past three years through the California Apprenticeship Initiative to promote the creation of new apprenticeship programs in transportation and logistics, advanced manufacturing, health care, and information technology.⁹

The following provides a description of the apprenticeship system for the skilled construction trades, where apprentices are prepared for a career in a particular trade and program graduates earn a journey card, which is an industry-recognized credential. Apprenticeship in the trades is particularly important for achieving the state’s climate goals because of the key role of the construction industry in building clean energy and sustainable transportation systems and infrastructure, in retrofitting buildings and industry to lower energy use, in constructing denser cities to reduce vehicle miles traveled, and in other activities to lower greenhouse gas emissions.

Apprenticeship programs in the construction trades can either be joint (i.e., a partnership between a local union and the employers with whom it has collective bargaining contracts) or unilateral (i.e., run solely by the employer[s] in a nonunion work environment). For the past five years, 89 percent of graduates of state-certified apprenticeship programs were from joint programs, and only 11 percent were from unilateral programs.¹⁰ Programs are mostly funded by the private construction industry; in the case of Joint Apprenticeship and Training Committee (JATC) programs, contractors and workers each make small payments for every hour worked that are deposited in a training trust fund. The state government helps fund the classroom portion of the training, which is administered by the community college system and carried out by each apprenticeship’s local public educational partner.

Requirements for the attainment of the journey-card credential vary by trade. For the electrical apprenticeship, for example, the *minimum* state requirements are 8,000 hours of on-the-job training, 640 hours of classroom learning, and competency tests for each



level of advancement.¹¹ In practice, programs often exceed this minimum; for example, all IBEW apprenticeship programs in California require between 800 and 900 hours of classroom training.¹²

The yearly number of openings in each apprenticeship program is determined according to the current labor contracts of each local union and to expectations about future work. Such demand-driven training ensures that people are trained only if jobs exist for them; unions will not sponsor new apprentices unless there will be enough work for them to finish their three- to five-year training program. Apprenticeship openings, therefore, tend to track cycles in the construction sector,¹³ with the number of program openings increasing only when the construction industry expands or unions' share of it grows. By limiting the number of new slots to the capacity of the unionized construction sector, this model avoids the common problem of low job placement rates that training program graduates sometimes face.¹⁴

Apprenticeship provides clear benefits to workers, and in the unionized construction trades, is one of few pathways to a middle-class career for workers without a college degree.¹⁵ Apprentices receive the same health, pension, and other benefits as journey-level workers, and their training is free. During an apprenticeship, workers receive pay increases on a periodic basis as they acquire new skills, and upon graduation, they obtain their journey card and receive journey-level wages.¹⁶ For example, first-year apprentices in the Ironworkers start at \$18.00 per hour plus benefits; after completion of their four-year apprentice program, they will be paid the journey wage, currently \$36.00 per hour.¹⁷ Apprentice wages vary by trade and sometimes by county. Across all apprenticeships, workers who complete an apprenticeship see an average lifetime earnings gain of almost \$270,000. This is a greater income premium than community college.¹⁸ The programs also provide a clear safety benefit: apprenticeship includes comprehensive safety training, and construction workers are less likely to experience injuries¹⁹ in an occupation that has very high injury rates and the highest number of fatalities of all industries in California.²⁰

Employers also benefit from apprenticeship programs. Because of these direct, strategic investments in their workforce, employers are able to access skilled workers and upgrade their skills quickly as technologies change. Joint apprenticeship programs also have been shown to retain skilled workers amid the ups and downs of an extremely cyclical industry.²¹ These advantages lead to substantial employer investment in apprenticeship programs, one of the key factors in their success.

Although the main emphasis of the apprenticeship system is to deliver foundational training for the skilled construction trades, it also provides infrastructure for the other two critical phases of training: incumbent worker skill upgrades, and pipelines for inclusion. Journeypersons currently working in the skilled trades are periodically required to participate in “journey-upgrade” programs, which rely upon the same curriculum



committees and trainers as the apprenticeship system. Similarly, many programs also are closely linked with pre-apprenticeship programs aimed at preparing workers from disadvantaged backgrounds to participate and succeed in apprenticeship training. These additional components of the apprenticeship system will be addressed in the corresponding sections below.

Outcome Data from CWDB

In the 2018 Workforce Metrics Dashboard Report, the California Workforce Development Board (CWDB) evaluated the workforce development outcomes of state-certified apprenticeship programs, administered by the Department of Industrial Relations—Division of Apprenticeship Standards (DIR-DAS). This data shows that as of April 2017, state-certified apprenticeship programs were actively serving 74,221 registered apprentices. Sixty-three percent of these participants were people of color, 6 percent were women, and 5 percent were military veterans. These figures reveal the increasing racial diversity since program year 2014-15, when 59 percent of participants were people of color. In recent years, apprenticeship programs have expanded to include new occupations, but the great majority of program participants are still in the skilled construction trades.

The Workforce Metrics Dashboard reports that 86 percent of graduates of the apprenticeship program in 2015, the year of the most recent data on graduation rates, were employed as wage earners one year after finishing the program with an average annual wage of \$82,156.²² Graduates of apprenticeship had the highest median annual wages of all programs assessed in the Workforce Metrics Dashboard.

2. California Community Colleges

The California Community College system is the nation's largest higher education system, with 114 community colleges serving 2.1 million students annually.²³ This network of institutions is tasked with four main objectives: providing basic technical skills education leading to industry certification; supporting transfer to four-year colleges; aiding economic development by responding to labor market needs; and offering continuing education for incumbent workers. The vast array of roles that community colleges play is an enormous state asset.

Community colleges in California serve a wide range of populations, from recent high school graduates wishing to obtain their first two years of postsecondary education at a low cost to mid-career professionals coming back to take a few courses to upgrade their skills and knowledge within their field or to gain skills for a career change. The community college system is the primary system providing higher education opportunities for low-income youth, immigrant youth, and people of color. In the fall semester of 2017,



the community colleges served more than 1 million students of color, who made up 73 percent of the students system-wide.²⁴ Community colleges also serve as the main pipeline for inclusion of students from disadvantaged communities into professional occupations through their transfer programs into the California State University system and the University of California. Sixty percent of California State University and 30 percent of University of California graduates are community college transfers. California community colleges also have a long history of serving incarcerated and formerly incarcerated students through regular and long-distance education. Current efforts to assist the state's incarcerated and formerly incarcerated population are the result of two key laws: Senate Bill 1391 (Chapter 695, Statutes of 2014) and The Public Safety and Rehabilitation Act of 2016 (Proposition 57, 2016). Twenty-two community colleges provide instruction and support services to more than 7,000 inmates within California's 35 prisons.²⁵

Community colleges play multiple roles in workforce training. The bulk of their programming focuses on providing foundational training, education, and industry certification to students preparing to start their careers. The community college system provides one- or two-year terminal credentials in technical occupations, as well as two-year associate degrees. Roughly 1.4 million of the students are enrolled annually in Career Technical Education (CTE) certificate programs.

Community colleges also administer the publicly funded classroom portion of state-certified apprenticeship programs, which are required to have a local educational partner. The colleges also facilitate student internships and work-based learning programs with employers. True to the word "community," the colleges work with community-based organizations, charitable foundations, and local workforce development boards to remove barriers to entry for disadvantaged populations. Finally, contract education programs provide training for incumbent workers through partnerships with specific employers, which are funded by the employers themselves, collectively bargained training funds, and the state's incumbent worker training program administered by the Employment Training Panel (ETP).

Outcome Data from CWDB

The CWDB's 2018 Workforce Metrics Dashboard Report also evaluated the workforce development outcomes of the California Community College system, limiting their analysis to the system's CTE programs, as opposed to their transfer programs to four-year colleges or the other programming they offer. These roughly 200 CTE programs integrate academic knowledge with technical and occupation specific skills, across many occupations.

As with the analysis of the state-certified apprenticeship programs, three key metrics consist of graduation rates, as measured by certificate attainment; post-exit employment



rates; and post-exit wages, measured one year after exiting the program.²⁶ In program year 2014-15, CTE programs served 228,299 exiting participants. Among these exiting participants, 19,299 (8.5 percent) received Chancellor’s Office-approved certificates, an associate degree, and/or a California Community College bachelor’s degree. The remaining 209,000 (91.5 percent) exited without receiving official certification, though they may have obtained an accredited industry certification or achieved some other educational goal (known internally as “skill builders”). Among all the exiting participants, 66 percent were earning a wage four quarters after exiting the program.

As with state-certified apprenticeship programs, those who completed certification fared better in terms of post-exit employment as well as wages. The differences, however, are much smaller: 71.8 percent of those who attained a certificate were earning wages four quarters after exit, while 65.9 percent of those who did not achieve certification were employed. The median annual wage for certificate earners was \$33,420 and for non-earners, \$30,672. Very large numbers of community college students complete programs in occupations that are lower wage than construction, such as general business, retail, and hospitality. The lower returns from community college education compared with apprenticeship should thus not be interpreted as an apples-to-apples comparison.

3. Four-Year Colleges and Universities

California’s colleges and universities are key to training workers in professional occupations that are critical to addressing climate change and achieving the state’s climate targets. This robust education infrastructure includes numerous academic departments in engineering, architecture, transportation planning, agriculture, forestry and natural resources, and other key departments. Also critical are research centers at the University of California (e.g., the UC Davis Lighting Technology Center, the UC transportation research centers, and the UCLA Smart Grid Energy Research Center), which not only carry out research on technology, but also train the next generation of specialized engineers and planners.

In the professional occupations, particularly the key technical occupations related to clean energy and transportation, there are clear career paths with requirements for licenses to practice, based on industry-recognized educational credentials, on-the-job-training, and competency exams. For example, in order to obtain a license to practice, an architect must not only attain an educational degree, but also pass a competency exam and work a specified number of on-the-job hours under a licensed architect. To maintain their credentials, most professional workers must obtain continuing education credits, so there is a built-in mechanism to upgrade skills. These are middle- and upper-middle-class jobs, with significant returns on training and earnings clearly correlated with training.



There are of course significant barriers for gaining access to professional education and careers for disadvantaged students, but also important efforts to overcome these barriers. The community college system functions as a pipeline through its transfer programs, and California's public universities have developed specific outreach programs to support high school students from low-income backgrounds and under-performing schools.

IV. Using California's Workforce Development Infrastructure for the Carbon-Neutrality Transition

How well is the state leveraging these core postsecondary institutions to prepare workers—especially disadvantaged workers—for good jobs in the transition to carbon-neutrality? To optimize investments of public funds, the state's primary workforce education and training institutions need to break down silos. While some collaboration occurs across institutional lines, apprenticeship programs, community colleges, workforce development boards, community-based organizations, and public agencies do not always operate as a comprehensive workforce development system serving the California economy as a whole, and, more specifically, the industries critical to decarbonization. This section analyzes the effectiveness of this infrastructure in:

- Providing pipelines for workers from disadvantaged communities into career-training pathways and family-supporting jobs;
- Ensuring that the next generation of workers in key occupations needed to lower greenhouse gas emissions are trained in the most advanced theory and practice; and
- Upgrading the skills of incumbent workers to prepare them for the transition to a carbon-neutral economy.

The following section addresses the steps that the state's workforce development system and training and education institutions have taken to execute these functions, document best practices, and identify gaps. The summary of recommendations pinpoints key opportunities for further state action to bring best practices to scale and develop a comprehensive strategy to best undertake workforce preparation for the carbon-neutrality transition.



A. Entry-Level Inclusion: Strengthening Pathways to Family Supporting Careers for Disadvantaged Workers

The state is committed to ensuring the inclusion of all Californians in the economic opportunities created by climate policy, which is made explicit in the Scoping Plan.²⁷ The removal of barriers for workers from disadvantaged communities not only contributes to equity, but also increases the pool of trained workers to execute climate change mitigation and adaptation work and the diversity of that pool. Career access, advancement, and mobility improve the efficiency of the labor market by ensuring workers have the opportunities to provide their highest value.

The inclusion of workers from historically marginalized communities will not occur without intentional intervention, as persistent trends in the labor market continue to produce significant wage inequality across racial, ethnic, and gender lines. Connecting disadvantaged workers with career-track jobs requires specific efforts to overcome challenges on both the demand and supply sides of the labor market. On the demand side, addressed in Chapter 2, it is critical to ensure that jobs are accessible to disadvantaged workers and provide living wages and advancement opportunities. On the supply side, discussed here, it is critical to prepare workers so that they can take advantage of job opportunities when they arise. The success of inclusion programs should be measured by their ability to place graduates in career-track jobs with family-supporting wages and benefits, or to provide access to further training that offers entry into such jobs.

Building pathways to these career tracks will require targeted strategies specific to each occupation type: skilled construction trades and other apprenticed occupations; other technical and white-collar occupations served largely by the community colleges; and professional occupations. The state's core postsecondary educational and training institutions currently provide a variety of pipeline programs that can form the bedrock of efforts to increase inclusion into key occupations for the transition to a carbon-neutral economy, including professional occupations in engineering and architecture, and technical and blue-collar occupations such as facility managers, electricians, transit workers, mechanics, water and waste workers and others. See Appendix A, Mapping Sectors to Industries and Occupations, for a list of key occupations that are in industries that have key roles in reducing greenhouse gas emissions reductions.

Niche training programs to promote inclusion in the “green economy,” however compelling on paper, do not offer a comprehensive approach to workforce development. Inclusion efforts affixed only to specialized tasks in a particular industry or sector shortchange both workers and employers; in contrast, foundational skills training helps workers perform a broader array of tasks and more readily adapt to technological



advances. At the entry level for any careers, foundational skills must precede the acquisition of specialized skills. For example, an apprentice electrician must learn the basics of electricity before learning the particulars of solar energy, and a future engineer must have foundational STEM education before learning about energy efficiency.

Most work critical to a carbon-neutral economy is undertaken as an element of existing jobs. Pipeline efforts will thus be more successful as part of the state's existing workforce development programs that provide comprehensive training for high-quality careers, rather than as stand-alone programs where workers learn a narrow set of skills. It will be much cheaper and more effective to integrate bridges and pathways into existing broad curricula, rather than creating or expanding stand-alone “green” training programs.

Inclusion efforts can create pathways for unemployed adults or workers trapped in low-wage jobs, as well as high-school-to-career transitions. Targeting students still in high school can place young people from disadvantaged communities on a better career trajectory. Efforts underway in the community colleges, four-year colleges, and certified apprenticeship system to create greater opportunities for a smooth transition from high school to further education and careers are addressed below.

To target unemployed or low-wage adult workers, successful inclusion training programs require deep engagement with workers—providing career matching, screening, and other support, as well as integrated skills training that includes technical training, basic skills, and job readiness for each industry. A significant body of work has assessed how workforce development strategies can build pathways out of poverty. Much of this literature focuses on the construction industry but the lessons are applicable to other sectors involved in the carbon-neutral economy.²⁸ The CPUC Needs Assessment reviewed this work and describes the following elements as critical to building successful pipelines for inclusion.²⁹

- Extensive outreach, recruitment, and screening of candidates;
- Training for basic skills and entry-level technical skills;
- Effective adult learning strategies, including contextualized learning (for example, math in the context of construction blueprint reading), cohort-based bridge programs (to help create support networks for workers who have been long detached from training and education), and schedule accommodations for working adults and parents;
- Supports such as training and mentoring for life and soft skills, career counseling, and case management;
- A comprehensive package of services, such as transportation and child care assistance, driver's license acquisition, and other supports, many of which can be provided through other public funding; and
- On-the-job training or other workplace-based learning.



Reaching deep into the community to recruit workers may require specialized organizations that can find and orient new workers, help them identify the most appropriate training programs, prepare them for entry into these programs, and support their retention. At-risk youth, veterans, the formerly incarcerated, women in nontraditional occupations, and other groups all face specific barriers and may require tailored supports and programs, in addition to the strategies listed above.

For workers facing added barriers to employment, an increased level of support may be needed for successful completion of pre-apprenticeship or other pipeline programs. The following examination of efforts to assist formerly incarcerated Californians in the labor market illustrates this point. This population is of critical focus right now due to the large numbers of Californians who are being or will be released due to criminal justice reform and the greater awareness of the challenges that re-entry workers face.

Addressing the Challenge of Reentry: Efforts to Promote Employment for Formerly Incarcerated Californians

Criminal justice reform has accelerated in California in recent years, decreasing the state's prison population by approximately 24 percent, or 42,300 people, since its high point in 2006. As the result of a federal court order requiring California to reduce its prison population, the state embarked on a number of interlocking initiatives. The Public Safety Realignment Initiative, AB 109 (Chapter 15, Statutes of 2011), began housing new nonviolent, nonserious offenders in county jails. Proposition 36 (passed in 2012) and Proposition 47 (passed in 2014) further reduced the prison population, while also addressing jail overcrowding. These reforms raise the question of how California will reintegrate this population into the state's economy.

People with past criminal convictions face many barriers to employment, particularly access to stable jobs that pay a living wage. Research has shown that a criminal record lowers the likelihood of a callback from a job interview by more than 50 percent, with an even lower callback rate for African Americans with criminal convictions.³⁰ Nationwide, 60 to 75 percent of re-entering citizens lack employment for up to one year following their release.³¹ Those who do find employment following incarceration tend to be concentrated in low-wage industries, with one longitudinal study finding previous incarceration to be associated with a 20-percent decrease in future wages.³²

California faces one of the nation's highest rates of recidivism, with an average of 61 percent of formerly incarcerated individuals falling back into a cycle of re-offense and conviction.³³ A 2008 national study by the Urban Institute found that controlling for other factors, employment reduced the likelihood of recidivism by nearly half. Furthermore, the study found that higher wages reduce the likelihood of recidivism even more, with an hourly wage of \$10 or more decreasing the likelihood of recidivism down to just 8 percent, nearly three times lower than the 23 percent rate for people without employment.³⁴



In California, policy interventions have moved toward removing barriers to employment faced by formerly incarcerated individuals. In 2017, for example, the state legislature passed the California Fair Chance Act, one of the strongest “Ban the Box” laws in the country, which prevents public- and private-sector employers from asking about an applicant’s criminal record until after a conditional offer of employment has been made.³⁵ A 2018 report by Californians for Safety and Justice found that one in five Californians (an estimated eight million people) are still living with an old criminal conviction, and face over 4,800 laws that impose collateral consequences long after successful completion of a sentence that make it harder for people to rebuild their lives. Their survey found that 76 percent of Californians with a criminal conviction have experienced a barrier to success, including 46 percent who experienced difficulty finding a job, and 35 percent who experienced difficulty in obtaining an occupational license.

California releases approximately 36,000 people from the state prison each year, a portion of whom have received in-prison job-training rehabilitative services such as Career Technical Education (CTE) or have participated in programs operated by the California Prison Industry Authority (CalPIA). Concurrently, California manages federal Workforce Innovation and Opportunity Act (WIOA) funds through its State Workforce Plan developed by the California Workforce Development Board, and implemented by Local Workforce Development Boards (Local Boards) in 14 regions across the state.

While there is some, often informal, coordination between these two systems there is no formal, sustained, and systemic, relationship between them. Various re-entry and workforce programs have been created to target this population, and while these programs have provided good data and lessons learned, an ongoing marriage of the two systems is needed to better integrate services operating in isolation, and to fill gaps and provide holistic and long-term outcomes to reduce recidivism.

Formed in late 2017, the Corrections Workforce Partnership Agreement is intended to strengthen linkages between the workforce and corrections systems in order to improve the process by which formerly incarcerated and justice-involved³⁶ individuals re-enter society and the labor force. The Prison to Employment Initiative Grant Program was included in the 2018-19 State Budget and provides \$37 million over three years to operationalize integration of workforce and re-entry services in the state’s 14 labor regions. The goal is to improve labor market outcomes by creating a systemic and ongoing partnership between rehabilitative programs within California Department of Corrections and Rehabilitation (CDCR) and the state workforce system by bringing CDCR under the policy umbrella of the State Workforce Plan.

The CWDB has issued Regional and Local Planning Guidance through WSD18-01 spelling out new planning requirements on how Local Boards and Regional Planning Units (RPUs) will partner with Community Based Organizations (CBOs), CDCR contracted re-entry service providers, and representatives of Parole and Probation to



provide seamless, integrated services to this population in each of the 14 RPUs. RPUs are being encouraged to build on existing regional partnerships, including existing Community Corrections Partnerships (CCPs) to develop a comprehensive regional vision and plan for successfully integrating the formerly incarcerated and other justice-involved individuals into the labor market.

The State of California has recently increased its investments in pre-apprenticeship for disadvantaged populations, including the formerly incarcerated (in addition to federal WIOA dollars), this is addressed below in Section IV.A.1. The following promising example illustrates the strength of pre-apprenticeship programs as a vehicle for formerly incarcerated individuals to find career-track jobs that help to break the cycle of trauma and re-offense. The transition to a carbon-neutral economy provides the state with an opportunity to expand pathways to high-quality employment for this population.

PROMISING PRACTICE #3.1

Flintridge Center's Apprenticeship Preparation Program for Formerly-Incarcerated Workers

The Flintridge Center's Apprenticeship Preparation Program (APP), serving Los Angeles County, is one of a dozen pilot pre-apprenticeship programs supported by the CWDB with funding from the California Clean Energy Jobs Act (Proposition 39, 2012), and one of four with a focus on formerly incarcerated women.³⁷ The program provides a 12-week course offered three times per year that prepares participants for success in union apprenticeship programs in the building and construction trades.

The APP includes the Multi-Craft Core Curriculum (MC3) of North America's Building Trades Unions (NABTU), hands-on training at Habitat for Humanity construction sites, and a pathway into high-quality careers in union apprenticeship programs. The MC3, required by state law for construction pre-apprenticeship programs, provides basic training designed to prepare workers for any construction trade and to help

participants determine which trade is the best fit, thus increasing long-term retention.

The program also includes "wrap-around" supportive services, both in class—in the form of life-skills workshops—as well as out of class, in connections to childcare and housing assistance, tool and boot provision, record expungement, or drug and alcohol counseling. Workers get jobs in the skilled construction trades, such as electricians, carpenters, and sheet metal workers. The success of Flintridge's model can be seen in the key metric of recidivism: of the participants served in 2016, 94 percent have not become re-incarcerated, compared with 54 percent of formerly incarcerated individuals within Los Angeles County.

Flintridge's APP utilizes an innovative, trauma-informed approach to address challenges facing participants outside the classroom and to



promote success. This approach includes a focus on holistic recovery by incorporating components on fitness, nutrition, peer learning, collaborative skill building, and creative expression. The trainers themselves have experienced incarceration and act as mentors to participants. This kind of peer education is a key element of success according to project participants and is somewhat unique in programs serving the re-entry population.

These comprehensive approaches are paired with support in contacting and entering apprenticeship

programs with local unions. Specifically, Flintridge works with the Los Angeles and Orange Counties Building and Construction Trades Council to match program participants with slots in joint apprenticeship programs working on projects governed by local hiring laws and project labor agreements.

The Apprenticeship Preparation Program at Flintridge is funded by the CWDB, the City of Pasadena, private foundations, corporate sponsors such as Capital Group, and individual donors.

Best Practices and Scaling

Flintridge's model addresses two critical components of successful pre-apprenticeship programs:

1. Providing deep supportive services, offered by trusted mentors and teachers, that help participants overcome challenges related to poverty, mental health, and in this case, the specific challenges of re-entry after incarceration; and
2. Addressing employment barriers by directly connecting participants to family-supporting, career-track jobs as union apprentices, through a partnership with the local building trades council.

The program's interventions are aimed at treating sources of trauma as well as preparing individuals for greater success as they navigate the challenges of obtaining work, balancing life responsibilities, and addressing conflicts. Recently, the Employment Development Department (EDD) encouraged Flintridge staff to develop proposals for incorporating their best practices into the California Department of Corrections and Rehabilitation prison employment programs. The best practices highlighted above have been lifted up in the CWDB Annual Reports on Prop 39 Pre-Apprenticeship, and are included in the CWDB SB1 Workforce Guidelines, a set of 10 standards that the state believes should be met by any construction pre-apprenticeship partnership.³⁸ These practices and standards inform the CWDB High Road Construction Careers initiative, and could inform related RFPs from any state grant-making agency. Getting to scale requires a simple formula: a high-functioning pre-apprenticeship partnership connected to both the building trades and the agencies and resources with specific expertise in serving a justice-involved population. This is a virtuous circle that engages ex-offenders in the project of building new lives—and California's carbon-neutral future.



1. Pipelines into Skilled Construction Trades: Apprenticeship Preparation Programs

California has developed a robust model for apprenticeship preparation in the construction trades. Pre-apprenticeship programs using this model have proven track records for improving access to state-certified apprenticeship for workers from disadvantaged backgrounds and communities. They create a pipeline into apprenticeship for workers who have not been given the guidance and support necessary to successfully apply for entry on their own, who lack job readiness and other basic academic or construction skills, or who face other barriers. Once in an apprenticeship program, workers are on an earn-while-you-learn training pathway, and their wages rise as they acquire new skills.

In the past, the state did not have clear standards for pre-apprenticeship programs, and it had a very mixed track record in terms of placing participants into state-certified apprenticeships or good jobs in the construction industry. For example, during the American Recovery and Reinvestment Act (ARRA) period, some California Energy Commission (CEC) funded programs that were named pre-apprenticeship had little connection to state-certified apprenticeship programs and poor placement records.³⁹

In recent years, key elements of success and standard curricula have been identified by the federal Department of Labor, California's Division of Apprenticeship Standards, and the California Workforce Development Board. These elements have been incorporated as requirements for funding in competitive solicitations issued by the state, and training completion and placement rates have improved accordingly. A standard requirement in these solicitations is the use of the Multi-Craft Core Curriculum (MC3), which exposes students to multiple trades and helps them find the best fit, while providing basic construction skills, general job readiness skills, construction math, and occupational safety and health training. Another requirement is that the local building trades council is a named sponsor of the pre-apprenticeship training programs and could in some cases assume the role of articulating the training with apprenticeship programs of multiple trades in their local region. Perhaps the most significant innovation is the CWDB emphasis on building *partnerships* rather than programs, where training projects link labor, community, education, and the public sector in a joint effort to deliver successful pre-apprenticeship recruitment, training, and placement.

These elements were first explicitly incorporated in the pre-apprenticeship program funded with Prop. 39 funds for energy retrofits in California schools, as described in Chapter 6. Program outcome data have shown superior performance; the twelve pilot programs had average training completion rates of 83 percent and placement rates of 65 percent.⁴⁰ These programs all used the MC3 and included a partnership with the local building trades council among other entities. Other partners varied, but usually included



a community-based organization with deep ties to targeted workers, as well as local workforce boards and educational institutions (namely, adult high schools and community colleges). While funding for pre-apprenticeship under Prop. 39 training program has been exhausted, the same model of high-road pre-apprenticeship is now being developed for workforce investment with funding from the Road Repair & Accountability Act (Senate Bill 1, 2017). Funding in SB 1 includes \$25 million to the CWDB to develop pre-apprenticeship partnerships for disadvantaged job seekers, providing pipelines into construction careers.⁴¹ These pre-apprenticeship programs must use the MC3, coordinate with local state-certified apprenticeship programs, and include recruitment and retention strategies for women, minority populations, formerly incarcerated individuals, and disadvantaged youth. Pursuant to this legislation, the California Workforce Development Board has also developed guidelines for public agencies receiving funds to participate in, invest in, or partner with new or existing pre-apprenticeship training programs. The CWDB's SB 1 Workforce Guidelines establish ten standards for quality pre-apprenticeship, and are relevant to construction pre-apprenticeship writ-large.⁴² See **Promising Practice #6.2: Pre-Apprenticeship Programs for Structured Pathways Into Apprenticeship**, in Chapter 6.

2. Pipelines into Technical and Family-Supporting Blue-Collar Occupations

As described above, apprenticeship offers the best structure in which to link inclusion programs because the-earn-while-you-learn model provides paid work as part of its training program. This is one of the main reasons why community colleges and other institutions are trying to expand apprenticeship to non-construction occupations. Apprenticeships are being developed for several important low-carbon occupations, including zero-emission vehicle mechanics and water utility workers.

A number of other programs initiated by employers, unions, community colleges, and community-based organizations have also developed for blue-collar and technical occupations that are engaged in the transition to carbon neutrality. For example, LA Trade Tech has offered utility line worker training for women and weatherization training, both in partnership with the Los Angeles Department of Water and Power. New initiatives include a partnership being developed by the community colleges with the Transformative Climate Communities (TCC) program—a comprehensive emission reduction and community revitalization initiative funded by the Greenhouse Gas Reduction Fund (GGRF)—to analyze where pipeline programs could be developed by the community colleges to serve the economic development projects funded by the TCC.

Again, success depends on developing the deep engagement and supports needed by workers from disadvantaged communities or those with particular barriers to employment



as well as on a strong connection to jobs, which usually requires a partnership with employers and/or unions when relevant. A new initiative funded by the CWDB—the High Road Training Partnership, which has supported incumbent worker training via labor-management training partnerships—offers promising inclusion programs, precisely because employers are partners, and training always starts with the jobs. See Section IV.C for a discussion of the H RTP initiative.

3. Pipelines into Professional Occupations

Finally, broadening access to economic opportunities that emerge from the growth of low-carbon sectors should not exclude efforts to broaden inclusion in jobs that require bachelor's or graduate degrees. For professional occupations that require further postsecondary education, inclusion efforts are most successful when linked to preparation in high school, as it is much more difficult to create paths to higher education after workers have been detached from school for long periods of time. Efforts are underway to build successful school-to-career transition in both community colleges and four-year institutions. The existing initiatives include the California Partnership Academies (CPA),⁴³ the California Linked Learning Initiative,⁴⁴ and the California Career Pathways Trust.⁴⁵ Each of these inter-linked initiatives promote college and career readiness for students in low-income communities by integrating rigorous academics with career-based learning and real-world workplace experiences. Funding to improve inclusion into professional and technical occupations related to the transition to carbon neutrality should contribute to these existing initiatives.

For many disadvantaged Californians, the community college system is itself a pipeline into professional occupations. Robust remedial education is available to support students that come to community college with basic education deficits. Transfer programs from community colleges to colleges and universities that offer bachelor's and graduate degrees is a fundamental part of the state's educational strategy. For programs targeting students who will transfer to four-year colleges, specialized programs customized to critical occupations for the carbon neutrality transition are not needed because students at the community college level are still gaining their foundational knowledge—specialized training occurs later. Building on this essential premise, community college efforts for inclusion cut across all programs for all occupations, as described below, rather than remaining isolated in niche programs designed only to address greenhouse gas emission reductions.



PROMISING PRACTICE #3.2

Approaches for Systemic Inclusion Efforts: The Community College System

In 2018, the California Community Colleges' Chancellor and Board of Governors approved a new "Vision for Success" to be implemented by all 114 community colleges.⁴⁶ This mandate specifically addresses California's equity gap and provides a roadmap for educational achievement and entry into living wage jobs within underserved populations. Two of the Vision's six core tenets are:

- Reduce equity gaps across graduation, transfer to four-year institutions, and entry into a job within the student's field of study through faster improvements among traditionally underrepresented student groups, with the goal of cutting achievement gaps by 40 percent within five years and fully closing those achievement gaps within 10 years. \$140 million annually is invested by the community colleges in the Student Equity Allocations program in addition to individual college investments in the success of underserved populations.⁴⁷
- Reduce regional achievement gaps across all of the above measures through faster improvements among colleges located in regions with the lowest educational attainment of adults, with the ultimate goal of fully closing regional achievement gaps within 10 years. Strong Workforce Program funds of more than \$200 million are invested by the Community College System annually in regional best practice programs for Career Technical Education.⁴⁸ This amount is additive to the annual apportionment received by the colleges.

Also in 2018, the legislature revised the California Community Colleges' apportionment formula to require that 40 percent of a community college's annual

funding be based on achieving progress toward the "Vision for Success." This performance incentive, which takes effect in 2020, is a major departure from the prior practice of funding based on the number of full-time equivalent students and is already impacting the way students from underserved populations are recruited and supported.

Underserved populations are supported through the community colleges' Guided Pathways program, which offers career exploration and planning, provides student support services, and assists in student completion through streamlined programs structures and proven success strategies like the cohort model.⁴⁹ Further development of Guided Pathways now creates meta-majors within related fields of study, offering students a career "lattice" that allows credit transfer across programs and enables students to seamlessly shift their education strategy as their career goals evolve. For example, a student starting in an electrician program can shift to carpentry, if so desired, and retain many course credits in the transition.

Guided Pathways also creates new career resiliency through "stackable credentials" within the pathway. This feature enables the student to earn industry-recognized and accredited certifications in multiple related competencies, broadening transferable skills that are valuable during down-cycles in the economy.

Significant funding linking K-12 students to community college programs also was approved by the legislature in 2018. This funding creates an infrastructure that facilitates early career decisions, enables more students to complete community college courses while in high school, and reduces the length of time for students to enter a living wage job.



B. Foundational Education and Training for the Future Workforce: Incorporating New Knowledge and Skills

Most skilled workers across the economy complete some form of postsecondary education as their foundational education before they embark on or change their career. This period of intense training shapes their knowledge and skills for many years to come. Ensuring that they acquire the training needed for the low-carbon transition for each field of study and associated occupation is essential to the state's climate efforts. All fields of study undergo change as the skill needs of employers evolve, and the state's training and education institutions have processes in place to update curricula over time.

1. Training for Skilled Construction Trades

Apprenticeship programs continually respond to employers' changing needs because employers sit on the apprenticeship curricula committees that determine what is taught. They also pay for training via their contributions to the training trust fund. This close relationship between industry need and training facilitates the incorporation of new knowledge and skills that are required as new technologies are adopted. Apprenticeship programs that are linked to employers at the cutting edge of low-emission, high-efficiency practices thus have an immediate mechanism to update curricula regularly.

However, it is risky for apprenticeship programs to invest in training for new technologies that have yet to broadly penetrate the market. For emerging technologies that the state is trying to promote through research and development funds, subsidies, and other policies, there is a parallel need for funding curriculum enhancements and training of instructors. The agencies that serve as hubs of emerging and best practice low-emission technologies may have an interest in lowering this risk in order to help apprenticeship programs respond quickly to advancing technological change.

Employers who use apprenticeship are good targets as early adopters in efforts to promote low-emission technologies in their sectors. The advantage of working with employers that have state-certified apprenticeship programs is that these companies have developed a high-road business model based on an ongoing commitment to training a professionalized workforce. Since they pay higher wages and contribute to a training trust for each hour their employees work, they are very conscious of the investment they are making in their professionalized workforce. Thus, public or ratepayer funding would be matched by significant private funding.

Over the past several years, the Investor Owned Utility Workforce Education and Training (IOU WE&T) team has collaborated in training instructors of sheet metal workers, carpenters, and stationary engineers to introduce, expand, and enhance energy efficiency content in their apprentice and journey-level worker training programs. These



collaborations have included customizing existing IOU classes for delivery to a specific audience, training trainers on building-envelope testing equipment, and providing educational materials on energy efficiency for instructors to customize and integrate into their training programs.

2. Training for Technical Occupations

Training for technical occupations that do not require a four-year degree is largely carried out in the community college system. While the community colleges do not rely on the strong contractual training partnerships with employers that exist in the apprenticeship system, they are strengthening industry advisory councils for their low-carbon initiatives. Many of these advisory councils have been in place for years at the state and regional level, informing ongoing curriculum development via subject-matter experts, donating lab equipment, providing work experience for students, and delivering professional development training for faculty. Leading-edge curriculum developed by industry associations is frequently offered at free or reduced licensing rates, allowing the colleges to continuously respond to evolving industry needs.

In order to prepare workers with the most advanced skills and knowledge needed to help achieve emission reductions goals, continued investments are necessary for curriculum upgrades at the primary institutions providing their foundational training and education. Community colleges require an intense internal process to incorporate new skills and knowledge through regular faculty curriculum review. Recent process designs through Lean Six Sigma techniques⁵⁰ and other evidence-based methods have significantly streamlined and shortened approval cycles. In some cases, cycle time has been reduced by two-thirds, while in other cases entire levels of review have been eliminated.

To further increase the system's speed and responsiveness, the "Doing What Matters" initiative from the Community Colleges' Chancellor's Office has developed deep industry partnerships and "Guided Pathways" in 10 key growth sectors, designed to train students in skills needed by employers at the regional level.⁵¹ The community college system employs a statewide "sector navigator" and regional deputy navigators for each sector. These staff members are responsible for liaising with employers to develop training partnerships, identify skill gaps, and connect graduates of the appropriate programs to job opportunities. Two of the sectors with sector navigators directly related to the carbon neutrality transition are the Advanced Transportation and Logistics Initiative and the Energy, Construction, and Utilities Initiative. Thirteen sector team members are assigned to connect industry priorities with community college programs, secure funding to develop responsive workforce initiatives, and support the colleges' implementation of those initiatives. Supporting these teams is a statewide network of labor market researchers and a constellation of industry advisory councils. More than 60 of the 114 community colleges are currently participating in these sector-based low-carbon initiatives.



Advanced Transportation and Logistics (ATL, formerly, the Clean Energy and Transportation Initiative/Advanced Transportation and Renewable Energy, CETI/ATRL) comprises a series of training programs aimed at developing skills for workers to go on to jobs in various branches of advanced clean transportation.⁵² Programs include training on electric, hybrid, and hydrogen fuel cells; gaseous fuel for heavy-duty vehicles; and photovoltaic, concentrated solar, geothermal, and wind energy technologies. Funding from the California Energy Commission (CEC) has allowed ATL staff to develop high school outreach and bridge programs to recruit students.

The Energy, Construction, and Utilities Initiative provides training for workers aiming to find careers in a wide range of fields, including as HVACR technicians, building operators, energy auditors, facility managers, automation and control technicians, workers in construction trades focused on residential and nonunion markets, and building energy systems professionals.⁵³ Hands-on courses train students to design, install, measure, operate, maintain, and analyze HVACR, lighting control, and building envelope systems in residential and nonresidential buildings to increase energy efficiency. Statewide professional development programs have trained faculty in Title 24 code changes as well as the occupations critical to energy efficiency noted above; funds from Prop. 39 have provided \$5 million annually to support the initiative.

3. Training for Professional Occupations

Academic departments at four-year colleges and universities have a process for curriculum review and revision that is largely led by faculty and accrediting bodies. Academic programs preparing graduates for professional occupations relevant to the carbon neutrality transition are predominantly in a variety of engineering and information technology fields but also include architecture, transportation planning, and construction management. These programs provide students with foundational knowledge upon which employers in energy, transportation, and other climate change sectors can build through on-the-job training.

In order to enhance the skills of these workers to help achieve emission reductions goals, continued investments are necessary for curriculum upgrades at the primary institutions providing their foundational training and education. Two assets are critical here. First, the close ties to professional associations in a particular field help keep faculty abreast of advancements in knowledge. Second, in the case of the University of California system, the existence of research centers, some funded by the state agencies in charge of climate policy implementation, creates a hub for emerging technologies and a source of new knowledge that can be incorporated into curricula. See for example the California Lighting Technology Center at UC Davis, discussed in **Promising Practice #3.4**.⁵⁴



C. Incumbent Worker Training: Upgrading the Skills of the Existing Workforce

Once workers are in the workforce, employer engagement is critical for successful efforts to upgrade incumbent workers' skills. Employers' willingness to support worker training differs by industry and by occupation, creating opportunities and challenges for the state's efforts to facilitate incumbent worker training. The state should concentrate on collaborating with employers who have demonstrated commitment to ongoing investments in training, so public support builds from already-acquired skills and leverages industry investments in training.⁵⁵

For the skilled construction trades and other occupations where state-certified apprenticeship programs exist, the vested interest of employers who already participate and pay for apprenticeship facilitates their involvement in upgrade training, as well. For professional workers, a requirement for continuing education exists in most occupations, and the depth of foundational training facilitates both continual learning and an expectation of keeping up with changes in the field.

Incumbent worker training is more challenging in businesses that cannot rely on either the apprenticeship system or structured continuing education. For blue-collar and technical occupations in these businesses, there are some existing industry partnerships that can be leveraged and opportunities to create more industry-led partnerships can be explored. Examples of this work follow.

One model that could be expanded is the CWDB High Road Training Partnership (H RTP) initiative, which since 2017 has funded eight industry partnerships that all include incumbent worker training in sectors relevant to the transition to carbon neutrality. High-road training partnerships bring together industry leaders from management and labor in key industries and regions to identify skill needs and other shared problems. In response, staff representing relevant public resources—from community colleges and high schools to workforce boards and state agencies—work together to develop training and skill programs directly relevant to the industry and its workforce. Job quality is central to the CWDB High Road Training Partnership initiative, designed to simultaneously improve income mobility, address environmental challenges and resilience, and build skills for California's best employers. This initiative defines high road employers as firms that compete based on quality of product and service achieved through investment in human capital and can thus generate family-supporting jobs where workers have agency and voice in their worksite.⁵⁶ The H RTP initiative provides funding for the development of industry-based, worker-focused training partnerships to build skills for California's high-road employers in key climate sectors other than construction, including transit, building services, and logistics.

One example in the initial group of grantees is the Green Janitors training program, which has resulted in energy savings in commercial buildings at very low cost.



PROMISING PRACTICE #3.3 Green Janitors Education Program

The Green Janitors Education Program (GJEP) is a significant example of unions, community groups, and industry working together to advance the skills of incumbent workers to help them contribute to the transition to a carbon-neutral economy. Often overlooked as a climate mitigation resource, janitors are the frontline staff to keep buildings operating in the most low-emission way possible. GJEP trains janitors to be partners in energy efficiency efforts within buildings, as well as providing them with nontoxic products for cleaning. Since its start in 2014, this labor-management partnership has improved the lives of low-wage workers, while also helping them be more effective at implementing emission reduction strategies.⁵⁷

The program consists of a 30-hour curriculum and, to date, has trained nearly 600 janitors who work in buildings throughout Los Angeles, San Diego, and Orange counties. Janitors learn about the benefits of using green cleaning products instead of more toxic substances. They also learn about the importance of efficiency in electricity and water usage and how to recognize and respond to leaks or other wasteful practices.

In buildings that are certified to the green building standards in the Leadership in Energy and Environmental Design (LEED) certification program or are in the process of becoming certified, GJEP helps janitors actively participate in the LEED goals, with an emphasis on energy efficiency and building health. Prior to this program, most janitors had received no training in sustainable procedures and materials or the methods they could use to reduce energy and water consumption.

Between 2013 and 2016, 76 percent of buildings where GJEP was implemented saw a decrease in energy and water usage.⁵⁸ These buildings used

5.6 percent less energy on average in 2016 than non-GJEP buildings. In addition, water usage declined in 76 percent of buildings where the training program was implemented.

GJEP also helps janitors learn about recycling and compost practices that are newly required of many building owners as part of the Zero Waste goals of the City of Los Angeles and in statewide recycling and composting mandates. The training benefits building owners and tenants, as there are financial benefits for compliance with more stringent recycling and composting policies designed by the city. This training will also improve waste diversion rates and therefore emission reductions.

The program is a partnership that includes the U.S. Green Building Council-Los Angeles chapter, the Building Owners and Managers Association of Greater Los Angeles, the Service Employees International Union–United Service Workers West (SEIU-USWW), and the Building Skills Partnership. The Building Skills Partnership (BSP) is a nonprofit collaboration between SEIU-USWW, commercial building owners, janitorial employers, client companies, and community leaders. Its mission to improve the quality of life for low-wage property service workers and their families by increasing their skills, access to education, and opportunities for career and community advancement.⁵⁹

BSP is one of the first cohort of grantees in the CWDB High Road Training Partnership initiative, which is allowing it to expand to northern California. BSP was chosen because it links workforce innovation to regional challenges of job quality, economic mobility, and environmental sustainability.⁶⁰ The program has also been incorporated into the Los Angeles Mayor's Sustainability Plan.



In addition to the HRTP initiative, the state's Employment Training Panel (ETP), funded through a small addition to payroll taxes and other specific appropriations, has annual funds typically ranging between \$60 million to \$100 million to reimburse companies for incumbent worker training in California.⁶¹ ETP has funded a number of incumbent worker trainings for emerging technologies in advanced transportation, including low-emission transit fleet vehicle conversion efforts focusing on servicing and repair. It has also funded incumbent worker upgrade training in building systems and industrial energy efficiency. ETP funding has helped labor-management joint apprenticeship programs in the skilled construction trades add modules, in both their apprenticeships and their journey-upgrade programs, to incorporate cutting-edge technologies essential to the transition to carbon neutrality. These include the training programs developed by IBEW-NECA for advanced lighting controls, electric vehicle charging stations, energy storage, and microgrids. All have partnerships with community colleges. ETP complements and aligns with the HRTP initiative: HRTP provides initial funding for partnership development. Once formed, these partnerships can then also apply for training funds from the ETP.

The community colleges maintain an Upskill California network of 23 colleges that engage exclusively in incumbent worker training. An example is Chaffey College's InTech Center in Fontana which trains incumbent workers in industrial electricity, mechanical systems, automation and controls, and HVAC. This self-sustaining facility contracts with employers to fund worker upskill programs, using ETP funds where appropriate. Regional employers comprise the InTech Center Advisory Council, investing in worker training, building out the center's facilities, guiding curriculum, and providing adjunct instructors. Similar programs and industry relationships exist throughout the Upskill California network.

1. Upgrading Skilled Construction Trades

Because apprentices are put on the job as soon as they enter the training program, apprenticeship by definition addresses incumbent worker training. The capacity of the apprenticeship system to quickly adapt to changes in skill needs in an industry is especially valuable for fourth- and fifth-year apprentices who are close to mastering their trade.

Apprenticeship also provides valuable infrastructure for incumbent workers in the construction trades, namely, journeypersons. This journey-upgrade training is usually provided at no cost to workers, as it is paid for through the training trust that funds the apprenticeship program. Journey-upgrade programs that are developed for emerging technologies are then eventually incorporated into the main apprenticeship programs. A number of journey-upgrade programs have been developed to prepare workers installing key emission-reducing technologies.



PROMISING PRACTICE #3.4

The California Advanced Lighting Controls Training Program (CALCTP)

One acclaimed example of workforce training to support emission reductions in the energy sector is the California Advanced Lighting Controls Training Program (CALCTP). CALCTP is a statewide initiative aimed at upgrading the skills of currently employed electricians. The program builds on existing skills by training and certifying C-10 licensed electrical contractors and state-certified general electricians in the proper way to program, test, install, commission, and maintain advanced lighting control systems. The CALCTP program is designed to overcome the poor installation of advanced lighting systems, which caused users to override them and undermined the widespread adoption of this significant energy-saving technology. The program encourages the expanded use of existing technologies, such as dimmers and occupancy sensors, while also proactively developing the skills necessary to install and maintain emerging technologies, such as photo-sensors, relay modules, and communication-based control devices. Improving upon the installation and maintenance practices of this incumbent workforce has the potential to dramatically improve energy efficiency in commercial buildings across the state, helping California achieve its energy efficiency and emission reduction goals.

The CALCTP program is a model industry partnership, because it brings together employers, government agencies, community colleges, and labor organizations to develop training curriculum and infrastructure to meet the workforce needs of the advanced lighting control sector as a whole. Partners include utilities such as PG&E and the Sacramento Municipal Utility District; research institutions such as the California Lighting Technology Center at UC Davis; the industry association, the National Electrical Manufacturers Association (NECA); and the union that

represents electricians, the International Brotherhood of Electrical Workers (IBEW). This partnership began as the utilities and other agencies charged with improving energy efficiency in the state—as well as researchers, employers, and the electricians union in the lighting controls sector—identified workforce issues as a significant impediment to the adoption of advanced lighting controls.

This program also is integrated into the apprenticeship infrastructure, so pipelines for entry-level workers are already in place, and apprenticeship connections with pre-apprenticeship programs ensure inclusion of people from low-income communities. For this reason a certification, which sometimes is seen as a barrier to entry for historically marginalized groups, actually expands opportunities by being part of a full training pipeline from entry-level to advanced.

The missing piece of this model certification program is that it has not at the time of writing been incorporated as a requirement in utility incentive programs for advanced lighting. Returns on the large private investment made by NECA and its union partner will not be realized without policy to help create demand for electricians who know how to properly install this emerging and very promising technology.

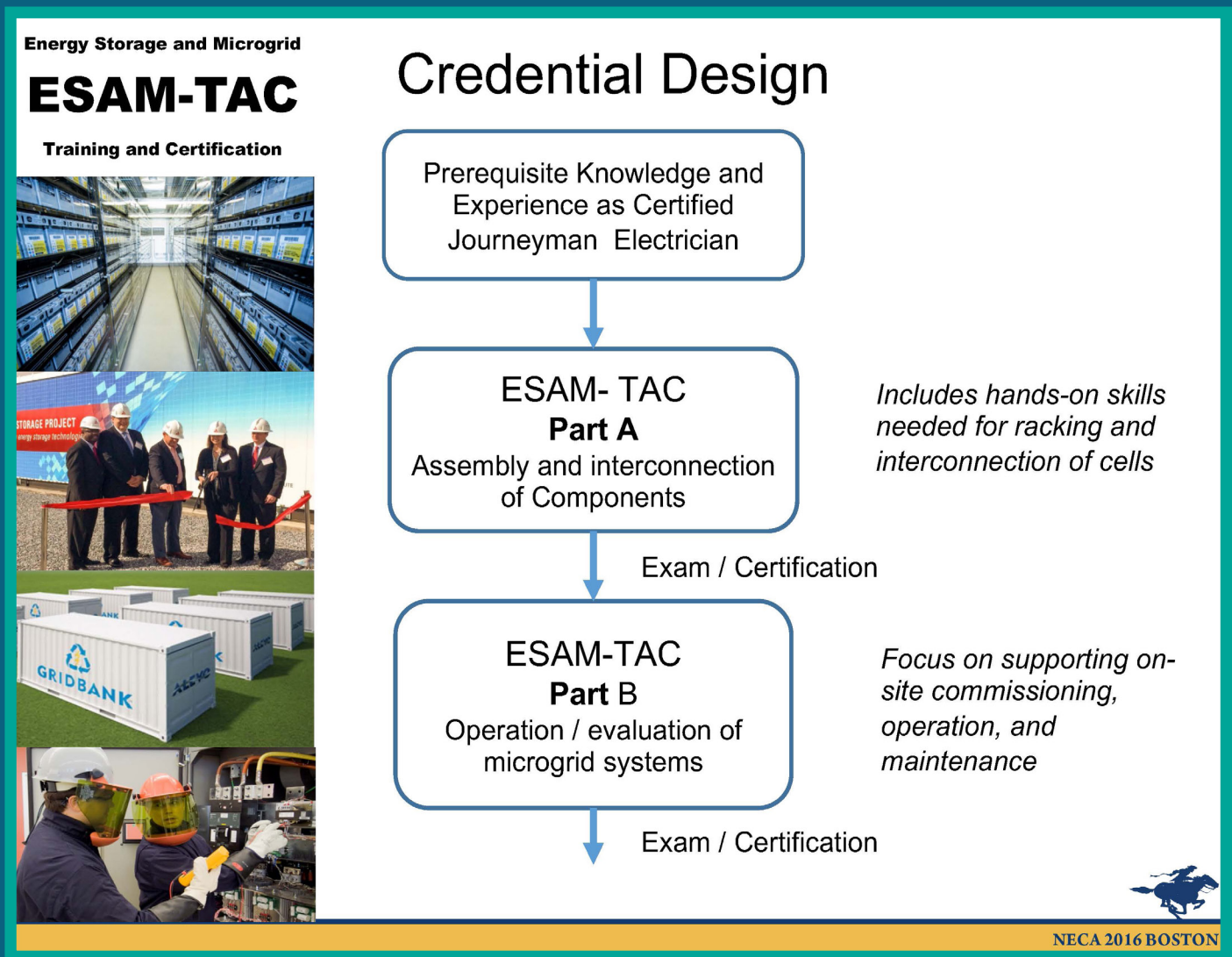
The CALCTP industry training model has been replicated for electric vehicle charging stations, where the same partners have created an upgrade certification—the Electrical Vehicle Infrastructure Training Program (EVITP)—for electricians installing charging stations. Here, policy has supported this investment in training: the CPUC issued a decision that workers installing any utility-owned charging station have to be certified with EVITP to help ensure



proper installation and safety. The industry partnership has also developed the ESAM-TAC training and certification program for battery and microgrid installation, again building upon the foundational knowledge of electricians and creating a credential for advanced emission-reducing technologies that is industry recognized and validated by a third party, in this case the Electric Power Research Institute (EPRI). Community colleges were involved in the initiation of

CALCTP as an alternative site for this training and also are involved in EVITP and ESAM-TAC.

The strength of these skill certification initiatives is their ability to respond to clear demand for skills in the marketplace, which is facilitated when industry-recognized certifications exist in the market or in government programs to incentivize advanced, clean technologies.



2. Upgrading Technical Occupations

Industry partnerships are essential for incumbent worker training for occupations not requiring a four-year degree, but they do not exist in many industries. As described earlier, intermediaries often play a role in convening employers and developing industry partnerships. These intermediaries can be workforce development and training institutions, including community colleges, and are also often nonprofit organizations and unions.

3. Upgrading Professional Occupations

Continuing education and professional development for professional occupations are linked closely to professional organizations, graduate programs, and university research centers in engineering and other key fields that are relevant to climate change mitigation. As with upgrading curricula in degree programs, there are well-developed mechanisms in place for skill upgrades for professional workers, mostly through incentives or mandates for continuing education to keep professional standing or obtain promotions. This infrastructure has been used and could be expanded upon by state agencies and bodies involved in promoting emerging emission-reducing technologies.

One gap noted by a number of experts is the need for continuing education for public agency professional staff who are charged more and more with managing systems to lower greenhouse gas emissions. For example, transportation researchers pointed out that local or regional transportation managers have limited access to training and capacity building in emerging systems design that can lower vehicle miles traveled (VMT). Professional development for professional staff in often budget-strapped and atomized public agencies that impact VMT is an opportunity that could be addressed through a competitive solicitation process as described in the recommendations below.

V. Summary and Recommendations

The State of California is in an excellent position to leverage its training and education infrastructure to provide employers in the carbon-neutral economy with a skilled workforce, while concurrently preparing workers for pathways into family-supporting, career-track jobs. The supply-side workforce development recommendations outlined here are critical, but work best in tandem with the demand-side strategies outlined in Chapter 2. Unless there is demand for skilled workers, in the form of real jobs with actual employers, graduates of training programs will not get jobs, and unless the jobs created are good jobs, workers will not benefit from training.



In order to prepare California’s workforce for the transition to a carbon-neutral economy, state investments in education and training should seek to influence the skill development of a broad set of workers whose actions impact greenhouse gas emissions, rather than to train a specific number of workers solely on specialized “low-carbon” tasks. These workers often are not specialized “low-carbon” workers nor do they think of themselves as such. For example, architects and HVAC workers both have a significant impact on the energy use in buildings, but may not have the specific energy efficiency training needed to incorporate best practices into their work. Investment in ongoing training to develop and upgrade the knowledge, skills, and abilities (KSAs) of workers in key occupations related to greenhouse gas emissions is therefore needed. In this context, the most effective and strategic investments in training incorporate KSAs pertinent to climate change mitigation into the broader skill sets of workers in the prominent occupations.

The above analysis highlighted the robust infrastructure that the state has for workforce development in its community college, certified apprenticeship, and public university systems. It presented how these institutions support foundational postsecondary training for the next generation of workers in the key occupations critical to the transition to a carbon-neutral economy. It showed the role these institutions can play in broadening access to career-training pathways and jobs for workers from disadvantaged communities, as well as their role in upgrading the skills of the incumbent workforce. The three phases of training—including pipeline training for workers from disadvantaged communities for entry-level jobs or further training, incumbent worker training, and postsecondary training and education in the state’s core institutions of community colleges, state-certified apprenticeship, and four-year colleges—all must be a part of the necessary adaptations within the workforce development system as the economy transitions.

Crucially and in summary, investments in training should:

1. Support and enhance existing programs in California’s key workforce development institutions, so that they can respond to the needed changes, instead of building new training programs specifically for new clean technologies.
2. Fund comprehensive training that prepares workers for careers, rather than niche programs that train on one particular “green” skill or “green” technology.

Funding already exists for many of the initiatives recommended below. Ratepayer funds for the Electric Program Investment Charge (EPIC) and IOU energy efficiency programs both already fund training, but the funding could be better deployed with this



clear strategic vision for skill development. Pipeline training for the skilled construction trades has been available from Prop. 39 and will soon be available from SB 1. Instead of each specific climate program funding its training program, funding should support and enhance existing programs. A number of agencies responsible for implementing climate policy also have training funds. The challenge is to align these funds and avoid duplication and further fragmentation of training for California's workers.

Specific recommendations include the following:

1. Redirect and align funding for industry-led incumbent worker training.

State investments stand to make the greatest immediate impact by focusing on training workers already employed in the key occupations of the transition to a carbon-neutral economy. Employer engagement in training of incumbent workers is critical. For the professional occupations, continuing education that already is embedded in licensing or credential renewal may be sufficient; for blue-collar and technical workers, high-road training partnerships provide a model for successful incumbent worker training.

Funding is currently available from a variety of sources, including the CWDB, the ETP, the California Energy Commission, Caltrans, the community colleges, EPIC, the IOU workforce education and training budget, and other agencies involved in climate policy implementation; efforts should be made to align this funding and support industry partnerships as described below. **Funding from climate agencies should not be used to create new programs divorced from the state's existing training institutions.**

1a. Support high-road industry training partnerships.

The CWDB High Road Training Partnership (H RTP) initiative should serve as a model for expanded funding for industry partnerships in key industries in each of the Scoping Plan sectors.⁶²

State training investments stand to make the greatest immediate impact on skill delivery by focusing on training workers already employed in the key occupations of the transition to a carbon-neutral economy. Industry partnerships are essential for training incumbent workers and can also improve inclusion of disadvantaged workers in entry-level jobs. H RTP can serve as a model for an expanded initiative that could include apprenticeship programs, labor-management partnerships, and other industry-based, worker focused training initiatives in key industries. These initiatives and partnerships can deliver skills to accelerate the adoption of emission-reducing technologies. In addition, they can provide a structure in which to engage and protect workers and find collaborative solutions as technological change and/or climate policies cause large disruptions to or even elimination of certain jobs.



There are numerous opportunities for expansion of high road training partnerships in industries critical to achieving California's climate targets. As discussed in the sector chapters, examples of possible high-road training partnerships include: fire prevention jobs in California's forests and wildlands, where an expanded workforce is needed because of increased fire risk; occupations engaged in pollution abatement and process improvements in refineries; occupations involved in waste diversion activities, which are required due to more stringent waste diversion mandates; emerging water conservation programs in the state's water utilities; and occupations involved in methane capture in dairies and waste facilities due to new mandates on emissions with high global warming potential.

1b. Support existing apprenticeship programs and, where conditions are favorable, create new apprenticeship programs.

State-certified apprenticeship is one form of a high-road industry training partnership and is the gold standard in training for occupations that do not require a four-year college degree. Apprenticeship has the following advantages: it is industry driven and funded, provides high returns and no debt to workers through its earn-while-you-learn model, delivers broad skills needed by employers that lead to mastery of a trade or occupation, uses both classroom and on-the-job training, leads to wage increases as skills are acquired, and calibrates the number of training slots to the number of available jobs.⁶³ Governor Newsom has championed the expansion of apprenticeship, and the State Workforce Plan includes a commitment to significantly increase the number of apprentices in California.⁶⁴

New apprenticeship programs are in development in the manufacturing of zero-emission buses as well as in transit operations and vehicle repair and maintenance. In occupations where apprenticeship programs already exist or where there are willing employers who wish to initiate new programs, public funding for training should support these existing or new apprenticeship programs.

2. Redirect and align funding for a statewide strategy for pipeline programs to expand inclusion of disadvantaged workers into family-supporting career-track jobs in the low-carbon economy.

California's commitment to inclusion requires specific interventions that can reach all occupations critical to the carbon neutrality transition. All inclusion programs should include the following elements: 1) comprehensive services that include entry-level skills training and a suite of supports, mentoring, and wrap-around services tailored to targeted



populations; and 2) explicit connections to family-supporting jobs through specific commitments from employers or other proven avenues to job placement or entry into further career training that leads to placement in family-supporting careers.⁶⁵ Inclusion programs are needed in a variety of high-road occupations that already generate family-supporting jobs. They should not be developed for low-wage jobs unless coupled with strategies to make the low-wage jobs better or create ladders from low-wage to good jobs. As with incumbent worker training, funding from climate agencies should not be used to create new programs divorced from the state's existing training institutions.

2a. Support a statewide initiative for pre-apprenticeship for construction careers.

Support for pre-apprenticeship is critical to improving inclusion in the skilled construction trades. Any investments related to pre-apprenticeship should connect to, align with, or feed into the emerging statewide infrastructure that is being modeled by the CWDB High Road Construction Careers (HRCC) initiative. This initiative is developing a statewide pre-apprenticeship strategy that links to all state and local agencies that award public works contracts.⁶⁶ Pre-apprenticeship programs should not be developed to prepare workers for only projects in particular climate programs, but rather increase access to high-quality career pathways in construction.

The CWDB has identified and implemented successful practices that connect disadvantaged Californians to middle-class construction careers and can be scaled up for public works across California. The know-how and existing infrastructure for apprenticeship and pre-apprenticeship can be harnessed efficiently to align with climate investments.⁶⁷ Funding from disparate sources, currently administered by a variety of agencies, could be consolidated to support and expand the HRCC network of coordinated regional pre-apprenticeship partnerships. In order to ensure calibration between the number of pre-apprenticeship training slots and the number of job openings at a regional level, the consolidated funding stream could be governed by an interagency collaboration between CWDB, DIR-DAS, the community colleges Chancellor's Office, and agencies administering California Climate Investments (CCI).

2b. Support inclusion programs for technical and blue-collar jobs via high-road training partnerships.

There are a set of jobs critical to the carbon neutrality transition that do not require a four-year college degree and are not already linked to apprenticeship programs, but still offer important opportunities for inclusion programs. The high-road training partnerships described above for incumbent worker training are also a vehicle for pipeline programs. These collaborations can include partnerships with organizations that can provide the comprehensive supports needed for workers from disadvantaged groups so that a



qualified applicant pool is developed. One significant opportunity for creating inclusive pipelines is in water and energy utilities, where the existence of good jobs and an aging workforce present ideal conditions for inclusion policies. Other strategies designed to improve jobs while reducing emissions, such as initiatives to reform contracting processes so that they include strong labor and environmental standards, can also incorporate inclusion programs to ensure that as wages rise, opportunities for historically excluded groups are expanded. A key industry in this category is waste, where reform of contracting models is necessary to achieve the more stringent targets for waste diversion. Jobs in fire prevention and forest management in the Department of Forestry and Fire Protection also offer opportunities for inclusion through insourcing of work that is now contracted out and through the expansion of pipeline programs.

2c. Support inclusion programs for professional clean economy jobs.

A commitment to broaden access to economic opportunities that emerge from the growth of industries advancing carbon neutrality should also focus on inclusion into jobs that require bachelor's or graduate degrees, such as engineers, architects, and other professional and technical workers. For these jobs, inclusion efforts are most successful when linked to preparation in high school, as it is much more difficult to create such pathways after workers leave school. The California Partnership Academies, the California Linked Learning Initiative, and the California Career Pathways Trust all are recent initiatives, designed to build successful high-school-to-college transitions for California's many underserved youth, which can eventually lead into critical occupations related to climate mitigation and adaptation. The community college system, via its transfer programs, is itself a pipeline for many disadvantaged Californians into professional occupations.⁶⁸

Students must first gain their foundational knowledge before getting specialized training and should be exposed to as wide a variety of viable career paths as feasible during this phase of their education. Funding to improve inclusion into professional and technical occupations related to the carbon neutrality transition should contribute to these existing initiatives, rather than initiate new ones that focus only on climate-critical occupations.

3. Support curriculum upgrades and teacher training for emerging technologies in occupations critical to the low-carbon transition.

To prepare the next generation of energy engineers, electricians, zero-emission bus mechanics, transportation planners, and all the other priority occupations that are necessary to develop, design, plan, build, operate, and maintain new technologies that lower greenhouse gas emissions, the state should support the incorporation of



new relevant skills and knowledge in the existing key institutions that already provide foundational training for priority occupations. In this effort, the state should support curriculum upgrades and instructor professional development in apprenticeship programs, community colleges, and four-year colleges.

For training incumbent workers and educating the new generation of workers to embark on their careers in key climate-related occupations, continuing analysis of skill gaps is needed and should be done in collaboration with high-road industry partnerships. For emerging technologies, identifying the need for skill upgrades should be a component of the state's various strategies to encourage accelerated adoption of new cleaner technologies, as described in Chapter 2.

4. Track outcomes of all training programs.

To evaluate and improve training investments over time, all training programs should track workforce outcomes for the participants of publicly funded training programs. Methods of data collection and analysis, as well as the resources to support them, need to be identified and implemented before any field investments are made. Key metrics include not only number of enrollees and number of graduates, but also attainment of industry-recognized credential, job placement, job retention, initial wages and wage mobility over time. In addition, resources could be devoted to the challenging but valuable work of tracking the benefits to employers in increased productivity and quality. Requiring tracking at any level of training, from entry level to incumbent worker training, is essential to improve training over time and direct training investments towards the best outcomes for workers. The state should also continue to invest in third-party studies and evaluations that assess the broad, integrated, social and economic impact of workforce partnerships, considering the costs and value of building a high road training infrastructure that addresses both climate and equity concerns, and measuring broader community outcomes in addition to individual labor market advancement.



Endnotes

- 1 California Workforce Development Board, “Skills Attainment for Upward Mobility; Aligned Services for Shared Prosperity: California’s Unified Strategic Workforce Development Plan Under the Workforce Innovation and Opportunity Act (WIOA) for Program Years 2016-2019,” December 2018, https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/01/Unified-State-Plan-modifications.Final_.12.27.18.1.pdf.
- 2 Carol Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response” (UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011), <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.
- 3 Zabin et al.
- 4 Carol Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014), <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>
Unpublished job placement data provided by California Employment Development Department.
- 5 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”
- 6 Betony Jones, Peter Philips, and Carol Zabin, “The Link Between Good Jobs and a Low Carbon Future” (UC Berkeley Donald Vial Center on Employment in the Green Economy, July 2016), <http://laborcenter.berkeley.edu/the-link-between-good-jobs-and-a-low-carbon-future/>.
- 7 U.S. Department of Labor, “What Is Registered Apprenticeship?,” Apprenticeship.gov, 2014, <https://www.doleta.gov/OA/apprenticeship.cfm>.
- 8 California Labor & Workforce Development Agency, “Labor and Workforce Development Agency Announces Record Number of Apprentices,” May 15, 2018, <https://www.dir.ca.gov/DIRNews/2018/Record-Number-of-Apprentices.pdf>.
- 9 California Labor & Workforce Development Agency.
- 10 Glen Forman, personal communication with author, Deputy Director, Division of Apprenticeship Standards, California Department of Industrial Relations, August 28, 2017.



- 11 Electrical Industry Training Committee, “Commercial/Industrial Electrical Industry Construction Training Criteria” (California Apprenticeship Council, October 2010), <https://www.dir.ca.gov/das/MITC/MITC/Electrical/Electrical.pdf>.
- 12 IBEW Local 595, “San Leandro JATC Electrical Apprenticeship,” accessed August 2, 2017, http://www.ibew595.org/index.cfm?zone=/unionactive/view_article.cfm&HomeID=254085&page=Apprenticeships.
- 13 Center for Construction Research and Training, *The Construction Chart Book: The U.S. Construction Industry and Its Workers*, Fifth Edition (Silver Spring, MD: The Center for Construction Research and Training, 2013), <https://www.cpwr.com/sites/default/files/publications/5th-Edition-Chart-Book-Final.pdf>.
- 14 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”
- 15 Anneta Argyres and Susan Moir, “Building Trades Apprentice Training in Massachusetts: An Analysis of Union and Non-Union Programs, 1997-2007,” Labor Resource Center Publications (University of Massachusetts, Boston, Labor Resource Center, October 2008), http://scholarworks.umb.edu/lrc_pubs/2/?utm_source=scholarworks.umb.edu%2Firc_pubs%2F2&utm_medium=PDF&utm_campaign=PDFCoverPages.
- 16 Jeffrey G. Woods, “An Analysis of Apprentices in the U.S. Construction Trades: An Overview of Their Training and Development with Recommendations for Policy Makers,” *Education + Training* 54, no. 5 (June 29, 2012): 401–18, <https://doi.org/10.1108/00400911211244696>.
- 17 California Department of Industrial Relations, “Public Works Apprentice Wage Sheets,” October 2016, <https://www.dir.ca.gov/OPRL/pwappwage/PWAppWageStart.asp>.
- 18 Anthony P. Carnevale, Tamara Jayasundera, and Andrew R. Hanson, “Career and Technical Education: Five Ways That Pay Along the Way to the BA” (Georgetown University Center on Education and the Workforce, September 2012), <https://eric.ed.gov/?id=ED535321>; see also Debbie Reed et al., “An Effectiveness Assessment and Cost-Benefit Analysis of Registered Apprenticeship in 10 States” (Mathematica Policy Research, July 25, 2012), http://wdr.doleta.gov/research/fulltext_documents/etaop_2012_10.pdf.
- 19 Peter Philips, “Environmental and Economic Benefits of Building Solar in California: Quality Careers—Cleaner Lives” (UC Berkeley Donald Vial Center on Employment in the Green Economy, November 10, 2014), <http://laborcenter.berkeley.edu/environmental-and-economic-benefits-of-building-solar-in-california-quality-careers-cleaner-lives/>.



- 20 U.S. Department of Labor, Bureau of Labor Statistics, “State Occupational Injuries, Illnesses, and Fatalities, California,” accessed July 17, 2017, <https://www.bls.gov/iif/oshstate.htm#CA>.
- 21 Cihan Bilginsoy, “The Hazards of Training: Attrition and Retention in Construction Industry Apprenticeship Programs,” *Industrial and Labor Relations Review* 57, no. 1 (October 2003): 54–67, <https://doi.org/10.2307/3590981>.
- 22 Myke Griseta, “Workforce Metrics Dashboard Report 2018: AB 2148 Legislative Report” (California Workforce Development Board, 2018), <https://cwdb.ca.gov/wp-content/uploads/sites/43/2018/05/2148-Report-FINAL.pdf>.
- 23 California Community Colleges, “Welcome to the California Community Colleges Chancellor’s Office,” accessed October 10, 2018, <http://www.cccco.edu/>.
- 24 California Community Colleges Chancellor’s Office, “Management Information Systems Data Mart,” accessed October 10, 2018, https://datamart.cccco.edu/Students/Enrollment_Status.aspx.
- 25 California Community Colleges, “Inmate Education Pilot Program,” accessed October 30, 2018, <http://extranet.cccco.edu/Divisions/AcademicAffairs/InmateEducation-PilotProgram.aspx>.
- 26 Wages were reported by CWDB as quarterly amounts and converted to annual figures for this report.
- 27 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- 28 See, for example, Robert P. Giloth (ed.), *Workforce Intermediaries for the Twenty-First Century* (Temple University Press, 2004), <https://www.jstor.org/stable/j.ctt14bszvp>; Joan Fitzgerald, *Moving Up in the New Economy: Career Ladders for U.S. Workers*, A Century Foundation Book (Ithaca, NY: Cornell University Press, 2006); or Sheila Maguire et al., “Tuning in to Local Labor Markets: Findings from the Sectoral Employment Impact Study” (Public/Private Ventures, July 2010), <http://ppv.issuelab.org/resources/5101/5101.pdf>.
- 29 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”
- 30 Amy L. Solomon, “In Search of a Job: Criminal Records as Barriers to Employment,” *National Institute of Justice Journal*, no. 270 (June 15, 2012), <https://www.nij.gov:443/journals/270/pages/criminal-records.aspx>.
- 31 National Employment Law Project and In The Public Interest, “Reentry and Employment for the Formerly Incarcerated and the Role of American Trades Unions,”



April 6, 2016, <https://www.nelp.org/publication/reentry-and-employment-for-the-formerly-incarcerated-and-the-role-of-american-trades-unions/>.

32 Bruce Western, “The Impact of Incarceration on Wage Mobility and Inequality,” *American Sociological Review* Vol. 67, no. 4 (August 2002): 526–46.

33 California Department of Corrections and Rehabilitation, “2013 CDCR Outcome Evaluation Report” (California Department of Corrections and Rehabilitation, January 2014), <https://sites.cdcr.ca.gov/research/wp-content/uploads/sites/9/2018/04/2013-Outcome-Evaluation-Report.pdf>.

34 Christy Visher, Sara Debus, and Jennifer Yahner, “Employment after Prison: A Longitudinal Study of Releasees in Three States” (Urban Institute Justice Policy Center, October 2008), <https://www.urban.org/sites/default/files/publication/32106/411778-Employment-after-Prison-A-Longitudinal-Study-of-Releasees-in-Three-States.PDF>.

35 National Employment Law Project, “California Governor Brown Signs Fair Chance Act, Extending ‘Ban the Box’ to Private Employers,” October 15, 2017, <https://www.nelp.org/news-releases/california-governor-brown-signs-fair-chance-act-extending-ban-the-box-to-private-employers/>.

36 “Justice-involved” refers to individuals who are on parole, probation, mandatory supervision, or post-release community supervision and are supervised by, or are under the jurisdiction of, a county or the CDCR.

37 California Workforce Development Board, “Overview of PROP 39 Pre-Apprenticeship Training Pilots,” 2016, https://cwdb.ca.gov/wp-content/uploads/sites/43/2016/08/Prop39TrainingReport020917Final_Digital_85x11.pdf; California Workforce Development Board, “Construction Pre-Apprenticeship Pipeline for Ex-Offenders Awards,” June 8, 2017, https://cwdb.ca.gov/wp-content/uploads/sites/43/2017/03/Ex-Offender_Web_Announcement-6-8-17.pdf.

38 California Workforce Development Board, “Overview of Prop 39 Pre-Apprenticeship Training Pilots,” September 30, 2017, https://cwdb.ca.gov/wp-content/uploads/sites/43/2017/03/Prop39TrainingReport020917Final_Digital_85x11.pdf; California Workforce Development Board, “SB 1 Workforce Guidelines,” January 2019, <https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/02/SB1-Workforce-Guidelines-1.18.2019.pdf>.

39 California Employment Development Department, “Final Report for the California Clean Energy Workforce Training Program,” April 13, 2012, https://listserver.energy.ca.gov/efficiency/existing_buildings/documents/ARRA-Programs/final_reports/CA_Clean_Energy_Wrkfc_Training_Program-Final_Report_2012-04-13.pdf.



- 40 California Workforce Development Board, “Overview of PROP 39 Pre-Apprenticeship Training Pilots.”
- 41 California Department of Transportation, “SB 1 Overview,” Rebuilding California SB1, accessed November 14, 2018, <http://rebuildingca.ca.gov/overview.html>.
- 42 California Workforce Development Board, “SB 1 Workforce Guidelines.”
- 43 Career Advancement Academies (CAA) were designed to establish pipelines to college and high-wage careers for young adults facing multiple barriers to postsecondary education. In place since 2007, CAAs serve 27 college sites with \$31 million funding by the California Community College Chancellor’s Office to date. The California Community College Career Advancement Academy Phase III grant cycle will award up to \$6 million in SB 1070 (Steinberg) Career Technical Education Pathways Program funding over three years, including \$4 million FY 2013-14 budget, with potential renewal of up to a total \$2+ million for FY 2014-15. These renewal grants will aim to both scale and institutionalize CAAs and their key elements under four previously funded regional consortia.
- 44 Career Ladders Project, “California Community Colleges Linked Learning Initiative (CCLLI),” accessed November 19, 2018, <http://dev.careerladdersproject.org/initiatives-programs/california-community-college-linked-learning-initiative-cccli-2/>.
- 45 The California Department of Education Career Pathways Trust (AB 86) allocates \$250 million for 2014-2016 to establish regional consortia of K-12 and community college districts for “the purpose of developing regional plans to better serve the educational needs of adults.” Included in the list of target areas are: 1) short-term career technical programs with high employment potential; and 2) programs for apprentices. See California Department of Education, “California Career Pathways Trust (CCPT),” August 7, 2019, <https://www.cde.ca.gov/ci/ct/pt/index.asp>.
- 46 Foundation for California Community Colleges, “Vision for Success: Strengthening the California Community Colleges to Meet California’s Needs,” July 17, 2017, <http://californiacommunitycolleges.cccco.edu/portals/0/reports/vision-for-success.pdf>.
- 47 California Community Colleges Chancellor’s Office. “Student Equity Allocation Memo,” September 29, 2017, available via https://www.mtsac.edu/president/cabinet-notes/2017-18/2017-18_Student_Equity_Allocations_Memo.pdf.
- 48 California Community Colleges Chancellor’s Office, “Strong Workforce Program,” California Community Colleges, November 15, 2018, <https://www.cccco.edu/About-Us/Chancellors-Office/Divisions/Workforce-and-Economic-Development/Strong-Workforce-Program>.
- 49 California Community Colleges Chancellor’s Office, “California Community Colleges Guided Pathways,” accessed June 16, 2019, <http://cccgp.cccco.edu/>.



- 50 U.S. Environmental Protection Agency, “Lean and Six Sigma Process Improvement Methods,” Overviews and Factsheets, April 3, 2014, <https://www.epa.gov/lean/lean-and-six-sigma-process-improvement-methods>.
- 51 California Community Colleges, “Latest ATL News!,” ATL – Advanced Transportation and Logistics, accessed October 12, 2018, <http://www.atreeducation.org/category/news/>; Energy Construction & Utilities, California Community Colleges, Workforce & Economic Development, “Key Initiatives,” ECU Sector: Engage. Enroll. Employ., accessed October 12, 2018, available via Internet archive at <https://web.archive.org/web/20170823074408/http://www.ecusectordwm.com/key-initiatives.html>.
- 52 California Community Colleges, “Welcome to ATL,” ATL – Advanced Transportation and Logistics, accessed November 15, 2018, <http://www.atreeducation.org/>.
- 53 Energy Construction & Utilities, California Community Colleges, Workforce & Economic Development, “ECU Sector.” Energy Construction & Utilities, California Community Colleges, Workforce & Economic Development, “ECU Sector: Engage. Enroll. Employ.,” accessed November 15, 2018, available via Internet archive at <https://web.archive.org/web/20170823074408/http://www.ecusectordwm.com/key-initiatives.html>.
- 54 UC Davis California Lighting Technology Center, “Advanced Controls,” accessed June 16, 2019, <https://cltc.ucdavis.edu/research/advanced-controls>.
- 55 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”
- 56 Laura Dresser and Sarah White, “Equity. Climate. Jobs.” (California Workforce Development Board, June 2018).
- 57 Scott Barenfeld et al., “Analyzing and Expanding the Green Janitor Education Program” (SeedLA, 2017), <http://www.buildingskills.org/wp-content/uploads/2013/11/SEEDLAFinalpdf.pdf>.
- 58 Barenfeld et al., 2.
- 59 Building Skills Partnership, “About Us,” accessed November 13, 2018, <http://www.buildingskills.org/about/>.
- 60 California Workforce Development Board, “Model High Road Training Partnership Awards,” December 21, 2017, <https://cwdb.ca.gov/wp-content/uploads/sites/43/2018/01/HRTPAmentedAwardAnnouncement122117.pdf>.
- 61 CalTraining Inc., “California ETP Training Grants,” accessed November 15, 2018, http://www.caltraining.com/california_etp_training_grants.htm.



62 California Workforce Development Board, “High Road Training Partnerships,” accessed September 11, 2019, <https://cwdb.ca.gov/initiatives/high-road-training-partnerships/>.

63 Nikki Luke et al., “Diversity in California’s Clean Energy Workforce: Access to Jobs for Disadvantaged Workers in Renewable Energy Construction” (UC Berkeley Center for Labor Research and Education, August 31, 2017), <http://laborcenter.berkeley.edu/diversity-in-californias-clean-energy-workforce/>.

64 California Workforce Development Board, “Skills Attainment for Upward Mobility; Aligned Services for Shared Prosperity: California’s Unified Strategic Workforce Development Plan Under the Workforce Innovation and Opportunity Act (WIOA) for Program Years 2016-2019,” December 2018, https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/01/Unified-State-Plan-modifications.Final_.12.27.18.1.pdf.

65 Luke et al., “Diversity in California’s Clean Energy Workforce.”

66 California Workforce Development Board, “High Road Partnerships for Construction Careers,” accessed October 12, 2018, <https://cwdb.ca.gov/initiatives/hrcc/>.

67 See the California Workforce Development Board, “SB 1 Workforce Guidelines”, statutorily required guidance on the development of construction pre-apprenticeships.

68 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 4:

Just Transition: Tools for Protecting Workers and Their Communities at Risk of Displacement Due to Climate Policy

by J. Mijin Cha

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I. Framework and Best Practices for Addressing Workforce Issues in Declining Industries

Moving away from carbon-intensive fuels, implementing more energy efficient industrial processes, and capturing fugitive methane emissions will result in substantial reductions in greenhouse gas emissions and route the state toward a carbon neutral future. There will be some economic decline in certain industries as a result of a reduction in the use of carbon-intensive fuels and processes, but ultimately, there will be net-positive economic impacts. Limited job losses are expected primarily in industries that produce fossil fuel energy, such as oil and gas extraction and refining, rather than in industries that use fossil fuel energy but could switch to cleaner fuels, including renewable energy, renewable natural gas, or biodiesels. The more dependent a community or workforce is on fossil fuel use or extraction, the more economically and socially challenging the transition away from fossil fuels will be. Ensuring these communities and workers are able to thrive in a low-carbon economy is fundamentally necessary for a “just transition” away from an economy dependent on fossil fuel.

“Just Transition” refers to protection, support, and compensation for displaced workers and communities when a society makes significant policy decisions that result in job loss in affected businesses. In the 1970s, union leader Tony Mazzocchi was an early exponent of the idea of just transition in the context of post-war disarmament and the nation’s growing commitment to environmental clean-up from industry. In the early 1990s, when the concept that fossil fuels produce global warming was first being widely accepted, Mazzocchi advocated a just transition for workers in carbon-intensive industries, dubbing the idea a “Superfund for workers” under the logic that “if there can be a Superfund for dirt, there can be a Superfund for workers.”^{1,2} Mazzocchi reasoned that supporting displaced workers as the economy shifted was not welfare; instead, those who had worked to “provide the world with the energy and the materials it needs deserve a helping hand to make a new start in life.”³ Just transition refers to ensuring that workers and communities supported by a declining industry are able to transition into a new economy with a comparable level of economic security or retire with dignity. In the current context, a just transition means that carbon-dependent communities and workers must not be forced to bear the costs of change.⁴

Just transition programs are complex. They require support and funding for both immediate short-term assistance to workers and communities directly affected by the decreasing use of fossil fuels, and long-term assistance to move fossil fuel communities and workers into a low-carbon economy. Short-term assistance will include skill retraining and upgrade, unemployment insurance, assistance for job placement in comparable jobs for younger workers, and bridges to retirement with fully funded pensions and health care for older workers. Long-term assistance will require diversification of local economies dependent on fossil fuel industries, including support for economic development planning,



to help regions better identify the most promising emerging new industries based on regional assets including geography, educational and research institutions, and existing workforce skills. This process will include attracting new businesses and industries and ensuring quality job creation in the same geographic region where jobs are being lost to minimize displacement and relocation.

This chapter will discuss how California can ensure a just transition for workers and communities negatively affected by the climate policies discussed in this report. The chapter examines several previous transition assistance programs for declining industries, with an analysis of challenges and successes, followed by an examination of just transition programs specific to the fossil fuel industry. That section begins with the successful examples of the Ruhr region in Germany and the Black Mesa Generating Station in Laughlin, Nevada, then turns to the more recent Diablo Canyon nuclear power plant and the Obama administration POWER Initiative.

The chapter concludes with a series of recommendations for crafting a just transition program for California. The need to transition off fossil fuels is urgent, but realistically, such a transition will take time, and our recommendations reflect this process. Maximizing efforts to reduce local emissions while fossil fuels are still being consumed and produced in California will lessen the economic impact on workers and communities while continuing to work toward emissions reduction targets. These goals can be achieved by committing to several tactics, including ongoing efforts to increase industrial energy efficiency, use of Best Available Retrofit Control Technology, capturing fugitive emissions, and providing allowances to energy-intensive industries when leakage would otherwise occur. Fully funding and supporting these programs maximizes emissions reductions and minimizes job disruption in the short term.

II. Industries and Sectors at Possible Risk of Job Loss

Three categories of jobs in the Scoping Plan sectors should be analyzed to assess the risk of job loss and the need for transition assistance. These are:

- Jobs directly impacted by the shift away from fossil fuels, such as fossil fuel extraction, refineries, and natural gas pipelines; discussed in the industry chapter of this report (Chapter 8);
- Jobs in energy-intensive and/or greenhouse-gas-emissions-intensive sectors whose operating costs would increase due to increased fossil fuel costs or increased costs due to having to replace or retrofit equipment, switch to cleaner fuel, or otherwise abate greenhouse gas emissions, also discussed in Chapter 8; and



- Jobs in industries that are already going through disruptions but may be further impacted by climate policies. For example, automation in the transportation sector offers opportunities for reducing greenhouse gas emissions as fleets are replaced but may also eliminate jobs. The intersection of climate policy and job-eliminating technologies is discussed in the chapters on energy and transportation (Chapters 6 and 7, respectively).

A. Just Transition Programs for Declining Industries

Moving away from fossil fuel use and production is not the nation's first workforce transition. In the United States, assistance for workers negatively impacted by trade agreements, military base closures, and tobacco farming are just a few examples of efforts to provide transition programs and assistance to workers and communities affected by changing or declining industries. As discussed below, these programs have had mixed results. Some of the military bases that were closed were able to be re-purposed into a new use. The Trade Adjustment Assistance program—the main program to help workers and communities negatively affected by globalization and trade agreements—has had more limited success due to poor program design, low participation rates, insufficient funding, and an inability to place workers in jobs of the same quality with regards to wage level and benefits.⁵ These examples provide insight into the scale and complexity inherent in a just transition program for workers and communities impacted by the move to a low-carbon economy.

1. Trade Adjustment Assistance

Started in 1974, the Trade Adjustment Assistance (TAA) program helps support U.S. workers adversely affected by globalization and trade.⁶ As former Labor Secretary Tom Perez describes, the program provides skill-training support, career counseling, and monetary support, such as wage supplements for older workers, job search and re-location allowances, and income support for workers in training programs.⁷ TAA has had limited success due to uneven funding and support of the program, the restricted scope of the program, and new employment paying lower wages with fewer to no benefits.

Analysis from Cornell University and the Apollo Alliance shows that over the history of the program, eligibility requirements, training, job search assistance, and levels of income support have fluctuated significantly.⁸ During the program's early years, eligible workers received only income and relocation support but did not receive training or job assistance.⁹ During the 1980s, the main focus of TAA shifted to job search and placement assistance, while income support was substantially reduced to less than half of previous income.¹⁰ In 1988, the TAA program was amended to require all workers



be enrolled in training programs in order to receive income support.¹¹ A number of improvements were made to the program in the 2000s, including doubling training funds, expanding eligibility to additional worker groups, including service and public sector workers, creating a health coverage tax credit, establishing wage insurance benefits for older workers, and creating a community assistance grant program.¹²

From its inception in 1974 to the end of 2013, 2.2 million workers have been served under the program. According to the U.S. Department of Labor, this total is less than one-half of the 4.8 million workers eligible to receive program benefits.¹³ In addition, early in the program's history, proving their work was directly impacted by a specific trade action was not possible for many workers, and they were excluded from the program.¹⁴ While the burden of proof was eventually eased, eligibility continued to be a problem. For example, a U.S. Government Accountability Office (GAO) investigation in 1992 found that nearly two-thirds of all petitions from 1990-1991 were wrongly decided—with almost equal numbers of incorrect denials as incorrect certifications.¹⁵ The usefulness of TAA in today's economy is further limited because the program does not extend to the vast majority of unemployed workers, many of whom have lost their jobs to automation or robotics.¹⁶

Funding for the TAA program has fluctuated widely, which undermines program stability. In 2010, federal spending on TAA was \$975 million; in 2012, this amount had substantially declined to just \$575 million.¹⁷ The fluctuations in funding are due both to varying numbers of eligible workers and changes in political support, but in general, analysts concur that funding has been inadequate to maintain the income levels of displaced workers. One 2016 report estimated the program spent \$8,806 per participant.¹⁸ This figure included expenditures for training, income support after unemployment benefits had expired, subsidies for health insurance, wage subsidies for older workers, financial support for job search and relocation, and other services that may have been provided by other workforce programs.¹⁹

Research on displaced workers eligible for TAA has found that the majority are unable to find employment at their previous wage level. A 2001 study found that 40 percent of displaced workers did not find employment within the first two years after initial job loss, while another 40 percent found work at lower wages and with fewer benefits.²⁰ A 2007 GAO study of the TAA program that included five case study sites found that displaced workers who secured new employment were able to replace approximately 80 percent of their previous wages.²¹ These numbers indicate a need for job creation policies to ensure that replacement jobs are good jobs that provide comparable wages and benefits.

Analysis of the TAA program shows that key steps can improve the success of just transition programs. In particular, the Cornell University and Apollo Alliance analysis makes the case that adequate financial support, including fully funded pensions and health benefits, is necessary for successful transition programs.²² In addition, transitional



income support should be provided for as long as participants are in training programs in order for workers to maintain living standards during their training.²³ Without continual financial assistance, participants enrolled in training programs generally dropped out when the financial assistance ended.²⁴

2. Military Base Closures

Under the Base Realignment and Closure (BRAC) process, 97 military bases were either closed or realigned, leading to reductions and/or relocation of civilian personnel, between 1988 and 2005.²⁵ These closures entailed the relocation of hundreds of thousands of personnel.

Closing military bases reduces local government revenue as collection of property, sales, and other local taxes drops with loss of people and economic activity. The reduction in revenue, in turn, hinders a community's ability to support existing services. Rural communities, in particular, have struggled to recover from base closures.²⁶ Research shows that base closures have a negative economic impact including job loss in communities surrounding the base.²⁷ However, it is possible to mitigate some of the negative economic impacts of base closures; in instances where preparation for base closures included the creation of a realistic plan for redevelopment, some of the lost jobs were replaced, and some lost income was restored.²⁸

Some closed bases have been successfully redeveloped into manufacturing facilities, airports, or research laboratories.²⁹ Others have been re-purposed for use by other federal agencies. For example, Fort McClellan in Alabama was closed in 1999 and is now used both for training by the Alabama National Guard and to house the Department of Homeland Security's Center for Domestic Preparedness.³⁰ When Fort Ord in Monterey, California, was closed, most of the property was given to the state of California. It is now home to California State University, Monterey Bay (CSUMB), with a section reserved for a state park and the Fort Ord National Monument.³¹

In Pennsylvania, the closing of the Philadelphia Naval Shipyard resulted in 7,000 jobs lost.³² The city of Philadelphia took over the naval port and redeveloped it, resulting in 120 companies now using the port facilities and 10,000 people being employed in the old Navy Yard. The former port is home to a diverse set of businesses, including the headquarters for large national companies, and the U.S. Navy's Naval Inactive Ship Maintenance Facility remains housed at the port.

It is important to note that redevelopment of closed military bases had strong government support. Much of the successful redevelopment of former bases occurred when another branch of federal or state government took over and re-purposed the bases, rather than successful private redevelopment. Moreover, the redevelopment of closed bases had strong financial support. In the 2005 round of closures, the Department of Defense



closed 24 major bases, realigned 24 major bases, and relocated 125,000 personnel at a cost of \$35.1 billion.³³ However, while proactive steps, as detailed above, can mitigate some of the negative economic consequences, not all redevelopment efforts have been successful in mitigating the negative economic impacts that base closures cause to local communities. As of the end of 2017, the Trump Administration began advocating for a new round of military base closures, the first since 2005.³⁴

3. Tobacco Farmers

The transition away from tobacco farming has been complex and continues today. Tobacco farming was a significant source of economic activity for many parts of the Southeastern United States. A U.S. Department of Agriculture report found that in 1998, consumers spent nearly \$60 billion on tobacco products, which supported thousands of businesses that manufacture, transport, market, and sell tobacco products.³⁵ Roughly 90,000 farms grew tobacco leaf to support this consumer demand. The tobacco economy was also an importance tax revenue source for federal, state, and local governments.

Government policies targeted toward reducing tobacco consumption, such as prohibiting smoking in public places, combined with litigation brought by smokers and states against tobacco manufacturers for damage to health, resulted in a reduction in demand for tobacco.³⁶ This groundbreaking litigation also resulted in a settlement between tobacco companies and 46 state attorneys general in 1998.³⁷ Tobacco companies paid about \$106 billion in settlement funds through 2015 and will pay billions more in perpetuity because healthcare costs due to citizens' smoking-related illnesses will likely continue indefinitely.³⁸ As funding for transition programs is a perpetual concern, the tobacco settlement presents an interesting example of an industry providing a funding stream for transition programs as part of its reparations for damage caused by its product.

As part of the massive settlement between cigarette companies and states, cigarette manufacturers agreed to pay cigarette tobacco farmers \$5.15 billion to compensate them for losses due to declining demand.³⁹ An estimated 124,000 farm operators are negatively impacted by the declining rates of tobacco use—research shows that between 1988 and 1998, cigarette consumption fell by almost 20 percent (from 563 billion pieces to 470 billion pieces).⁴⁰ To compare with the TAA program, which spent around \$8,000 per impacted worker, a rough calculation of the settlement amount of \$5.15 billion divided among the 124,000 farm operators equals an average of \$41,532 per farm operator. While not a direct comparison, the two numbers give an idea of the difference in scale between TAA support for workers and tobacco settlement monies allocated to farmers.

Pre-existing federal income support for tobacco farmers also created challenges for transition policy. These federal tobacco programs limited production of crops to keep supply low and prices high, set a minimum price for tobacco at market, and provided government loans to farmers' cooperatives.⁴¹ As a result, growing tobacco brought much



higher returns to farmers than most other agricultural or livestock enterprises. In 1997, for instance, tobacco farmers planted tobacco on just 6 percent of their land but received 79 percent of their gross income from that crop.⁴² This higher rate of return, combined with the nearly \$60-billion demand for tobacco products, means that addressing the decline in tobacco farming was particularly challenging and not as straightforward as transitioning tobacco farmers into other agricultural crops. Further complicating the transition is the fact that in 1998, the year the tobacco settlement was finalized, the approximately 20,000 cigarette manufacturing workers were among the highest paid in the manufacturing sector.⁴³ In 1998, cigarette manufacturing paid an average of \$24.34 per hour, compared to the national average manufacturing wage of \$13.49.⁴⁴ Therefore, any transition plan needed to take into consideration the higher wages paid in the declining industry.

Similar to other declining industries, the ability of workers and communities to transition away from tobacco has had mixed results. Some tobacco farms are being transformed into farms with organic and sustainable crops. In North Carolina, tobacco remains one of the state's most profitable crops, bringing in \$754 million dollars as recently as 2013.⁴⁵ However, there is a sustained downward trend in tobacco farming and a marked shift in the state away from tobacco and towards more sustainable farming practices. The promise of sustainable agriculture is evident in efforts in western North Carolina, where a group of farmers and citizens, anticipating the economic loss of tobacco, developed the Appalachian Sustainable Agriculture Project to build consumer demand for locally grown farm products and provide an alternative to tobacco farming.⁴⁶ As a result, the level of farm income lost in the region fell at a rate far lower than that of the state and nation. Increases in produce production and direct sales helped to offset the decline of tobacco.⁴⁷

B. Fossil Fuel Just Transition Programs

As the previous examples show, just transition programs for declining industries are complex and costly, and they have had mixed results. Given the scale and scope of transitioning away from fossil fuels, a successful just transition program will need very strong and sustained government support and funding as well as a robust training system that is directly connected to job creation to ensure placement of trained workers in comparable jobs. Placing displaced fossil fuel workers directly into clean energy jobs is often offered as a solution to employment losses but is frequently not feasible in practice: worker skills do not necessarily directly transfer from one industry to the other, and clean energy jobs are often in other geographic areas than where fossil fuels are being lost. A just transition to a carbon neutral economy will require diversifying regions that are heavily dependent on fossil fuel extraction and use, eliminating the disconnection between where fossil fuel jobs are lost and where new good jobs are created, and ensuring that communities and workers are fully supported through the transition.



The following section presents two examples of just transition programs that targeted fossil fuel communities and workers. The first example in Ruhr, Germany, is one of the most successful transformations of a region away from fossil fuels to date. The Ruhr transition, however, took nearly five decades and was possible not only because of Germany's very strong social safety net, but also because of a very robust state-supported industrial planning and reinvestment strategy. The Mohave Generating Station in Laughlin, Nevada, near the Arizona border is on a much smaller scale than the Ruhr example but provides insight into a plant-level transition program.

1. Germany's Ruhr Region

One of the few examples of successful just transition is the Ruhr region in Germany, which has been undergoing a transition away from fossil fuels for more than 50 years.⁴⁸ By 2018, the region had completely phased out coal subsidies and successfully diversified its economy away from being dependent on just one or two industries. The Ruhr example highlights the need for short- and long-term strategies. Short-term strategies, such as wage replacement and healthcare coverage, help workers in the immediate aftermath of displacement. Long-term strategies, such as infrastructure investments and skill retraining, help a region and workforce transition into a more diversified low-carbon economy.

The Ruhr Valley is in the state of North-Rhine Westphalia. Steel and coal production dominated the region for decades, and cities within the region developed around coal mines in the 1800s. At one point, the Ruhr region was the largest industrial site in Europe, and coal and steel production were major employers.⁴⁹ However, coal mining and steel production became increasingly less competitive as cheaper products became available on the global market. As a result, the area has seen rising unemployment and industrial decline for more than 50 years. In 1957, coal mining employed 473,000 workers. By the end of 2013, that number had fallen to 11,448.⁵⁰ The share of the economy provided by coal mining fell from 61 percent in 1960 to 21 percent in 2014. The federal state has been steadily divesting from coal, and coal subsidies were completely phased out by 2018, making coal mining even more expensive and even less competitive.⁵¹

Due to the historic dominance of coal and steel production in this region, there was little economic diversity. Once coal production began to decline, few options existed to help mitigate the resulting economic losses. The region was left with air and water pollution, coal mining waste, and ground disruption from underground tunnels used for coal mining that caused regular sinkholes in the region.⁵²

Coal and steel production oscillated for a few decades during the 1960s to the 1980s, but by the mid-1980s, it became clear that the region could no longer be sustained by coal and steel production. As detailed in a case study by Robert Taylor of the Institute for Industrial Productivity, the federal government—with program and implementation



support from the state—began a series of investments in three areas that were important to the region’s future success: infrastructure, particularly intra- and inter-regional public transportation and roads; new universities and technical institutes; and environmental protection.⁵³

These investments were important because they linked the region to other areas, laid the groundwork for training and retraining opportunities, and dealt with the legacy of pollution, which, in turn, made the region a more desirable place to vacation and relocate. The region further transformed in the late 1980s through the 1990s, a period of innovation and technological investment.⁵⁴ One of the larger initiatives funded more than 120 projects along a major river with a €2.5 billion investment, about one-third of which came from private-sector sources.⁵⁵ While the BRAC 2005 round of U.S. military base closures spent \$35.1 billion on 48 base closures and redevelopment nationwide, Germany’s €2.5 billion investment was concentrated within just the Ruhr region. The projects funded by this initiative focused on ecological improvements along the river, creating parkland, developing new uses for abandoned industrial buildings, developing new work locations, and building new housing.

Taylor notes that in the case of the Ruhr region, just transition policies can be categorized as short-term policies focused on the needs of immediately displaced workers or long-term actions to diversify the region’s economy and employment base. To deal with the issues that current workers faced, short-term policies included: wage subsidies, compensation payments and early retirement or, if early retirement was not appropriate, job transfer schemes. Short-term policies helped ease the immediate transition after a mine or plant shut down. Germany’s strong social safety net helped provide economic security for transitioning workers. Fossil fuel workers tend to skew older, so early retirement can cover a large portion of the workforce. For the remaining workers, job transfer schemes are necessary.

In addition, research by Judson Abraham from Virginia Polytech University found that through the role of trade unions in training and retraining workforces, trade unions were key to protecting coal miners in the Ruhr.⁵⁶ Working with the federal government, the state governments, and an energy conglomerate, the key union—the *Industriegewerkschaft Bergbau, Chemie, Energie* (IG BCE, the Mining, Chemical, Energy Industrial Guild)—negotiated an agreement to end all hard coal mining in Germany by 2018 and provide displaced workers with decent compensation and assistance with job replacement.⁵⁷ The agreement provided an opportunity for early retirement for workers 49 years or older who had worked for at least 25 years, offering a monthly stipend as wage replacement until they qualified for a pension.⁵⁸ Younger miners were guaranteed placement in another energy or mining job, or the opportunity to enroll in a specialty retraining center to develop new skills while still receiving decent pay and job placement assistance.⁵⁹ Tens of thousands of workers have since benefited from this agreement, which was signed when Germany had eight remaining coal mines (seven of these in the Ruhr region) that employed 35,000 workers.⁶⁰



Knowing there would be a permanent transition away from coal left decision makers and advocates with the difficult task of transforming the economic and employment base of the Ruhr region. Long-term policies to diversify included efforts to attract investment from high-tech and knowledge-based firms, expand the service sector, and promote local entrepreneurship. An example of a long-term project in the Ruhr region is the transformation of Gelsenkirchen—a town that used to be dominated by the coal industry—into a “solar city” that is the largest supplier of solar energy in Europe.⁶¹ City officials began to develop the city’s solar industry in the 1990s by taking advantage of Germany’s feed-in tariff, a guaranteed premium rate paid to renewable energy generators who feed power back into the grid. This encouraged solar power generation, even though coal mining was still dominant in Gelsenkirchen.⁶² Nine hundred solar panels were installed on rooftops, which at the time of installation was the largest rooftop solar installation in the world.⁶³

The German national government also invested in building an educational infrastructure to create new technical institutions and universities in the region. Diversifying the economic and employment base prevented the region from becoming overly dependent on one industry and allowed for healthier economic growth. Additionally, transforming the region aided the overall community, and not just fossil fuel workers. While short-term policies focus on the needs of displaced workers, long-term policies focus on the needs of the community and region in a low-carbon future.

2. Black Mesa⁶⁴

The second example is the closure of the Mohave Generating Station (MGS), a two-unit, 1,580 MW coal-fired power plant located in Laughlin, Nevada, near the Arizona border.⁶⁵ Southern California Edison operated MGS and was also the majority owner.⁶⁶ The coal for the MGS came from a 275-mile slurry line from the Black Mesa coal mine on the Hopi and Navajo Reservations in Arizona, operated by Peabody Western Coal Company and jointly owned by the Navajo Nation and Hopi Tribe.⁶⁷ The water for the slurry line was groundwater from an aquifer under the Hopi and Navajo reservations.⁶⁸

During its period of operation, the MGS emitted up to 40,000 tons of sulfur dioxide (SO₂) per year, and at one point was “the largest emitter of SO₂ emissions in the West.”⁶⁹ The slurry line drew substantial amounts of water from the aquifer that was essential to Hopi and Navajo traditional life and customs.⁷⁰ Ninety-three percent of the jobs at the mine were held by Native Americans, nearly all Navajo.⁷¹ The total economic benefit to the tribes and local communities from MGS operations was estimated at around \$83 million annually.⁷² To understand the economic magnitude of MGS operations, the Hopi Tribe’s general budget in 2017 was \$14.6 million.⁷³

In 2006, Southern California Edison decommissioned and dismantled the Mohave Generating Station, rather than upgrade the plant to abide by Clean Air Act



requirements.⁷⁴ In addition to the emissions of greenhouse gas and other air pollutants from the power plant, the land and water bore the scars of coal extraction for the plant from the Black Mesa coal mine in Arizona. Closing the MGS resulted in immediate environmental benefits but eliminated a critical source of royalties, tax revenue, and employment for the Hopi Tribe and Navajo Nation. The tribes, with allies in the environmental movements, were able to negotiate a just transition package with the California Public Utilities Commission (CPUC) and Southern California Edison that was substantial enough to mitigate a good portion of the economic costs of plant closure.

To provide funding for a just transition program, a Just Transition Coalition comprised of Native American grassroots organizations and environmental organizations was able to use the regulatory process in a creative way. As detailed by Ramo and Behles,⁷⁵ the MGS was a part of the acid rain emissions trading program, and because it was decommissioning, the plant had surplus allowances. Under the emissions trading scheme for SO₂ emissions, Southern California Edison would be allowed to sell its sulfur allowances that resulted from the closure of the MGS, which would then generate a revenue stream that could fund just transition efforts. Although the California Public Utilities Commission had considered community impacts from utility operations before, using sulfur allowances to benefit out-of-state non-ratepayers was new.⁷⁶ As a result of the coalition's efforts, the CPUC required Southern California Edison to put revenue from the acid rain emissions trading program into an account to be disbursed to the Hopi and Navajo communities.⁷⁷

The sale of SO₂ allowances created a revolving fund of \$4.5 million annually to pay development deposits for renewable energy projects that benefit the Hopi Tribe and the Navajo Nation.⁷⁸ While this amount is just a fraction of the \$83 million in economic benefits brought by MGS operations, it provides a dedicated funding stream to help diversify the community's economy that can, in turn, generate additional economic growth. Moreover, the shutdown of the plant stopped the associated environmental destruction and protected the tribes' water source. The Navajo Nation also passed legislation to establish the Green Economy Fund and Commission to support green initiatives using a mixture of state, federal, and foundation funding.⁷⁹ In addition to the work of the Green Economy Commission, advocates have developed other projects that include a green business incubator, the Black Mesa Solar Project, the Navajo Wool Market Improvement Project, and the Food Sovereignty Project.⁸⁰ The new projects show an effort to diversify economic development, helping transition away from dependence on a single economic driver like fossil fuel development.

The example here also shows how a market mechanism, whose main goal is to place a cap on emissions and allow private businesses to determine the least costly way to comply with the cap, can also produce revenues that are a possible source of transition assistance. This approach is relevant to California's main market mechanism, the Cap-and-Trade Program, which is similarly funded from the sale of greenhouse gas



emissions allowances.⁸¹ These revenues go into the state’s Greenhouse Gas Reduction Fund (GGRF) and are used to fund projects on affordable housing, renewable energy, public transportation, zero-emission vehicles, sustainable agriculture, and more.⁸² Annually, at least 35 percent of these funds must be spent on projects located within, and benefiting residents of, disadvantaged communities and low-income communities, as well as low-income households.⁸³ See Chapter 5 for a discussion of the GGRF and Chapter 8 for a discussion of the Cap-and-Trade Program.

C. Current Fossil Fuel Just Transition Programs

While the transition detailed in this section are too new to document outcomes, they provide insight into the program elements being adopted into just transition initiatives. The first example examines the efforts at Diablo Canyon Power Plant, a nuclear plant in San Luis Obispo County, California. Diablo Canyon presents a unique case in which a diverse coalition came together to proactively propose a just transition plan in anticipation of the plant going offline. Diablo Canyon also highlights how the cost of funding this transition program has been allocated, including the decision to pass some costs to ratepayers and some costs to shareholders of this regulated utility.

The second example describes an agreement to close TransAlta’s Centralia Power Plant, the last coal-fired power plant in Washington State, and offers a model of a public stakeholder strategy that engaged businesses, government agencies, and environmental and labor organizations.

The third example details the Obama administration’s POWER Initiative, an effort coordinated among 10 federal agencies to provide economic and workforce development resources to communities and workers impacted by declines in the coal industry. The POWER Initiative is reminiscent of the TAA program, with a particular focus on the coal industry. It includes successful elements from other transition programs, among them the diversification of local economies and provision of income support, as well as health and retirement security. While funding was dispersed as recently as March 2018, it is unclear whether the current administration will continue funding the initiative.

The section concludes with a discussion of a carbon fee ballot initiative in Washington State. Even though it was defeated in 2018, the ballot initiative provides a blueprint for designing a transition program for workers and communities using an intensive stakeholder process that included representational decision-making.

1. Diablo Canyon Nuclear Power Plant

The Diablo Canyon nuclear power plant, located in San Luis Obispo County, has been operating since 1985.⁸⁴ The two-unit nuclear power plant generates a total of 2,240 MW. Diablo Canyon is set to be taken offline when the current operating licenses expires,



which is by 2024 for Unit 1 and 2025 for Unit 2.⁸⁵ Retiring the nuclear power plant, the last nuclear power generation plan in California, is a complex and extensive process with implications for ratepayers, workers, and the surrounding community.

In anticipation of the CPUC proceedings to decide the terms of the transition plan for retiring Diablo Canyon, the main stakeholders—the plant operator (Pacific Gas and Electric, PG&E), environmental advocacy organizations (the Natural Resources Defense Council, Environmental California, and the Alliance for Nuclear Responsibility), and the pertinent unions, IBEW Local 1245 and the Coalition of California Utility Employees—worked together to negotiate a plan, known as the Joint Proposal, that met environmental, worker, and community interests. The following section presents the main components of the Joint Proposal to Retire and Replace Diablo Canyon and the final plan which was adopted by the legislature in 2018.⁸⁶ The Diablo Canyon case also provides insight into what costs can be passed on to consumers (ratepayers) in the case of a regulated industry.

The Joint Proposal set out a plan for closing Diablo Canyon and was submitted to the CPUC. The proposal included: replacing Diablo Canyon with a greenhouse-gas-free portfolio to substitute for the Diablo Canyon power; an employee retention, retraining, and compensation plan; and mitigation to the local community for the loss of tax revenue and other economic costs of closure.⁸⁷ In January 2018, the CPUC approved PG&E's application to retire Diablo Canyon, however, the CPUC did not agree to all the provisions in the Joint Proposal as detailed below.⁸⁸

The Joint Proposal parties did agree to an employee program that included a severance package for approximately 1,500 employees, a retention program to ensure adequate staffing levels until closure, and a retraining and development program to facilitate redeployment of a portion of plant personnel to the decommissioning project and elsewhere within PG&E. The estimated cost of the employee program was \$350 million. CPUC approved only \$222.6 million for the program and allowed PG&E to recover these funds from ratepayers.⁸⁹

Diablo Canyon currently contributes approximately \$22 million in property taxes to San Luis Obispo County annually. PG&E proposed to compensate San Luis Obispo County for the loss of property taxes due to the declining rate base in Diablo Canyon through 2025. PG&E also came to an agreement with labor and environmental groups, the County of San Luis Obispo, the Coalition of Cities, and the San Luis Coastal Unified School District to create a Community Impacts Mitigation Program that will cost \$85 million.⁹⁰ This program includes funds for the offset of any potential negative impacts to essential services, and the creation of a \$10-million Economic Development Fund to ease local economic impacts arising from the plant's closure. The agreement also includes continued funding for offsite community and local emergency preparedness and planning until the two nuclear reactor units are fully decommissioned. The CPUC declined to fund these efforts through rate recovery.⁹¹



The final order from the CPUC funded a much smaller transition package than the Joint Proposal. The employee retention plan would be funded by rate recovery, while the community impact fund was left to be funded by PG&E shareholders. CPUC's argument, with respect to the community mitigation program, was that ratepayers should only pay for utility costs and not for government services, and community mitigation was seen as a government service.⁹² Employee retention programs and license renewal, on the other hand, were viewed as utility services and could, therefore, be passed on to ratepayers.

In response to the final CPUC order, advocates introduced a bill, Senate Bill 1090 (Monning, Chapter 561, Statutes of 2018),⁹³ to force the CPUC to accept the Joint Proposal as originally presented.⁹⁴ The bill passed both the state assembly and senate and was signed by the governor on September 19, 2018.⁹⁵

2. Centralia Power Plant Closure⁹⁶

The closure of the TransAlta's Centralia Power Plant, the last coal-fired power plant in Washington State, provides another model of a public stakeholder strategy that successfully engaged business, government, environmental, and labor organizations.

The Sierra Club and a coalition of faith-based, public health, and worker organizations launched a campaign to retire the TransAlta plant by 2015, following the failure of cap-and-trade legislation in the Washington legislature in 2009. The coalition supported a bill to shutter the plant by 2015 and an alternative bill to close it by 2020, which would take offline the largest single-point source for mercury and greenhouse gas emissions in the Pacific Northwest. TransAlta, which had recently invested in scrubbers and other best practices in pollution control, argued for the extension of operations until 2025. The local community also remained skeptical of any potential closure deal and what it would mean for the local economy. In 2006, TransAlta had abruptly closed a coal mine adjacent to the plant after determining that the costs of necessary safety upgrades were too high. Six hundred workers were let go. After the mine closed, unemployment in the county reached 12 percent as there were only very limited opportunities for good jobs outside of the coal plant.⁹⁷

When the negotiations appeared deadlocked, the governor brought together the coalition and the company to broker a deal. Although the International Brotherhood of Electrical Workers (IBEW), which represented the plant workers, was not included in the negotiation, the coalition advocated for worker retention during the process of closure, reemployment in the plant clean-up, a pathway to retirement for older workers, and retraining for young workers in new energy technologies. In exchange, TransAlta agreed to close one boiler in 2020 and the second in 2025, during which time 40 percent of the plant's workforce would reach retirement age. Younger workers received eight years' notification to plan their next steps before the plant closed. The company also endowed a \$30-million community investment fund and provided \$25 million for an energy-technology transition fund.⁹⁸



3. Obama Administration POWER Initiative

On the federal level, the Obama Administration introduced the POWER (Partnerships for Opportunity and Workforce and Economic Revitalization) Initiative, a coordinated effort among 10 federal agencies to align, leverage, and target a range of federal economic and workforce development programs and resources to assist communities and workers that are affected by declines in the coal industry. The POWER Initiative was the primary economic and workforce component of President Obama's POWER+Plan, which proposed more than \$9 billion to support economic diversification in coal communities, employment and training services for workers displaced from the coal economy, the health and retirement security of coal miners and their families, the reclamation and redevelopment of abandoned mine lands, and the deployment of carbon capture and sequestration technology.⁹⁹

In many ways, the POWER Initiative builds on the TAA program by providing training and retraining opportunities as well as income and benefits support. The initiative also addresses the economic development and demand for labor by funding projects that diversify local economies away from extreme dependence on coal and create jobs in new industries.

As of March 2018, the Appalachian Regional Commission, a federal-state partnership, has awarded \$94 million through the POWER Initiative to help 250 coal-impacted Appalachian counties diversify and grow their economies.¹⁰⁰ The grants include:

- \$1.9 million to Bevill State Community College in Jasper, Alabama, to create a Rapid Training Center at Bevill State's Jasper campus that will serve as a regional workforce training and job placement hub in northwest Alabama;
- \$7.47 million to the University of Pikeville in Pikeville, Kentucky, to help launch the Kentucky College of Optometry project, which will grow the healthcare workforce and improve access to vision care in Central Appalachia; and
- \$1.75 million to the Fayette County Community Action Agency, Inc., in Uniontown, Pennsylvania, for the Southwestern PA Development of a robust local food shed that provides new and diverse economic opportunities to communities in 38 counties impacted by the decline of the coal industry across Pennsylvania, West Virginia, and Maryland.¹⁰¹

These investments are expected to create or retain almost 8,800 jobs and leverage an additional \$210 million in investment. As demonstrated through these projects, the goal is to diversify economic growth and not replicate over-dependence on one industry. While the latest grants were dispersed in March 2018, it is unclear whether the program will continue to have support under the current federal administration.



4. Washington State Initiative 1631

Initiative 1631, though defeated on the November 2018 ballot in the state of Washington, provides an example of a comprehensive climate policy that includes a just transition package as a central component of the proposal.¹⁰² Developed by a coalition of labor, environmentalist, and environmental justice organizations, and supported by more than 250 organizations, including racial equity organizations, environmental advocates, tribal nations, and the Alliance for Jobs and Clean Energy, the initiative proposed a carbon fee policy that was expected to generate more than \$2 billion over five years.¹⁰³ As recorded in the text of the initiative, the carbon fee would begin at \$15 per ton of CO₂ equivalent and then increase by \$2 every year, adjusted for inflation until 2035, as long as the greenhouse gas emission reductions targets were on track to meet the state's 2050 reduction goal.¹⁰⁴ Seventy percent of the revenue raised would be used for clean air and clean energy investments, 25 percent for clean water and healthy forest investments, and 5 percent for a healthy community fund.¹⁰⁵

The initiative directly addressed the transition of workers by requiring a minimum of \$50 million of the carbon fee revenue fund to be set aside and replenished every year for a support program for workers negatively impacted by the transition away from fossil fuels.¹⁰⁶ This support fund for displaced workers included full wage replacement, health benefits, pension contributions for employees who were within five years of retirement, and wage insurance for up to five years for workers with more than five years of service, as well as full wage replacement, health benefits, and pension contributions for each year of service for workers with between one and five years of service.¹⁰⁷ Wage insurance makes workers whole by paying any difference between re-employment wages and the wages they had been earning in the lost job.¹⁰⁸

The initiative also provided retraining costs, peer counseling services, job placement services, relocation expenses, priority hiring in the clean energy sector, and other services deemed necessary.¹⁰⁹ The initiative addressed just transition for communities, as well. A minimum of 35 percent of all investments would be allocated to benefit environmental justice communities (those that bear the highest pollution burdens); 15 percent of investments would assist lower-income populations in urban and rural communities in transitioning to a clean energy economy; and 10 percent of investments would require formal support from a tribal government (along with mandated consultation of tribal nations on any projects affecting their lands).¹¹⁰

In addition, the initiative would have created a public board for accountability, ensuring robust public involvement and transparency. The board was designed to comprise 15 voting members, including government agency officials, a tribal representative, and a representative of the environmental justice community.¹¹¹

The revenue raised from the carbon tax, if it had passed, would have provided strong financial support for the proposed transition programs. The level of specificity of the



programs offered a clear roadmap of how the money would be spent and how displaced workers and marginalized communities would benefit. The initiative also laid out how worker and environmental justice voices would be integrated into decision-making processes. These elements address shortcomings of previous transition programs, particularly the lack of steady funding and the lack of services to overcome the many challenges workers and communities face in industrial transitions.

Finally, a study commissioned to assist in developing the Washington climate ballot initiative provides an important example of how to estimate the costs of alternative transition packages. The Washington State economic analysis identifies the critical parameters that must be estimated to determine annual and cumulative costs. These include the specific benefits package that is chosen, the number and timing of job losses, and characteristics of the industry such as the age profile of the workforce, worker turnover rates, rehire needs before closure, and the health of pension plans. The cost estimates of the proposed just transition program vary widely depending on assumptions about these factors, but based on a likely pattern of alternating periods of steady contraction with occasional episodes of large-scale employment loss, the very comprehensive transition program analyzed in the study is estimated to cost between \$30-\$40 million per year. This amount is a small percentage of the estimated revenues from the proposed carbon fee, which at the lowest carbon price of \$15 per ton was estimated to generate revenues of more than \$1 billion for the first several years and hundreds of millions of dollars annually over time as carbon emissions decrease.

III. Recommendations for Just Transition

The following recommendations aim to assist the state in planning for the protection and support of workers, their families, and communities at risk of decline due to contracting fossil fuel industries.

As California transforms its economy and its workforce to meet 2030 climate targets, the state will need to create new opportunities not only for traditionally disadvantaged Californians, but for workers and communities dependent on fossil fuel or carbon-intensive industries. The question is how to support individual workers who lose their jobs and take action to diversify regional economies over the longer term.

(As mentioned throughout this chapter, transitioning away from carbon-intensive industries is one part of a larger economic transformation that is anticipated with the increasing automation of many jobs and occupations. Moreover, automation will likely have significant impact on key industries affected by climate policy, such as the energy and transportation sectors. While the issue of automation is beyond the scope of this report, the challenges of addressing job loss—and creating new job opportunities—are



similar).

The examples presented in this chapter show that successful programs require the support of diverse coalitions that include workers, communities, and labor unions. In Black Mesa, the various stakeholders worked together to provide economic alternatives for the Hopi Tribe and Navajo Nation when the coal mine and generating station went offline. Similarly, a wide coalition came together to provide a proactive transition plan for the Diablo Canyon closure.

In addition to strong stakeholder collaboration, local, state, and federal government support is essential to promote the broader economic restructuring that is needed to transition away from fossil fuels. Moving forward, investing in research and developing transition programs in collaboration with impacted parties, including community groups, unions, and business, will provide grounded solutions at the scale and scope necessary to build a carbon-neutral economy.

1. Short Term: Fully explore alternatives to plant closures when there are other strategies available that will achieve greenhouse gas emissions reductions and local pollution abatement.

In specific communities, immediate plant closure may not be the best and most equitable way to achieve the state's carbon emission goals. It is important to explore whether in the short term, continued investments in emissions abatement and targeted enforcement of pollution mandates for heavy emitting industries could ensure maximum job retention concurrent with decreasing emissions. This includes deploying Best Available Retrofit Control Technology as required in Assembly Bill 617 (C. Garcia, Chapter 136, Statutes of 2017),¹¹² fugitive methane emissions capture mandates, and industrial energy efficiency incentive programs. Targeted investments in pollution abatement can create jobs, many in sectors where skilled workforce standards already ensure job quality.

2. Longer-term: Convene an interagency task force to develop concrete, specific plans for short-term and long-term transition.

2a. Identify priority transition assistance needs.

The state could work to identify the most vulnerable industries, firms, and localities through research and engagement of business, labor, and community, and develop a set of the most likely job disruption scenarios through 2030. For each scenario, the task force could develop cost estimates for a transition plan, incorporating a variety of assistance



packages, options for retraining and job placement, and considerations regarding the speed of industry transition, and firm and worker characteristics such as the health of pension plans and the age of workforce. This work could be facilitated by the High Road Training Partnerships described above, which would provide a framework for stakeholder discussion and planning.

2b. Facilitate a planning process for transition assistance.

Based on the identification of priorities, the state could work with at risk communities, labor, and business—again, ideally through regional industry partnerships such as the HRTPs—to develop and propose a set of key criteria for transition programs that include a combination of income and benefits support, skills training, and job creation and placement. Ultimately, any program will need to be directly beneficial to the specific region and industry affected. Potential benefits could include income support; continued pension and healthcare benefits; a bridge to retirement for older workers; sizable job training, re-training, or education allowances and case management to improve the likelihood of reemployment at comparable wages; consideration of guaranteed employment in public works or first source privilege in hiring; and even outside the box ideas such as college aid for the children of displaced workers.



Endnotes

- 1 Alexandra Bradbury, “How Do We ‘Change Everything’ without Pitting Workers against the Planet?,” *Labor Notes* (blog), September 8, 2015, <https://labornotes.org/blogs/2015/09/how-do-we-change-everything-without-pitting-workers-against-planet>.
- 2 Labor Network for Sustainability and Strategic Practice Grassroots Policy Project, “‘Just Transition’ – Just What Is It? An Analysis of Language, Strategies, and Projects,” July 6, 2016, <http://www.labor4sustainability.org/uncategorized/just-transition-just-what-is-it/>.
- 3 Robert Pollin and Brian Callaci, “A Just Transition for U.S. Fossil Fuel Industry Workers,” *The American Prospect*, July 6, 2016, <http://prospect.org/article/just-transition-us-fossil-fuel-industry-workers>.
- 4 French Economic, Social and Environmental Council, “No Jobs on a Dead Planet—Trade Union Summit on Climate Change,” International Trade Union Confederation, July 27, 2015, <https://www.ituc-csi.org/no-jobs-on-a-dead-planet-trade>.
- 5 Elena Foshay, Jill Kubit, and Lara Skinner, “Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy” (Apollo Alliance & Cornell University, ILR School Global Labor Institute, 2009), http://www.climatechange.ca.gov/eaac/comments/2009-12-11_California_Labor_Federation_attachment_2.pdf.
- 6 Jeffrey Zients, “Trade Adjustment Assistance: What You Need to Know,” resident Barack Obama White House Archives, June 11, 2015, <https://obamawhitehouse.archives.gov/blog/2015/06/11/trade-adjustment-assistance-what-you-need-know>.
- 7 Zients.
- 8 Foshay, Kubit, and Skinner, “Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy.”
- 9 Foshay, Kubit, and Skinner.
- 10 Foshay, Kubit, and Skinner.
- 11 Foshay, Kubit, and Skinner.
- 12 Foshay, Kubit, and Skinner.
- 13 U.S. Department of Labor, Employment and Training Administration, “Trade Adjustment Assistance for Workers Program,” Fiscal Year 2013, <https://www.doleta.gov/tradeact/docs/AnnualReport13.pdf>.



- 14 Foshay, Kubit, and Skinner, “Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy.”
- 15 Foshay, Kubit, and Skinner.
- 16 Jennifer Mason and Mireya Solís, “Globalization on the Cheap: Why the U.S. Lost Its Way on Trade,” Brookings, August 28, 2017, <https://www.brookings.edu/blog/order-from-chaos/2017/08/28/globalization-on-the-cheap-why-the-u-s-lost-its-way-on-trade/>.
- 17 Tom DiChristopher, “Sizing up the Trade Adjustment Assistance Program,” *CNBC*, June 26, 2015, <https://www.cnbc.com/2015/06/26/is-aid-to-trade-displaced-workers-worth-the-cost.html>.
- 18 Sarah Dolfin and Peter Z. Schochet, “The Benefits and Costs of the Trade Adjustment Assistance (TAA) Program Under the 2002 Amendments” (Mathematica Policy Research, December 2012), https://wdr.doleta.gov/research/FullText_Documents/ETAOP_2013_09.pdf.
- 19 Dolfin and Schochet.
- 20 Lori G. Kletzer, *Job Loss from Imports: Measuring the Costs* (Institute for International Economics, 2001).
- 21 Sigurd R. Nilsen, “Trade Adjustment Assistance: Program Provides an Array of Benefits and Services to Trade-Affected Workers,” Testimony before the Committee on Ways and Means, House of Representatives (U.S. Government Accountability Office, June 14, 2007), <https://www.gao.gov/new.items/d07994t.pdf>.
- 22 Foshay, Kubit, and Skinner, “Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy.”
- 23 Foshay, Kubit, and Skinner.
- 24 Loren Yager, “Trade Adjustment Assistance: Improvements Necessary, but Programs Cannot Solve Communities’ Long-Term Problems,” Testimony Before the Committee on Finance, Subcommittee on International Trade, U.S. Senate (U.S. General Accounting Office, July 20, 2001), <https://www.gao.gov/assets/110/108928.pdf>.
- 25 Tadlock Cowan, “Military Base Closures: Socioeconomic Impacts,” CRS Report for Congress (Congressional Research Service, February 7, 2012), <https://fas.org/sgp/crs/natsec/RS22147.pdf>.
- 26 Cowan.



- 27 Andy Hultquist and Tricia L. Petras, “An Examination of the Local Economic Impacts of Military Base Closures,” *Economic Development Quarterly* 26, no. 2 (2012): 151–61, <https://doi.org/10.1177/0891242412442374>.
- 28 Cowan, “Military Base Closures: Socioeconomic Impacts.”
- 29 Cowan.
- 30 Lee Cloer, “Closed Military Bases - What Are They Doing Now?” (Duotech, January 26, 2018), <https://duotechservices.com/closed-military-bases-where-are-they-now>.
- 31 Cloer.
- 32 Cloer.
- 33 Brian J. Lepore, “Military Bases: Opportunities Exist to Improve Future Base Realignment and Closure Rounds,” Report to Congressional Committees (U.S. Government Accountability Office, March 2013), <https://www.gao.gov/assets/660/652805.pdf>; Brian J. Lepore, “Military Base Realignment and Closures: Updated Costs and Savings Estimates from BRAC 2005,” Letter to chairs and ranking members of relevant committees of the U.S. Senate and the U.S. House of Representatives (U.S. Government Accountability Office, June 29, 2012), <https://www.gao.gov/assets/600/592076.pdf>.
- 34 Ellen Mitchell, “Pentagon Chief Pushes for New Round of Base Closures,” *The Hill*, October 18, 2017, <https://thehill.com/policy/defense/356054-pentagon-chief-pushes-for-new-round-of-base-closures>.
- 35 H. Frederick Gale, Jr., Linda Foreman, and Thomas Capehart, “Tobacco and the Economy: Farms, Jobs, and Communities,” Agricultural Economic Report (Economic Research Service/USDA, September 2000), <http://ageconsearch.umn.edu/record/34007/files/ae000789.pdf>.
- 36 Gale, Jr., Foreman, and Capehart.
- 37 Tobacco Control Legal Consortium, “The Master Settlement Agreement: An Overview” (Public Health Law Center, August 2015), <http://www.publichealthlawcenter.org/sites/default/files/resources/tclc-fs-msa-overview-2015.pdf>.
- 38 Tobacco Control Legal Consortium.
- 39 Gale, Jr., Foreman, and Capehart, “Tobacco and the Economy.”
- 40 Gale, Jr., Foreman, and Capehart; Jasper Womach, “Compensating Farmers for the Tobacco Settlement” (Congressional Research Service, July 6, 1998), https://www.everycrsreport.com/files/19980706_98-133ENR_7d619c539e22176ed4d9455fa47901770b076ae0.pdf.



- 41 “The Price Of Tobacco: The Basics,” *The New York Times*, March 22, 1993, <https://www.nytimes.com/1993/03/22/us/the-price-of-tobacco-the-basics.html>.
- 42 Gale, Jr., Foreman, and Capehart, “Tobacco and the Economy.”
- 43 Gale, Jr., Foreman, and Capehart.
- 44 Gale, Jr., Foreman, and Capehart.
- 45 Ashita Gona, “Tobacco to Tomatoes: The Reinvention of North Carolina’s Agriculture,” *Environmental Storytelling: Reporting by Students at UNC-Chapel Hill* (blog), December 9, 2014, <http://jomc565.web.unc.edu/2014/12/09/tobacco-to-tomatoes-the-reinvention-of-north-carolinas-agriculture/>.
- 46 Charlie Jackson and Allison Perrett, “The End of Tobacco and the Rise of Local Food in Western North Carolina” (Local Food Research Center, Appalachian Sustainable Agriculture Project, March 2018), http://asapconnections.org/wp-content/uploads/Final_The-End-of-Tobacco.pdf.
- 47 Jackson and Perrett.
- 48 A version of this section appears in Tahseen Jafry, ed., *Routledge Handbook of Climate Justice*, First, Routledge International Handbooks (Routledge, 2019), <https://www.routledge.com/Routledge-Handbook-of-Climate-Justice/Jafry/p/book/9781138689350>.
- 49 Dean Stroud et al., “Skill Development in the Transition to a ‘Green Economy’: A ‘Varieties of Capitalism’ Analysis,” *The Economic and Labour Relations Review* 25, no. 1 (January 13, 2014): 10–27.
- 50 European Trade Union Institute, “Social Partners and the Collaborative Approach Are Key to the Green Transition of the Ruhr Region,” *Etui* (blog), February 9, 2016, <https://www.etui.org/News/Social-partners-and-the-collaborative-approach-are-key-to-the-green-transition-of-the-Ruhr-region>.
- 51 Deutsche Welle, “The Rise and Fall of Germany’s Coal Mining Industry,” *DW* (blog), January 31, 2007, <https://www.dw.com/en/the-rise-and-fall-of-germanys-coal-mining-industry/a-2331545>.
- 52 Deutsche Welle.
- 53 Deutsche Welle.
- 54 Deutsche Welle.
- 55 Deutsche Welle.



56 Judson Abraham, “Just Transitions for the Miners: Labor Environmentalism in the Ruhr and Appalachian Coalfields,” *New Political Science* 39, no. 2 (April 14, 2017): 218–40, <https://doi.org/10.1080/07393148.2017.1301313>.

57 Abraham.

58 Abraham.

59 Abraham.

60 Spiegel Online, “End of an Industrial Era: Germany to Close Its Coal Mines,” *Spiegel Blog* (blog), January 30, 2007, <http://www.spiegel.de/international/end-of-an-industrial-era-germany-to-close-its-coal-mines-a-463172.html>.

61 Erica Peterson, “In Germany, A City Moves Away From Coal,” *WFPL News*, December 7, 2015, <http://energyfuture.wfpl.org/in-germany-a-city-moves-away-from-coal/>.

62 Peterson.

63 Peterson.

64 J. Mijin Cha, “A Just Transition: Why Transitioning Workers into a New Clean Energy Economy Should Be at the Center of Climate Change Policies,” *Fordham Environmental Law Review* 29, no. 2 (2017): 196–220.

65 Alan Ramo and Deborah Behles, “Transitioning a Community Away from Fossil-Fuel Generation to a Green Economy: An Approach Using State Utility Commission Authority,” *Minnesota Journal of Law, Science & Technology* 15, no. 1 (2014): 505–27.

66 Ramo and Behles.

67 Ramo and Behles.

68 Ramo and Behles.

69 Ramo and Behles.

70 Ramo and Behles.

71 Ramo and Behles.

72 Ramo and Behles.

73 Ramo and Behles.



- 74 Ramo and Behles; Center for Media and Democracy, “Mohave Generating Station,” SourceWatch, August 10, 2012, https://www.sourcewatch.org/index.php/Mohave_Generating_Station.
- 75 Ramo and Behles, “Transitioning a Community Away from Fossil-Fuel Generation to a Green Economy: An Approach Using State Utility Commission Authority.”
- 76 Ramo and Behles.
- 77 Ramo and Behles.
- 78 Jihan Gearon and Wahleah Johns, “Peabody’s Declaration of Bankruptcy Is ‘No Surprise’: Navajo Tribal Members Demand Just Transition to a Sustainable Economy” (Indigenous Environmental Network, April 14, 2016), <http://www.ienearth.org/peabodys-declaration-of-bankruptcy-is-no-surprise/>; Laura Shin, “Navajo Nation Approves First Tribal ‘Green Jobs’ Legislation” (InsideClimate News, July 22, 2009), <http://insideclimatenews.org/news/20090722/navajo-nation-approves-first-tribal-green-jobs-legislation>; Blackmesapeeps, *Navajo Green Job* (Youtube, 2009), <https://www.youtube.com/watch?v=tAJHuRxbImE>.
- 79 Gearon and Johns, “Peabody’s Declaration of Bankruptcy Is ‘No Surprise’: Navajo Tribal Members Demand Just Transition to a Sustainable Economy”; Shin, “Navajo Nation Approves First Tribal ‘Green Jobs’ Legislation”; Blackmesapeeps, *Navajo Green Job*.
- 80 Gearon and Johns, “Peabody’s Declaration of Bankruptcy Is ‘No Surprise’: Navajo Tribal Members Demand Just Transition to a Sustainable Economy”; Shin, “Navajo Nation Approves First Tribal ‘Green Jobs’ Legislation”; Blackmesapeeps, *Navajo Green Job*.
- 81 “Cap-and-Trade Dollars at Work,” California Climate Investments, accessed October 17, 2018, <http://www.caclimateinvestments.ca.gov/>.
- 82 “Cap-and-Trade Dollars at Work.”
- 83 “Cap-and-Trade Dollars at Work.”
- 84 Pacific Gas and Electric Company et al., “Joint Proposal to Retire Diablo Canyon Nuclear Power Plant at Expiration of the Current Operating Licenses and Replace It with a Portfolio of GHG Free Resources” (PG&E, June 20, 2016), <https://www.pge.com/includes/docs/pdfs/safety/dcpp/JointProposal.pdf>.
- 85 Pacific Gas and Electric Company et al.
- 86 Peter Miller, “Diablo Canyon Legislation Signed into Law by Governor Brown,” NRDC Expert Blog (blog), September 19, 2019, <https://www.nrdc.org/experts/peter-miller/diablo-canyon-legislation-signed-law-governor-brown>.



- 87 Pacific Gas and Electric Company et al.
- 88 California Public Utilities Commission, “Decision Approving Retirement of Diablo Canyon Nuclear Power Plant,” January 16, 2018, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M205/K423/205423920.PDF>.
- 89 California Public Utilities Commission.
- 90 Pacific Gas and Electric Company, “PG&E, SLO County, SLO Coastal Unified School District, Local Cities Reach Accord on Diablo Canyon Community Support Funding,” November 28, 2016, https://www.pge.com/en_US/safety/how-the-system-works/diablo-canyon-power-plant/news-and-articles/pge-slo-county-slo-coastal-unified-school-district-local-cities-reach-accord-on%20diablo-canyon-community-support-funding.page.
- 91 California Public Utilities Commission, “Decision Approving Retirement of Diablo Canyon Nuclear Power Plant.”
- 92 California Public Utilities Commission.
- 93 Bill Monning, “SB-1090 Diablo Canyon Nuclear Powerplant,” Chapter 561, Statutes of 2018 Public Utilities Code § 712.7 (2018), https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1090.
- 94 Monning.
- 95 Jeff St. John, “California Passes Bill Requiring Diablo Canyon Plant to Be Replaced With Carbon-Free Resources” (Greentech Media, August 24, 2018), <https://www.greentechmedia.com/articles/read/california-bill-requiring-diablo-canyon-carbon-free>; Natural Resources Defense Council, “Gov. Brown Signs Historic Diablo Canyon Nuclear Plant Bill,” September 20, 2018, <https://www.nrdc.org/media/2018/180920>.
- 96 This section is based on research conducted by Katherine Luke at the UC Berkeley Labor Center.
- 97 Scott Martelle, “Kick Coal, Save Jobs Right Now,” *Sierra Magazine*, 2012, <http://vault.sierraclub.org/sierra/201201/kick-coal-save-jobs.aspx>.
- 98 Jeremy Brecher, “Jobs Beyond Coal: A Manual for Communities, Workers, and Environmentalists” (Labor Network for Sustainability, 2012), http://report.labor4sustainability.org/coal_2012.pdf.
- 99 U.S. Office of the Press Secretary, “Fact Sheet: Administration Announces New Economic and Workforce Development Resources for Coal Communities through POWER Initiative,” President Barack Obama White House Archives, August 24, 2016, <https://obamawhitehouse.archives.gov/the-press-office/2016/08/24/fact-sheet-administration-announces-new-economic-and-workforce>.



- 100 Appalachian Regional Commission, “POWER Initiative,” 2019, <https://www.arc.gov/funding/POWER.asp>.
- 101 Appalachian Regional Commission, “POWER Award Summaries by State As of September 2017,” September 2017, <https://www.arc.gov/images/grantsandfunding/POWER2017/ARCPowerAwardSummariesbyState9-6-2017.pdf>.
- 102 “Building a Cleaner Future Together,” Yes On 1631, accessed October 17, 2018, available via Internet archive at <https://web.archive.org/web/20190206224755/https://yeson1631.org/learn/https://yeson1631.org/learn/>.
- 103 Washington State Office of Financial Management, “I-1631 Reducing Pollution: Fiscal Impact Summary,” August 24, 2018, https://ofm.wa.gov/sites/default/files/public/budget/ballot/2018/I-1631_Fiscal_Impact_Statement-082418.pdf.
- 104 “Initiative Measure No. 1631,” March 13, 2018, https://www.sos.wa.gov/_assets/elections/initiatives/finaltext_1482.pdf.
- 105 “Initiative Measure No. 1631.”
- 106 “Initiative Measure No. 1631.”
- 107 “Initiative Measure No. 1631.”
- 108 Lori G. Kletzer, “Why the U.S. Needs Wage Insurance,” *Harvard Business Review*, January 25, 2016, <https://hbr.org/2016/01/why-the-u-s-needs-wage-insurance>.
- 109 “Initiative Measure No. 1631.”
- 110 “Initiative Measure No. 1631”; “Building a Cleaner Future Together.”
- 111 “Building a Cleaner Future Together.”
- 112 Cristina Garcia, “AB-617 Nonvehicular Air Pollution: Criteria Air Pollutants and Toxic Air Contaminants,” Chapter 136, Statutes of 2017 (chaptered July 26, 2017), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB617.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 5: Introduction to Scoping Plan Sectors

by Carol Zabin

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I. Introduction

Chapters 6-11 of this report analyze the workforce issues in each of the sectors addressed in the Scoping Plan: energy, transportation, industry, natural and working lands, waste, and water. Each sector is responsible for greenhouse gas emission reduction by 2030 via a suite of climate policies, plans, and programs, which are known collectively as climate measures.

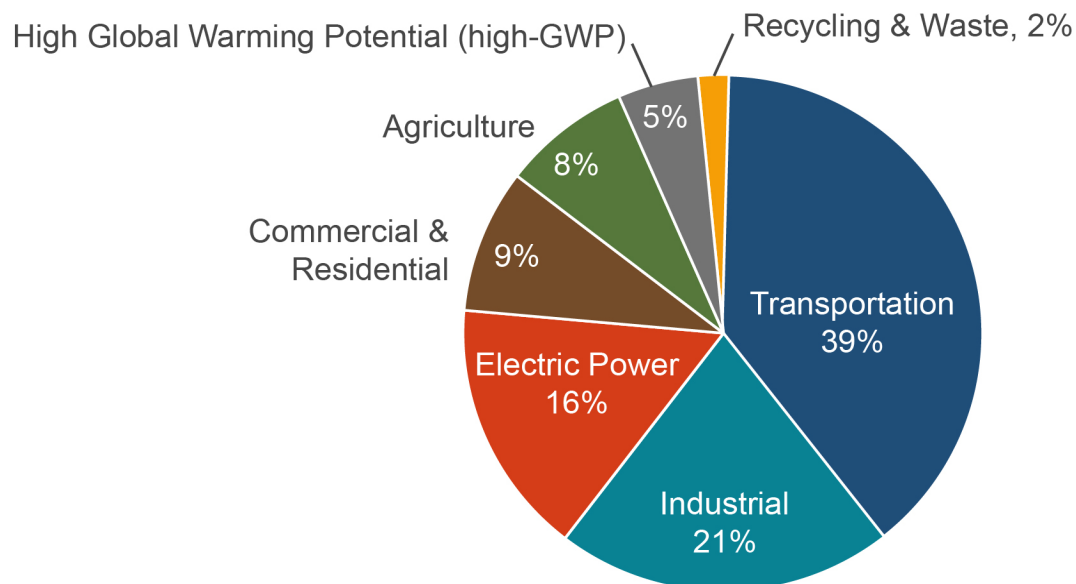
This chapter provides an overview and introduction to Chapters 6-11. First, it presents information on greenhouse gas emissions by sector to show the relative importance of each source of emissions and the corresponding expected emissions reductions from key climate measures in the Scoping Plan. Then it presents summary information on the Scoping Plan sectors, and identifies the key industries and occupations for each of the sectors. This chapter also presents an overview of the Greenhouse Gas Reduction Fund (GGRF), which is the single largest source of public funds dedicated for climate investments and is generated from the auction of emission allowances under the state's Cap-and-Trade Program. This overview is important because the GGRF provides funding for programs in all of the Scoping Plan sectors; more details for each sector are provided in relevant sector chapters. The reader should keep in mind that although the GGRF is a major source of public funding, it is only one source of investment in each sector and generally not the most important driver of emission reductions or employment. This chapter ends by laying out this report's approach to analyzing the workforce impacts of climate policies and programs, and to developing recommendations for each Scoping Plan sector.

II. Greenhouse Gas Emissions from Scoping Plan Sectors

Exhibit 5.1 presents data on current emissions for each main category of emissions in the state's greenhouse gas emissions inventory.¹ The chapters in this report follow the Scoping Plan's organization, which differs slightly from the emissions inventory categories as follows. First, the Scoping Plan and this report include both electric power generation and commercial and residential energy consumption (end use of electricity and natural gas) in the energy sector, while the emissions inventory counts generation and consumption separately. Second, high global warming potential (high-GWP) emissions are addressed in several of the Scoping Plan sectors and chapters of this report, rather than addressed as a separate category as depicted in the chart below. Third, the Scoping Plan and this report discuss the entirety of the natural and working lands sector, whereas only emissions from agriculture are captured in the state's inventory. Finally, the Scoping Plan includes the water sector, which is a major consumer of electricity in the state.



Exhibit 5.1. Current Greenhouse Gas Emissions as of 2017, by Sector

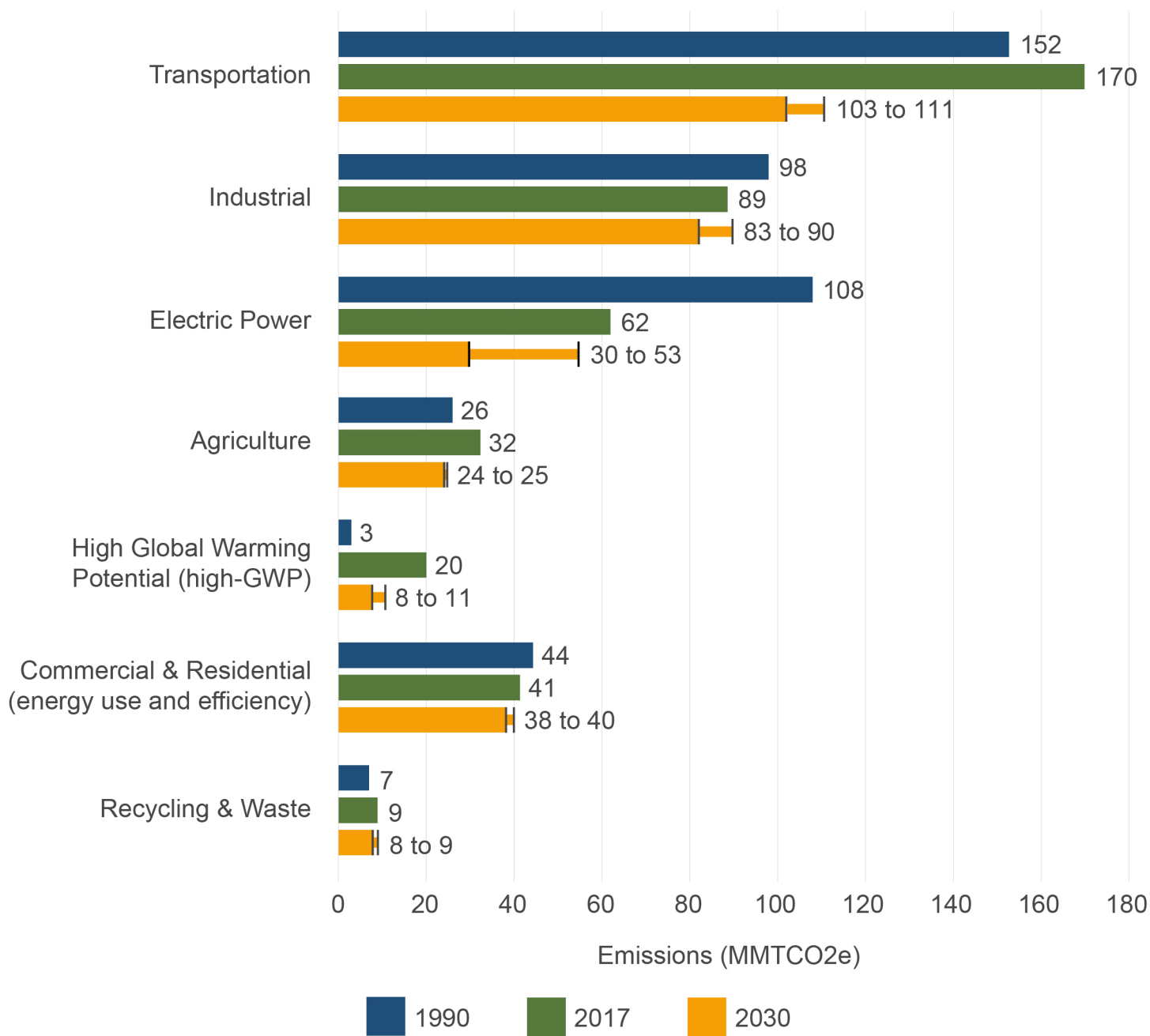


Source: California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019, https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf.

Exhibit 5.2 shows the trends in emissions over time, first for 1990, the reference year for percentage reductions; next for 2017, the most recent year of emission data at the time this report was written; and finally, the estimated range of emissions in 2030 from implementing the measures identified in the Scoping Plan. The Scoping Plan presents a high and low estimate of expected emissions reductions, with the high estimate expressed in the figure by the narrow part of the 2030 emissions bars; for example, the expected emissions in 2030 from transportation range from a high of 111 MMTCO₂e to a low of 103 MMTCO₂e. Missing from this figure are the expected emission reductions from the Cap-and-Trade Program. Since this market-based program covers all large sources of greenhouse gas emissions across all sectors and does not predetermine where emission reductions will occur, its projected impact in each sector cannot be illustrated. All these measures together, including the Cap-and-Trade Program, are expected to reduce emissions to meet the 2030 climate protection standard codified in Senate Bill 32 (Pavley, Chapter 42, Statutes of 2016).²



Exhibit 5.2. Greenhouse Gas Emissions, 1990 and 2017, and Expected Range of Emissions in 2030 after Implementation of Scoping Plan Measures, by Sector



Sources: 1990 levels and 2030 GHG emissions targets: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” page 31, table 3, November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf; 2017 levels from: California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.



III. Climate Change Scoping Plan Sectors

The Climate Change Scoping Plan categorizes economic sectors according to the sources of greenhouse gas emissions and the corresponding climate measures that have been, and could be, developed to reduce those emissions. The following provides a brief description of the Scoping Plan sectors.³

❖ Transportation

This sector covers the greenhouse gas emissions from a wide range of vehicles and equipment used to move people and freight, including on- and off-road mobile sources of pollution (e.g., cars, trucks, locomotives, ships, aircraft, and various cargo-handling equipment). The three primary strategies to reduce greenhouse gas emissions from the transportation sector are: replacing conventional vehicles and equipment with zero- and near-zero-emission options; lowering the carbon intensity of transportation fuels; and reducing the number of vehicle miles traveled. **Transportation currently accounts for 40.1 percent of California's greenhouse gas emissions.**

❖ Industrial

This sector covers the emissions from major emission-intensive production facilities, including oil refineries, cement, food processing, paper products, metals, and others; the sector includes oil and gas production. A key emission reduction measure is the Cap-and-Trade Program, which puts a price on carbon dioxide (CO₂) emissions and allows entities covered by the program to determine the most cost-effective method of reducing emissions. Other strategies include regulations that require or provide incentives for fuel switching, energy efficiency improvements, and modifying industrial processes. The manufacturing of low-carbon products that can substitute for emission-intensive products is also addressed in the industrial sector chapter. Emissions of high global warming potential (high-GWP) gases, like refrigerants, are counted in the industrial sector as well. High-GWP gases are a growing emission source and can be lowered by reducing leakage and by shifting to alternatives with lower global warming potential. **The industrial sector currently accounts for 25.8 percent of California's greenhouse gas emissions.**

❖ Energy

This sector covers the greenhouse gas emissions from the generation of electricity (in-state and imported) and the consumption of electricity and thermal energy in residential and commercial buildings. The primary strategies to reduce greenhouse



gas emissions from the energy sector are: switching from fossil fuels to renewable energy sources, and conserving energy and improving efficiency in residential and commercial buildings (industrial energy efficiency and water efficiency are addressed in the industry and water chapters, respectively). **Energy currently accounts for 24.4 percent of California’s greenhouse gas emissions.**

❖ **Natural and Working Lands [including Agriculture]**

This sector includes emissions from livestock, crop growing and harvesting, and other general fuel use by agriculture. Strategies and initiatives are in place to capture methane from dairies and other animal husbandry, improve crop production techniques and soil health for carbon capture, and reduce emissions from farm operations. This sector also covers California’s forests and other wildlands, as well as urban parks and greenspace; these emissions have not yet been quantified and are not included in the emissions data for this sector. Forest management and fire protection strategies to minimize black carbon emissions and increase carbon capture and sequestration are currently in development, as are incentives to promote healthy soils, rehabilitate wetlands and tidal environments, and promote greater adoption of land conservation practices. **Agriculture currently accounts for 7.6 percent of California’s greenhouse gas emissions.**

❖ **Waste**

This sector covers the emissions from landfills and other waste treatment facilities. Strategies to reduce emissions from the waste sector involve diverting waste from landfills to other types of facilities (recycling, composting, reuse, and remanufacturing); reducing solid waste generation (through packaging reduction and edible food rescue/recovery efforts); and capturing methane emissions from waste facilities to generate energy. **Waste currently accounts for 2.1 percent of California’s greenhouse gas emissions.**

❖ **Water**

This sector covers the emissions from the “water-energy nexus”—power consumed to heat and cool water in residential and commercial buildings and for industrial processes, and power needed for water conveyance, treatment, and distribution. Strategies to reduce emissions from the water sector include: water conservation and efficiency; use of renewable energy in major water operations; and deployment of lower emission technologies for water treatment and groundwater remediation and recharge. **Emissions from the water sector are accounted for within other sectors.**



IV. Industries and Occupations in the Six Scoping Plan Sectors

This report identifies the main industries that correspond to each Scoping Plan sector, based on existing research and expert knowledge regarding the impact of the major climate policies on economic activity. This report does not quantitatively estimate job growth or loss for all climate policies across all industries. When available, this report presents estimates of the job impacts of specific climate policies by specific industry segments, but detailed quantitative job impact studies by policy and industry are not available for most sectors. At the same time, the macroeconomic modeling of the employment impact of all climate policies across industries, which is available in a Scoping Plan appendix, is too aggregated to be useful for workforce planning.

The key industries that will be impacted by climate policy in each Scoping Plan sector can, however, be identified and U.S. Bureau of Labor Statistics (BLS) data can provide information on job characteristics and occupations, which is useful for workforce planning. Often only a segment of an industry is affected by climate policy, although over time the industry undergoes a “greening process” as more and more of the industry changes processes as well as inputs and products in the effort to reduce greenhouse gas emissions. For example, the manufacture of zero-emission cars is part of the auto manufacturing industry, but BLS jobs data have not yet distinguished between internal combustion engine and electric vehicle manufacturing. BLS data can thus provide a broad overview of jobs by industry and occupation, but this information reflects the industry as a whole, not just the segment specifically affected by climate policy. As such, it is inadequate for detailed workforce development planning, which requires very specific industry knowledge and is best carried out in the context of regional, sector-based training partnerships. It does, however, allow us to present in broad brush strokes an overview of key industries and occupations that guides the interventions recommended here.

To identify key industries and occupations, the economic activities that climate policies are meant to influence were identified. Existing research and expert knowledge were used to identify the main North American Industry Classification System (NAICS) industries in which these activities take place, at the most disaggregated level possible. Next, the occupational distributions for these industries were identified, using the Standard Occupational Classification (SOC) System for these NAICS codes, from data for California in the 2017 Bureau of Labor Statistics Occupational Employment Statistics (BLS OES) Research Estimates by State and Industry.⁴ See Appendix A, Mapping Sectors to Industries and Occupations, for a more detailed description of the occupations and the methodology used to identify them. When detailed industry knowledge was available that specified the occupational mix within the segment of the industry impacted by climate policy—at a more detailed level than the occupational mix for the industry as



a whole—this information was captured and used in the sector chapters. This was the case for the energy and water sectors, where previous industry research provided more detailed information.

Exhibit 5.3 is a summary table of the industries and occupations associated with each Scoping Plan sector. The table illustrates two findings that shape the analysis and the recommendations: the predominance of blue-collar work and the importance of the construction industry in the Scoping Plan sectors, particularly the energy and transportation sectors. Blue-collar occupations are defined here as: construction and extraction occupations; production occupations; transportation and material moving occupations; installation, maintenance, and repair occupations; building and grounds cleaning and maintenance occupations; and farming, fishing, and forestry occupations.

Again, it is critical to keep in mind that this table indicates what industries and occupations are affected by climate policy for each sector but does not assess the scale of impact nor indicate the nature of the impact. Therefore it is not possible to determine the impact of climate policies on the quantity of jobs by industry, nor predict growth, decline or change. Instead, these data present an overview of the main individual industries and occupations that will somehow be affected by climate policy for each sector. The sector chapters then delve into the variety of job impacts that may occur, examining changes in skill needs, job quality and job access, the direction (but not the scale) of job gain or loss, and finally, opportunities to improve job quality and job access through interventions.

Construction is the most significant industry in the expansion of both utility scale and distributed renewable energy generation, efficiency retrofits in the built environment, cleaner fuels infrastructure, infill and transit-oriented development, water infrastructure, infrastructure for waste energy capture, and the installation of emissions reductions technologies in refineries and other industrial facilities, and leakage abatement in oil and gas production and distribution. Construction constitutes 54% of the expenditures from the Greenhouse Gas Reduction Fund, due to investments in high-speed rail, other transit capital investments, and transit-oriented infill multi-unit housing.⁵ Other key industries in **Exhibit 5.3**, such as manufacturing, utilities, and forestry services, are also key to reducing greenhouse gas emissions; still, they comprise a limited slice of the California economy. The largest employment sectors of our economy—including healthcare, education, hospitality, and retail—make little appearance in the Scoping Plan, except as the subject of energy efficiency measures (carried out by construction and building operation activities) to lower energy use in the buildings they occupy. They are indirectly affected by changes in electricity and fuel prices but remain relatively untouched otherwise, showing that impacts of climate policy are concentrated in a limited number of industries and jobs.



Exhibit 5.3. Scoping Plan Sector, Subsector, Industry, and Percent Blue-Collar Employment

| Scoping Plan Sector | Subsector | Industry by NAICS | % Blue-Collar Jobs |
|-----------------------|---|--|--------------------|
| Energy | Utility Scale Renewables—Construction | Utility System Construction | 78% |
| | Utility Scale Renewables—Operations | Electric Power Generation, Transmission and Distribution | 38% |
| | Distributed Generation | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |
| | Energy Efficiency | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |
| | Natural Gas Leakage Abatement | Natural Gas Distribution* | 42% |
| Transportation | Cleaner Vehicles | Motor Vehicle Manufacturing | 87% |
| | | Automotive Repair and Maintenance | 78% |
| | Trucking | Truck Transportation | 77% |
| | Public Transit | Transit and Ground Passenger Transportation | 83% |
| | Clean Fuel Infrastructure | Electrical Contractors and Other Wiring Installation | 75% |
| | Transit Infrastructure | Other Heavy and Civil Engineering Construction | 76% |
| | Infill and Transit-Oriented Development | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |



| Scoping Plan Sector | Subsector | Industry by NAICS | % Blue-Collar Jobs |
|----------------------------------|--|---|--------------------|
| Industry | Emissions Intensive Manufacturing | Various* | 58%** |
| | Fossil Fuel Production, Refining, and Distribution | Oil and Gas Extraction | 41% |
| | | Petroleum and Coal Products Manufacturing | 55% |
| | | Pipeline Transportation | 63% |
| | Emissions and Leakage Abatement | Other Specialty Contractors | 79% |
| Electrification | Electrical Contractors and Other Wiring Installation | 75% | |
| Waste | Waste Diversion and Methane Capture | Waste Management and Remediation Services | 76% |
| Water | Water Conservation in Drinking Water, Storm Water, Waste Water, Efficient Water Infrastructure | Water, Sewage and Other Systems | 58% |
| | | Utility System Construction | 78% |
| | | Remediation and Other Waste Management Services | 72% |
| Natural and Working Lands | Forestry Services, Fire Prevention and Suppression | Forestry and Logging | 90% |
| | Lower Carbon Soil Management and Crop Production; Manure Management for Methane Capture | Agriculture, Forestry, Fishing and Hunting | 96% |
| | Wetlands Restoration, Urban Greening, etc. | Various* | N/A |

Notes:

* Detailed occupation profile of this industry is not available.

** Employment-weighted average of proportions of blue-collar workers within the NAICS industries listed as eligible for receiving allowances under the Cap-and-Trade Program Vintage 2018 Allowance Allocation. See California Air Resources Board, "Cap-and-Trade Program: Vintage 2018 Allowance Allocation," December 5, 2017, <https://www.arb.ca.gov/cc/capandtrade/allowanceallocation/v2018allocation.pdf>.

Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Exhibit 5.3 also illustrates the predominance of blue-collar work—defined as occupations in construction, production, transportation, maintenance, repair, and similar occupations—in the industries that are most directly affected by climate policy.⁶ The jobs tied to the production of fossil fuels, which are most at risk over the long run, are also largely blue-collar. In contrast to the Scoping Plan sectors and subsectors in **Exhibit 5.3**, the share of blue-collar occupations in the California economy as a whole is only 23 percent.⁷

The term blue-collar does not mean low-skilled; many blue-collar workers must gain skills to carry out their jobs, and they increasingly perform technical and computer-related tasks.⁸ The predominance of these occupations among the industries affected by climate policy does highlight the importance of workplace-based training and industry partnerships, since many of these workers are not required to have post-secondary education.⁹

The predominance of blue-collar occupations in climate policy implementation also highlights the need for particular attention to job quality. The quality of blue-collar jobs varies tremendously, even within the same industry, depending on the degree of subcontracting and outsourcing, degree and ease of employment law enforcement, unionization rates, and other factors.¹⁰ These differences in job quality within industries and between high- and low-road employers are often difficult to discern from government data, which also is not able to capture wage theft and other employment violations.¹¹

Professional occupations, defined here as engineering, scientific research and development, and other specialized occupations (e.g., lawyers and accountants) that mostly require a college degree, are also critical for the design, planning, and administration of emissions-reducing policies and programs. Jobs requiring a college degree generally pay family-supporting wages and provide workers with a return on their investment in education.¹² These occupations can provide important career mobility paths for workers from disadvantaged communities, but they are much more limited in number than blue-collar jobs and the barriers to entry are greater.

V. Climate Investments from the GGRF

This report also addresses the climate investments from the Greenhouse Gas Reduction Fund (GGRF) within each of the six Scoping Plan sector chapters. The report integrates GGRF-supported climate investments into the sector chapters, because they are intended to augment or compliment the policies and measures which are the main drivers of emissions reduction in each Scoping Plan sector. These investments, known as California Climate Investments (CCI), support a variety of programs and projects to reduce greenhouse gas emissions primarily, while improving public health, environmental quality, and economic opportunities throughout the California economy.¹³



A. Overview of CCI

It is useful to present an overview of California Climate Investments (CCI) here, because they affect all sectors and represent a key component of the state's public investments to fund emissions reduction activities and assist major industries and communities in California. Revenue generated from the auction of emission allowances under California's Cap-and-Trade Program is deposited in the GGRF and available for the CCI. Climate investments must reduce greenhouse gas emissions, although the use and objectives of the GGRF and CCI have been broadened by recent climate legislation. Specifically, Assembly Bill 398 (E. Garcia, Chapter 135, Statutes of 2017),¹⁴ which codified the extension of the Cap-and-Trade Program through 2030, outlined additional priorities for the CCI, which are ranked as follows: reducing toxic and criteria air pollutants; promoting low- and zero-carbon transportation; promoting sustainable agriculture; promoting healthy forests and urban greening; reducing short-lived climate pollutants; promoting climate adaptation and resilience; and supporting climate and clean energy research.¹⁵ Currently, CCI funds are distributed to state agencies that develop programs that are grouped in three priority areas: sustainable communities and clean transportation; clean energy and energy efficiency; and natural resources and waste diversion.¹⁶

To date, the CCI is making contributions to emission reductions goals and providing economic benefits for state residents. As of February 15, 2018, the CCI has been allocated roughly \$6.1 billion, \$2.4 billion of which was generated in FY 2017-2018 alone.¹⁷ CARB estimates that emission reductions of 23.2 MMTCO₂e will be achieved just by the programs already implemented by the end of November, 2017, roughly 6 percent of the state's 2017 carbon emission cap over the lifetime of the projects.¹⁸ These implemented programs constitute \$2 billion in spending, one-third of total funds allocated to date.¹⁹

The CCI has also resulted in benefits to low-income households and communities, as well as Disadvantaged Communities (DACs), which are communities disproportionately burdened by, and vulnerable to, multiple sources of pollution. All of the approximately 8,000 census tracts in California are scored against a set of indicators—grouped into pollution burden and socioeconomic indicators—with the top twenty-five percent of census tracts (i.e., the most disadvantaged) deemed DACs. Senate Bill 535 (de León, Chapter 830, Statutes of 2012)²⁰ first set a minimum requirement for the share of CCI funds that must benefit DACs, which was replaced and expanded to include low-income households and communities by Assembly Bill 1550 (Gomez, Chapter 369, Statutes of 2016).²¹ The new priority populations and investment requirements under AB 1550 are:



- At least 25 percent of funds must be invested in projects located within and benefiting individuals living in Disadvantaged Communities;
- At least an additional 5 percent must be invested in projects located within and benefiting individuals living in low-income communities, or benefiting low-income households anywhere in the state; and
- At least an additional 5 percent must be invested in projects located within and benefiting individuals living in low-income communities, or benefiting low-income households, which are within a half-mile of a DAC.²²

CARB's 2019 annual report on CCI found that GGRF expenditures exceed current statutory minimum funding requirements. In fact, about 57 percent of the \$3.3 billion in implemented investments in CCI projects to date is benefiting the priority populations identified by AB 1550 and SB 535.²³

The GGRF, as a source of substantial public investment, offers critical opportunities to align workforce policy with climate investment. The GGRF funds public agencies that provide direct grants for projects carried out by private businesses or non-profit organizations. Since the GGRF is often the primary, or sole, source of funding, the state has a high degree of leverage to incorporate workforce policies and require compliance by grantees. State law establishes that 60% of the revenue deposited into the GGRF annually is continuously appropriated to High Speed Rail (25%), Affordable Housing & Sustainable Communities (20%), Transit & Intercity Rail Capital (10%), and Low Carbon Transit Operations (5%). All of these programs can (and often have been) designed with robust workforce policies that can ensure family-supporting jobs and pipelines into them for workers from disadvantaged communities, as discussed in the sector chapters.

B. CCI Investments by Scoping Plan Sector

The CCI also affirms the importance of the construction industry in climate investments in California. This is largely due to large investments in high speed rail, and could change if the allocation of expenditures changes. **Exhibit 5.4** categorizes the CCI expenditures by Scoping Plan sector and reports investment levels, job impacts, and the industry in which investment and employment occurs, using data from a 2018 study by the UCLA Luskin School of Public Affairs.²⁴ In keeping with the Luskin study, job creation is reported here from both direct CCI investment and from additional investment due to matching fund requirements or other complementary investment by grantees (whether voluntary or mandated).²⁵



Exhibit 5.4. CCI Expenditures by Scoping Plan Sector

| GGRF program | CCI investment (\$millions) | Total CCI + Co-investment (\$millions) | Jobs per million (direct FTEs) | Direct FTEs from CCI + Co-investment | % construction | % manufacturing | % professional services | other |
|--|-----------------------------|--|--------------------------------|--------------------------------------|----------------|-----------------|-------------------------|-------|
| Transportation Sector | | | | | | | | |
| High Speed Rail | 707 | 6,307 | 4.528 | 28,559 | 72% | 0% | 28% | 0% |
| Transit and Inner City Rail | 208 | 209 | 2.483 | 519 | 73% | 19% | 8% | |
| Low Carbon Transit Operations | 116 | 116 | 8.336 | 967 | 8% | 3% | 0% | 90% |
| Affordable Housing and Sustainable Communities | 411 | 411 | 4.815 | 1,979 | 97% | 0% | 2% | 2% |
| Clean Vehicle Rebates | 204 | 679 | 1.701 | 1,154 | 0% | 26% | 5% | 69% |
| Hybrid and Zero-Emission Truck and Bus Vouchers | 20 | 81 | 0.346 | 28 | 0% | 67% | 33% | 0% |
| Enhanced Fleet Modernization | 12 | 43 | 1.628 | 70 | 0% | 7% | | 93% |
| Car Sharing and Mobility Options | 3 | 10 | 4.200 | 42 | 0% | 11% | 26% | 63% |
| Public Fleet Pilot | 3 | 13 | 2.154 | 28 | 0% | 25% | 3% | 72% |
| Financing Assistance Pilot | 1 | 2 | 14.500 | 29 | 0% | 0% | 95% | 5% |
| Zero-Emission Truck and Bus Pilot | 25 | 46 | 2.913 | 134 | 13% | 17% | 4% | 67% |
| Multi-Source Facility Demonstration | 25 | 47 | 3.255 | 153 | 11% | 24% | 17% | 48% |
| Zero-Emission Drayage Truck Demonstration | 25 | 41 | 0.634 | 26 | 22% | 33% | 19% | 26% |
| Energy Sector | | | | | | | | |
| Single Family/Small Multi-Family Energy Efficiency & Solar Water Heating | 49 | 49 | 10.896 | 534 | 34% | 0% | 0% | 66% |
| Single-Family Solar Photovoltaics | 72 | 72 | 4.583 | 330 | 38% | 10% | 53% | 0% |
| Large Multi-Family Energy Efficiency and Renewables | 24 | 29 | 4.664 | 133 | 54% | 5% | 49% | 0% |



| GGRF program | CCI investment (\$millions) | Total CCI + Co-investment (\$millions) | Jobs per million (direct FTEs) | Direct FTEs from CCI + Co-investment | % construction | % manufacturing | % professional services | other |
|---|-----------------------------|--|--------------------------------|--------------------------------------|----------------|-----------------|-------------------------|-------|
| Water Sector | | | | | | | | |
| State Water Efficiency and Enhancement Program | 56 | 56 | 2.165 | 120 | 57% | 43% | 0% | 0% |
| Water-Energy Grant Program | 47 | 47 | 6.850 | 321 | 15% | 0% | 37% | 43% |
| State Water Project Turbines | 20 | 26 | 2.538 | 66 | N/A | N/A | N/A | N/A |
| Natural and Working Lands Sector | | | | | | | | |
| Dairy Digester Research and Development Program | 11 | 37 | 2.810 | 105 | 55% | 9% | 20% | 15% |
| Urban and Community Forestry Program | 16 | 16 | 9.268 | 146 | 5% | 0% | 50% | 44% |
| Forest Legacy Program | 4 | 19 | 0.036 | 1 | N/A | N/A | N/A | N/A |
| Sacramento-San Joaquin Delta and Coastal Wetlands Restoration | 15 | 15 | 6.377 | 98 | 64% | 0% | 16% | 20% |
| Mountain Meadow Ecosystems Restoration | 6 | 6 | 6.153 | 36 | 24% | 0% | 58% | 17% |
| Forest Health Program | 18 | 18 | 13.434 | 245 | 0% | 0% | 0% | 100% |
| Waste Sector | | | | | | | | |
| The Greenhouse Gas Reduction Loan Program | 9 | 70 | 1.133 | 79 | 33% | 68% | 0% | 0% |
| Recycled Fiber, Plastic, and Glass Grant Program | 5 | 19 | 1.230 | 23 | 20% | 43% | 27% | 14% |
| Organics Grant Program | 15 | 45 | 3.744 | 170 | 86% | 7% | 7% | 1% |

Source: J.R. DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments” (UCLA Luskin Center for Innovation, August 14, 2018), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Employment_Benefits_from_CA_Climate_Investments_and_Co-investments.pdf.



C. Overall Job Impacts of CCI Expenditures

The Luskin study found that the \$2.2 billion of CCI funding between 2013 and 2016 directly supported 9,070 job years in California, with additional direct employment from induced investment of 27,036 job-years, for total direct employment of 36,106 job years.²⁶ By far the largest industry impacted by CCI expenditure was the construction industry, which accounted for 54 percent of the jobs from CCI implementation, as shown in **Exhibit 5.5**. The two next-largest industries were architecture and engineering, with 11 percent, and transit and ground transportation, with 10 percent.

Exhibit 5.5. Top 10 Industries Directly Impacted by GGRF Appropriations

Top 10 Industries Directly Impacted by Appropriations for California Climate Investments From FY 2013-14 Through FY 2015-16

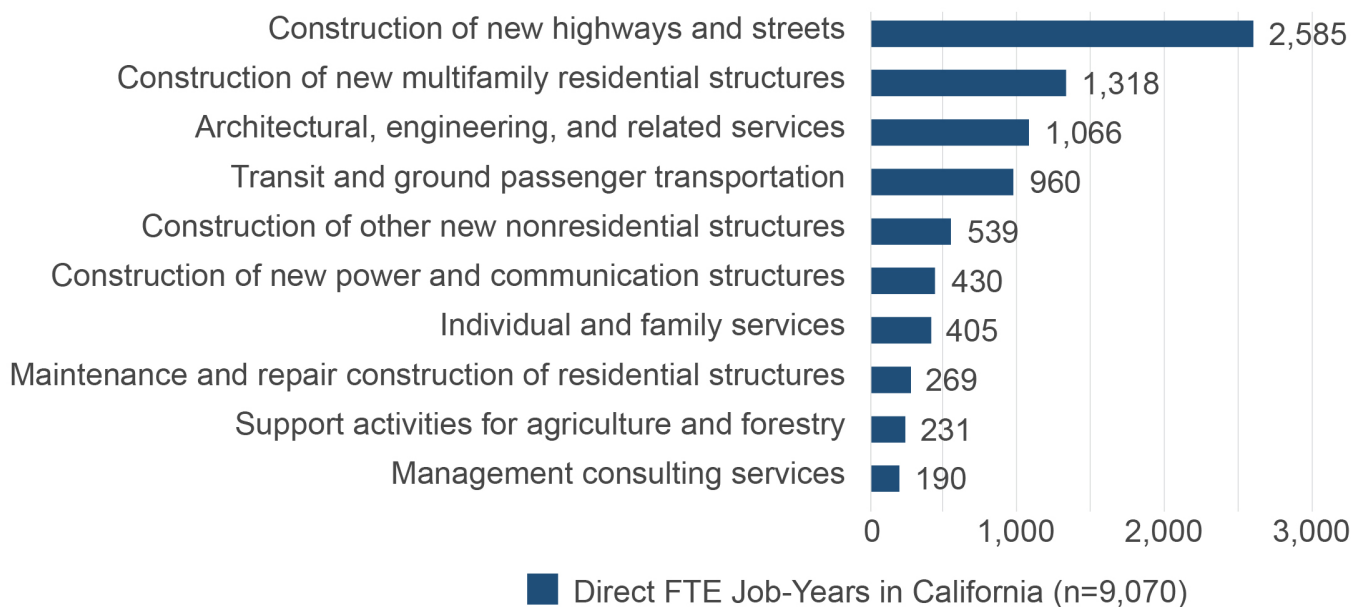
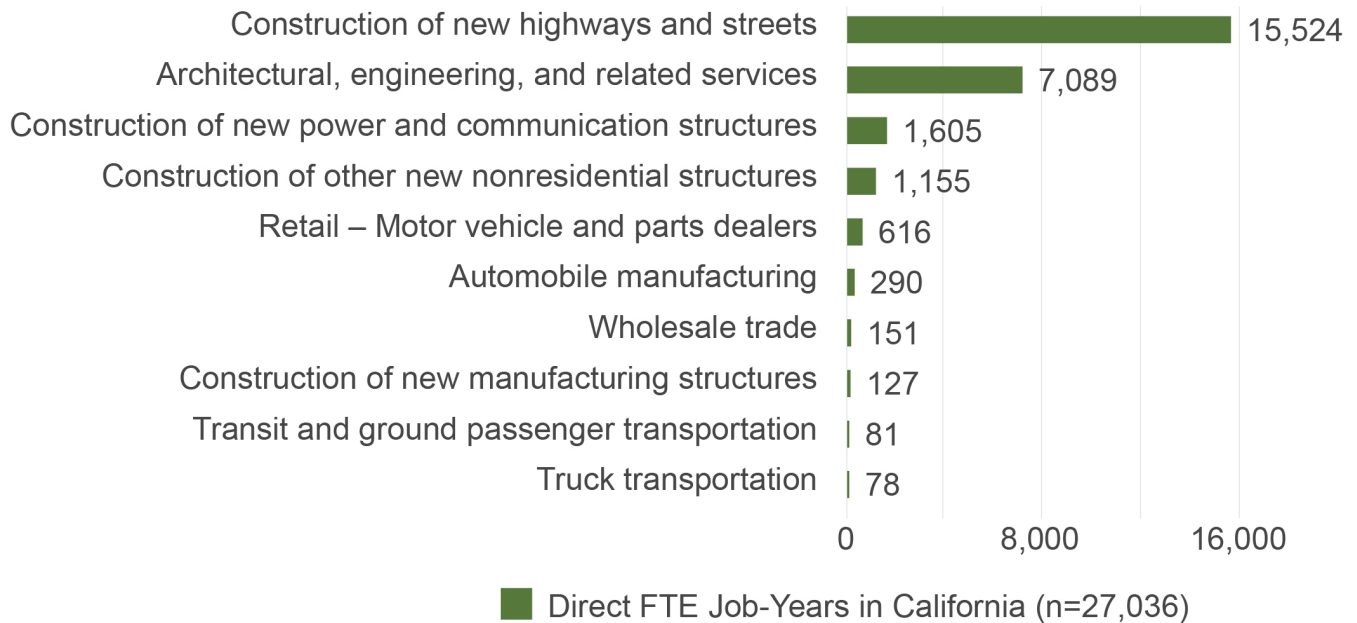


Exhibit 5.5 (continued)

Top 10 Industries Directly Impacted by Induced Co-Investment



Source: J.R. DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments” (UCLA Luskin Center for Innovation, August 14, 2018), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Employment_Benefits_from_CA_Climate_Investments_and_Co-investments.pdf.

Analysis of the workforce issues, including job quality and job access outcomes and recommendations for workforce policy related to this spending, can be found in the individual sector chapters where relevant CCI programs are discussed.



VI. Report Approach to Workforce Analysis

Chapters 6-11 analyze the workforce issues that have emerged or will emerge as a consequence of each major climate policy or measure for each of the six Scoping Plan sectors. Each of these sector chapters also presents workforce development recommendations using the demand-side, supply-side, and just transition tools from Chapters 2-4.

The sector chapters are organized as follows:

- Each sector chapter first presents information about greenhouse gas emissions from the sector and the key policies to reduce those emissions.
- Next, information about the industries and occupations in each sector is presented, using BLS data supplemented by quantitative and qualitative industry research where available. In some cases, the Scoping Plan sector is divided into subsectors, each of which is composed of an industry or group of industries jointly affected by the major climate policies for the sector.
- Next, for each subsector, the chapters present information about the current labor conditions and specific job impacts of the climate policies. The chapters address job growth and loss, job quality, job access, and training infrastructure, using existing research and available information. For job quality, the chapters assess when the jobs generated by the intervention have provided family-sustaining wages and benefits and identify the subsectors where low-road labor conditions exist. For job access, the chapters use available information to assess when the jobs are inclusive of a diverse workforce or have functioning pipelines for workers from underrepresented and disadvantaged groups.
- Finally, for each subsector, the sector chapters present recommendations that align with the recommendations in Chapters 2-4. When there are concerns about low-quality jobs, inadequate training, or lack of inclusion, the sector chapters present recommendations on policies and practices that could be put in place to ensure better workforce outcomes, drawing on the set of workforce interventions and recommendations outlined in Chapters 2-4, as well as sector-specific recommendations when they are relevant. This includes identification of interventions that impact the demand for labor and the type of jobs that are generated, as well as those that impact the supply side of the labor market and help workers prepare for employment changes. The sector chapters also indicate where there is risk of job loss and consequently a need to plan for a just transition.



The sector chapters draw on previous research and analysis that has been done on workforce issues in each sector, in particular, two comprehensive studies mandated by the California Public Utilities Commission (CPUC) to assess workforce needs and make recommendations about workforce policy for the IOU energy efficiency programs (both of which were carried out by the lead author of this report). The first study, the 2011 *California Workforce Education and Training Needs Assessment for Energy Efficiency, Distributed Generation and Demand Response* (Needs Assessment), provided research on labor demand and current training capacity to identify key gaps and opportunities for training investments and other workforce interventions.²⁷ It recommended the introduction of workforce standards, a reorientation of training programs, and specific programs to address inclusion. The second study, the 2014 *Workforce Issues and Energy Efficiency Programs: A Plan for California's Utilities* (Guidance Plan), was designed to transfer the analysis and higher-level recommendations from the Needs Assessment into specific, concrete actions that the IOUs can take to address workforce issues in their energy efficiency programs.²⁸ It included recommendations for specific workforce standards for IOU energy efficiency programs. The Needs Assessment and the Guidance Plan together provide the most in-depth examination of job quality, job access, and skill development emerging from climate policy. Like this report, these two studies use a high-road framework and provide specific recommendations for interventions on both the demand-side and supply-side of the labor market. Since the studies focus on workforce interventions that are applicable to any industry, many of the recommendations are relevant to all scoping plan sectors, not just the low carbon energy sector. This report draws extensively on these two studies when appropriate, and add to the analysis using all other available research on other sectors.

- When relevant, the sector chapters briefly discuss other contemporaneous changes in these sectors that will affect the workforce, beyond the impact of climate policy per se. While technological change and other forces have their own trajectories, climate policy can accelerate labor market disruptions in some cases, as traditionally regulated industries such as utilities face competition from unregulated entities or programs to incentivize investments in low-carbon technologies are accompanied by automation and job loss. These disruptions are sparking interest in some form of state industrial planning, of which workforce issues are an important element.
- Finally, each sector chapter concludes with a snapshot that summarizes the workforce recommendations.



A Note on Sources

For each sector chapter, this report uses the best available evidence on labor market conditions from existing quantitative and qualitative research publications, U.S. Bureau of Labor Statistics employment data, and other state and federal data sources and reports. When concerns about labor conditions have been raised but documentation from academic and government sources is deficient or non-existent, the report also cites investigative reporting from reputable newspapers and journals to augment limited sources. Reliable data on job quality is especially lacking in low wage labor markets, where research has shown that violations of labor and employment law affecting workers' pay are widespread.²⁹ Absent in-depth industry studies and/or surveys of workers, investigative reporting supplies important information that can supplement other sources when necessary.



Endnotes

- 1 California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2016: Trends of Emissions and Other Indicators,” 2018, https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.
- 2 Fran Pavley, “SB-32 California Global Warming Solutions Act of 2006: Emissions Limit.,” Chapter 249, Statutes of 2016 (chaptered September 8, 2016), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32.
- 3 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- 4 U.S. Department of Labor, Bureau of Labor Statistics, “OES Research Estimates by State and Industry,” Occupational Employment Statistics, March 30, 2018, https://www.bls.gov/oes/current/oes_research_estimates.htm.
- 5 J.R. DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments” (UCLA Luskin Center for Innovation, August 14, 2018), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Employment_Benefits_from_CA_Climate_Investments_and_Co-investments.pdf.
- 6 Blue-collar occupations as used here include the following Standard Occupational Classification (SOC) occupations: Blue-collar occupations are defined here as: construction and extraction occupations; production occupations; transportation and material moving occupations; installation, maintenance, and repair occupations; building and grounds cleaning and maintenance occupations; and farming, fishing, and forestry occupations. See Appendix A, Mapping Sectors to Industries and Occupations, for details on occupation categories.
- 7 U.S. Department of Labor, Bureau of Labor Statistics, “May 2017 OES National Industry-Specific Occupational Employment and Wage Estimates,” May 2017, <https://www.bls.gov/oes/2017/may/oessrci.htm>.
- 8 Sarah White and Jason Walsh, “Greener Pathways: Jobs and Workforce Development in the Clean Energy Economy” (Center on Wisconsin Strategies (COWS), The Workforce Alliance, and The Apollo Alliance, March 12, 2008), <https://www.cows.org/greener-pathways-jobs-and-workforce-development-in-the-clean-energy-economy>.
- 9 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Outlook Handbook,” accessed January 2, 2019, <https://www.bls.gov/ooh/home.htm>; Joel Rogers et al., “High Performance Partnerships: Winning Solutions for Employers and Workers” (State of Wisconsin Department of Workforce Development, 1999), <https://www.cows.org/high-performance-partnerships-winning-solutions-for-employers-and-workers>.



- 10 Sara Hinkley, Annette Bernhardt, and Sarah Thomason, “Race to the Bottom: How Low-Road Subcontracting Affects Working Conditions in California’s Property Services Industry” (UC Berkeley Center for Labor Research and Education, March 8, 2016), <http://laborcenter.berkeley.edu/race-to-the-bottom/>.
- 11 Ruth Milkman, Ana Luz Gonzalez, and Victor Narro, “Wage Theft and Workplace Violations in Los Angeles: The Failure of Employment and Labor Law for Low-Wage Workers” (UCLA Institute for Research on Labor and Employment, 2010), <https://escholarship.org/uc/item/5jt7n9gx>; Annette Bernhardt, “Labor Standards and the Reorganization of Work: Gaps in Data and Research,” IRLE Working Paper (UC Berkeley Institute for Research on Labor and Employment, January 2014), <https://escholarship.org/uc/item/3hc6t3d5>.
- 12 David Autor, “The Polarization of Job Opportunities in the U.S. Labor Market” (Center for American Progress and The Hamilton Project, April 2010).
- 13 Jeffrey L. Rabin, Colleen Callahan, and J.R. DeShazo, “Planning California Climate Investments in Disadvantaged Communities: A Guide to Greenhouse Gas Reduction Fund Program Designs, Expenditures, and Benefits” (UCLA Luskin Center for Innovation, August 2015), <http://innovation.luskin.ucla.edu/sites/default/files/Final%20081915.pdf>.
- 14 Eduardo Garcia, “AB-398 California Global Warming Solutions Act of 2006: Market-Based Compliance Mechanisms: Fire Prevention Fees: Sales and Use Tax Manufacturing Exemption,” Chapter 135, Statutes of 2017 (chaptered July 25, 2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398.
- 15 Center for Climate and Energy Solutions, “California Cap and Trade,” accessed November 19, 2018, <https://www.c2es.org/content/california-cap-and-trade/>.
- 16 California Air Resources Board, “California Climate Investments,” accessed November 19, 2018, <https://ww2.arb.ca.gov/our-work/programs/california-climate-investments/about>.
- 17 California Air Resources Board and California Department of Finance, “2018 Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds,” March 2018, https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/2018_cci_annual_report.pdf.
- 18 California Air Resources Board, “Attachment A: First Notice of Public Availability of 15-Day Amendment Text; Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation,” December 21, 2016, <https://www.arb.ca.gov/regact/2016/capandtrade16/attacha.pdf>.



19 California Air Resources Board and California Department of Finance, “2018 Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds.”

20 Kevin de León, “SB-535 California Global Warming Solutions Act of 2006: Greenhouse Gas Reduction Fund,” Chapter 830, Statutes of 2012 (chaptered September 30, 2012), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB535.

21 Jimmy Gomez, “AB-1550 Greenhouse Gases: Investment Plan: Disadvantaged Communities,” Chapter 369, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB1550.

22 California Environmental Protection Agency, “California Climate Investments to Benefit Disadvantaged Communities,” accessed November 19, 2018, <https://calepa.ca.gov/EnvJustice/GHGInvest/>.

23 California Air Resources Board, “Report: Cap-and-Trade Spending Doubles to \$1.4 Billion in 2018,” Press Release, March 25, 2019, <https://ww2.arb.ca.gov/news/report-cap-and-trade-spending-doubles-14-billion-2018>.

24 DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments.”

25 Since the workforce interventions addressed in this report are generally only feasible for the direct jobs that are influenced by climate policy, the indirect and induced jobs created by the GGRF expenditures are not discussed.

26 DeShazo et al.

27 Carol Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response” (UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011), <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.

28 Carol Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014), <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>.

29 Milkman, Gonzalez, and Narro, “Wage Theft and Workplace Violations in Los Angeles: The Failure of Employment and Labor Law for Low-Wage Workers”; Bernhardt, “Labor Standards and the Reorganization of Work: Gaps in Data and Research.”



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 6: Energy Sector

by Carol Zabin

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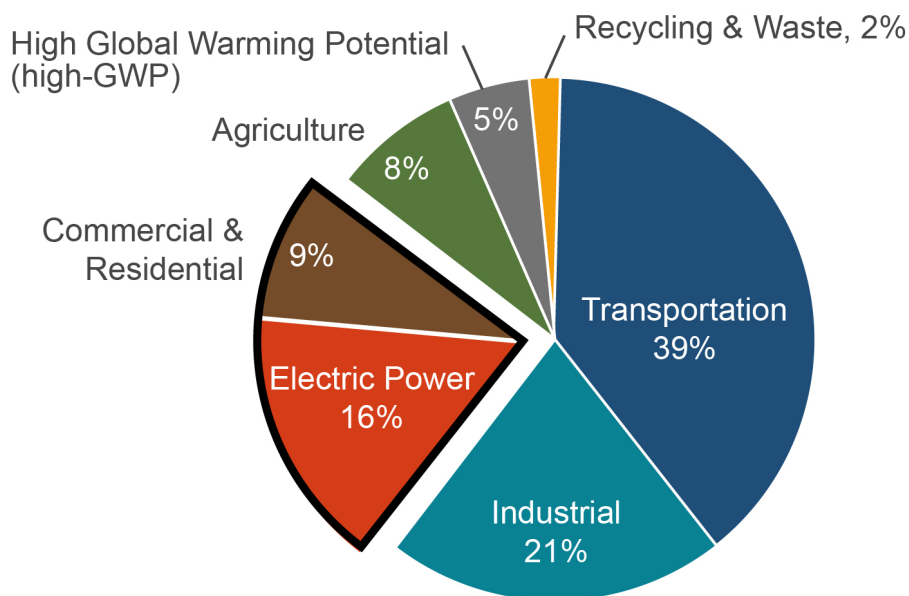


I. Overview of Sector and Key Climate Policies

The energy sector, as defined in the Scoping Plan, comprises the generation, transmission, and distribution of electricity generated from utility-scale power plants; the distribution of natural gas to end users; the generation of electricity on site by consumers (known as distributed generation); and the end-use consumption of electricity and natural gas in buildings, homes, factories, farms, and other businesses. These key points all offer intervention opportunities for California to produce cleaner electricity and consume less electricity and natural gas overall.

This sector accounts for a major portion of greenhouse gas (GHG) emissions and, therefore, is a main target for climate policy. Since 1990, the great majority of reductions in greenhouse gas emissions have come from the electricity sector.¹ **Exhibit 6.1** shows the share of GHG emissions from the energy sector. The figure follows CARB’s definition of the sector in the Scoping Plan by including not just the production of electricity but also the consumption of electricity and natural gas in end uses in commercial and residential buildings. CARB includes energy consumption as well as production, because demand management strategies—including energy conservation and efficiency—are critical strategies needed to reduce GHG emissions from the energy sector.

Exhibit 6.1. Energy Sector Emissions (MMTCO₂E) as of 2017

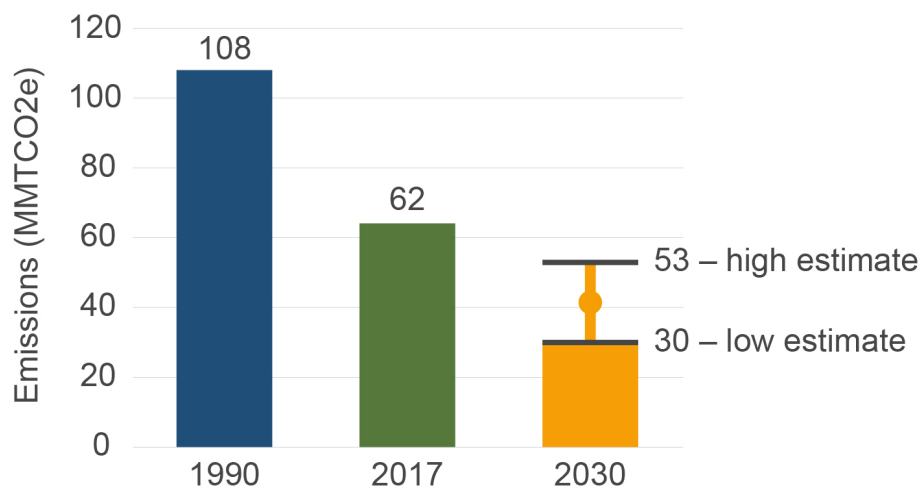


Source: California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019, https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf.



Exhibits 6.2 and 6.3 show trends in emissions from electric power and from commercial and residential end uses over time: first for 1990, the reference year for the percentage reductions; for 2017, the most recent year for which there is emissions data; and finally, the estimated range of emissions in 2030 from implementing the measures identified in the Scoping Plan. Missing from this figure are the expected emission reductions from the Cap-and-Trade Program. Since this market-based program covers all large sources of greenhouse gas emissions across sectors and does not predetermine where emission reductions will occur, its projected impact in each sector cannot be illustrated. This chapter follows the Scoping Plan categorization and includes the commercial and residential building sector, while saving the specific discussion of energy efficiency for the industrial, water, and agriculture sectors, in their respective chapters.

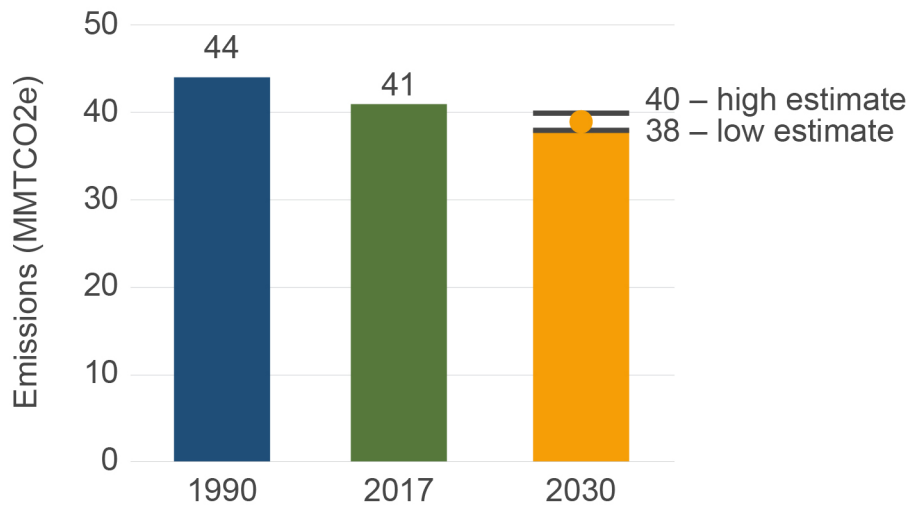
Exhibit 6.2. Electric Power Sector Greenhouse Gas Emissions, 1990 and 2017, and Expected Range of Emissions in 2030 after Implementation of Scoping Plan Measures



Sources: 1990 levels and 2030 GHG emissions targets: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” page 31, table 3, November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf; 2017 levels from: California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.



Exhibit 6.3. Commercial and Residential Sector Emissions Energy End Use 1990 and 2017, and Expected Range of Emissions in 2030 after Implementation of Scoping Plan Measures



Sources: 1990 levels and 2030 GHG emissions targets: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” page 31, table 3, November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf 2017 levels from: California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.

The electricity sector is undergoing tremendous change due to the transformation from a centralized grid, with power supplied in one direction from utilities to customers, to a multi-directional and decentralized electricity system that includes distributed energy resources that are both consumed on site and sent back to the grid. This grid decentralization and the expanding role of distributed energy resources, along with grid regionalization and new entities in the retail electricity business, such as community choice aggregators (CCAs), are resulting in changes to the utility business model and new challenges for regulation. These changes are intertwined with climate policy but not solely caused by it, and they should be kept in mind in this analysis of the workforce impacts of climate policies in this sector.



The following are key climate policies affecting the energy sector:

❖ **Renewable and Low-Carbon Energy**

➤ **SB 100 (Senate Bill 100, de León, Chapter 312, Statutes of 2018)²**

Requires utilities and other retailers of electricity to procure 60 percent of their load from renewable sources by 2030, and sets a goal of 100 percent of their load from zero-carbon by 2045. SB 100 is the culmination of a series of Renewables Portfolio Standard (RPS) policies that since 2002, have mandated progressively greater procurement of renewable energy.

➤ **Distributed Generation and Storage**

Ratepayer- and publicly-funded subsidies and electricity-pricing policies—including net energy metering, feed-in tariffs, and other policies to encourage more local, smaller-scale and/or self-generated “behind the meter” distributed power generation that is sited on utility customers’ homes and businesses.

➤ **The Multifamily Affordable Housing Solar Roofs Program (Assembly Bill 693, Eggman, Chapter 582, Statutes of 2015)³**

Provides up to \$100 million annually for financial incentives for the installation of rooftop solar photovoltaic (PV) systems (“solar roofs”) on qualified low-income multifamily buildings, starting in 2017, with the goal of at least 300 megawatts (MW) to be installed by 2030.

➤ **Energy Storage (Assembly Bill 2868, Gatto, Chapter 681, Statutes of 2016)⁴**

Led to a California Public Utilities Commission (CPUC) mandate for investor-owned utilities (IOUs) to procure 1,300 MW of energy storage by 2020 to accelerate widespread deployment of distributed energy storage systems.

➤ **Waste Heat and Carbon Emissions Reduction Act (Assembly Bill 1613, Blakeslee, Chapter 713, Statutes of 2007)⁵**

Encourages the installation and use of clean, efficient, small-scale combined heat and power (CHP) systems by creating a market for any excess electricity generation through a feed-in tariff program. The law applies to highly efficient CHP systems with 20 MW or less of generating capacity installed on or after January 1, 2008.



➤ **Conditions for Solar Energy System Incentives (Senate Bill 1, Murray, Chapter 132, Statutes of 2006)⁶**

Provided up to \$3.3 billion in financial incentives for the installation of residential, commercial, and institutional rooftop solar photovoltaic (PV) systems, with a goal of 3,000 MW of solar capacity and solar PV systems on 50 percent of new homes by 2020. The law includes three programs, the first two of which have been completed: 1) the California Solar Initiative, implemented by the CPUC for solar PV system installation on existing residential and existing or new commercial, agricultural, government, and nonprofit buildings (ended in 2016);⁷ 2) the New Solar Homes Partnership, administered by the California Energy Commission (CEC) for installation of solar systems on new residential buildings (ended in 2015);⁸ and 3) the publicly-owned utility (POU) component of the program, requiring the POUs to offer their customers financial incentives for solar PV system installation.⁹

➤ **Solar Water Heating and Efficiency (Assembly Bill 1470, Huffman, Chapter 536, Statutes of 2007)¹⁰**

Led to the implementation of the California Solar Initiative-Thermal Program (CSI-Thermal) to develop a market for solar water heating and other solar thermal technologies in California via financial incentives, standards, marketing, and outreach. The goal of the program was to install the equivalent of 200,000 residential solar water heating systems by 2018 within the IOU service areas.

❖ **Energy Efficiency**

➤ **IOU Energy Efficiency Programs**

IOU ratepayer-funded investments to promote private expenditures for energy efficiency measures and retrofits, which were begun in the 1970s. Senate Bill 350 (de León, Chapter 547, Statutes of 2015),¹¹ among other mandates, also required the CEC to establish targets statewide for energy efficiency savings and electricity demand reduction to achieve doubling of energy efficiency by 2030.

➤ **Comprehensive Energy Efficiency Program for Existing Buildings (Assembly Bill 758, Skinner, Chapter 470, Statutes of 2009)¹²**

Requires the CEC to develop a comprehensive program to achieve greater energy efficiency in existing buildings, especially those structures that fall significantly below current California Building Energy Efficiency Standards.



➤ **IOU and California Department of Community Services and Development (CSD) Low-Income Programs**

IOU ratepayer-funded and federally or state-funded programs that pay for weatherization of qualified low-income residences.

➤ **Prop. 39 School Retrofit Programs**

State-funded grant program of up to \$550 million annually to K-12 schools and community colleges for energy efficiency retrofits and distributed solar PV installation.

➤ **Title 20 and Title 24 Codes**

Appliance and building standards to decrease energy use and increase energy efficiency in homes and businesses. Codes and standards are regularly updated when it is deemed that sufficient market penetration has occurred to incorporate measures first promoted in incentive programs and convert the voluntary measures into mandates for all construction. Examples include more efficient lighting, HVAC equipment and building envelope materials such as insulation and windows.

➤ **Benchmarking and Other Data Transparency Initiatives**

Measures that encourage market expansion of energy efficiency by providing more certainty to investors and energy services companies (ESCOs).

❖ **Natural Gas**

➤ **Leakage Abatement (Senate Bill 1371, Leno, Chapter 525, Statutes of 2014)¹³**

Required the CPUC to develop regulations to abate leakage in natural gas pipeline facilities.

➤ **Building Electrification and De-Carbonization**

Emerging efforts that have not yet been implemented to replace gas-powered appliances and equipment with electric-powered substitutes for heating, cooling and cooking in buildings. While this transition will increase demand for electricity, it is expected to reduce GHG emissions from buildings as a result of California's RPS that mandates the shift from fossil to renewable fuels to generate electricity.



➤ **Renewable Natural Gas (RNG)**

Emerging efforts to support the development and eventual distribution of renewable natural gas (RNG) as a substitute for fossil natural gas for end-uses in buildings. Senate Bill 1440 (Hueso, Chapter 739, Statutes of 2018)¹⁴ authorizes the CPUC to adopt a biomethane procurement program, and Assembly Bill 3187 (Grayson, Chapter 598, Statutes of 2018)¹⁵ authorizes a CPUC proceeding to consider funding for RNG interconnection infrastructure, which has been a cost barrier for RNG.¹⁶

The electrification of the transportation sector (including on-road vehicles and off-road equipment), which reduces total GHG emissions while adding load to the grid, will be addressed in detail in the chapter on the transportation Scoping Plan sector. Clean energy (i.e., energy conservation, energy efficiency, and renewable energy measures) within industry, water, and agriculture will be addressed in their respective Scoping Plan sector chapters.

II. Industries and Occupations Affected

Two main industries are directly implicated in the low-carbon transition of the electricity sector: the construction industry and the utility industry. The construction industry is responsible for the building of renewable energy-generating facilities (utility-scale power plants and distributed generation such as rooftop solar PV), and for the installation of energy efficiency measures and energy retrofit of residential and commercial buildings. Firms constructing renewable energy-generating units range from large developers and construction firms building utility-scale power plants to residential construction companies installing rooftop solar. Construction firms, large and small, are also the principal businesses carrying out energy efficiency retrofits, although large retrofits are often directed by energy services companies (ESCOs). ESCOs operate mostly on larger projects and on municipal/state government buildings, universities, schools, and hospitals (known as the MUSH sector). They provide financing as well as installation to building owners and usually contract out installation to construction firms.

The occupations in renewable energy generation and energy efficiency span the construction occupations, including professional jobs for architects and engineers, blue-collar skilled trades jobs, and an assortment of white-collar jobs in administration, sales, and marketing. For the construction of utility-scale renewables, Jones et al. (2016) estimated that 78 percent of the work was performed by blue-collar skilled trades work, including primarily electricians, laborers, operating engineers, carpenters, ironworkers, pipefitters, and boilermakers.¹⁷ For large-scale solar installations specifically, the majority of the work is performed by the electrical trades and the rest by ironworkers, carpenters,



operating engineers, and laborers.¹⁸ Distributed generation involves relatively more white-collar jobs (e.g., in sales) than blue-collar trades jobs due to the smaller scale of the projects; the majority of workers however are still in construction occupations, including solar installers, electricians, and general construction workers.¹⁹

In energy efficiency, Zabin and Chapple (2011) estimated that about two-thirds of workers are in blue-collar trades occupations, divided between the electrical and mechanical trades, who work on building lighting and HVAC systems respectively, and carpenters and those in related trades, who work on the building envelope. Workers in the building services sector—like stationary engineers, facilities managers, and custodial staff—also have an impact on energy efficiency, and changes in their work processes can lead to energy savings in building, as well.

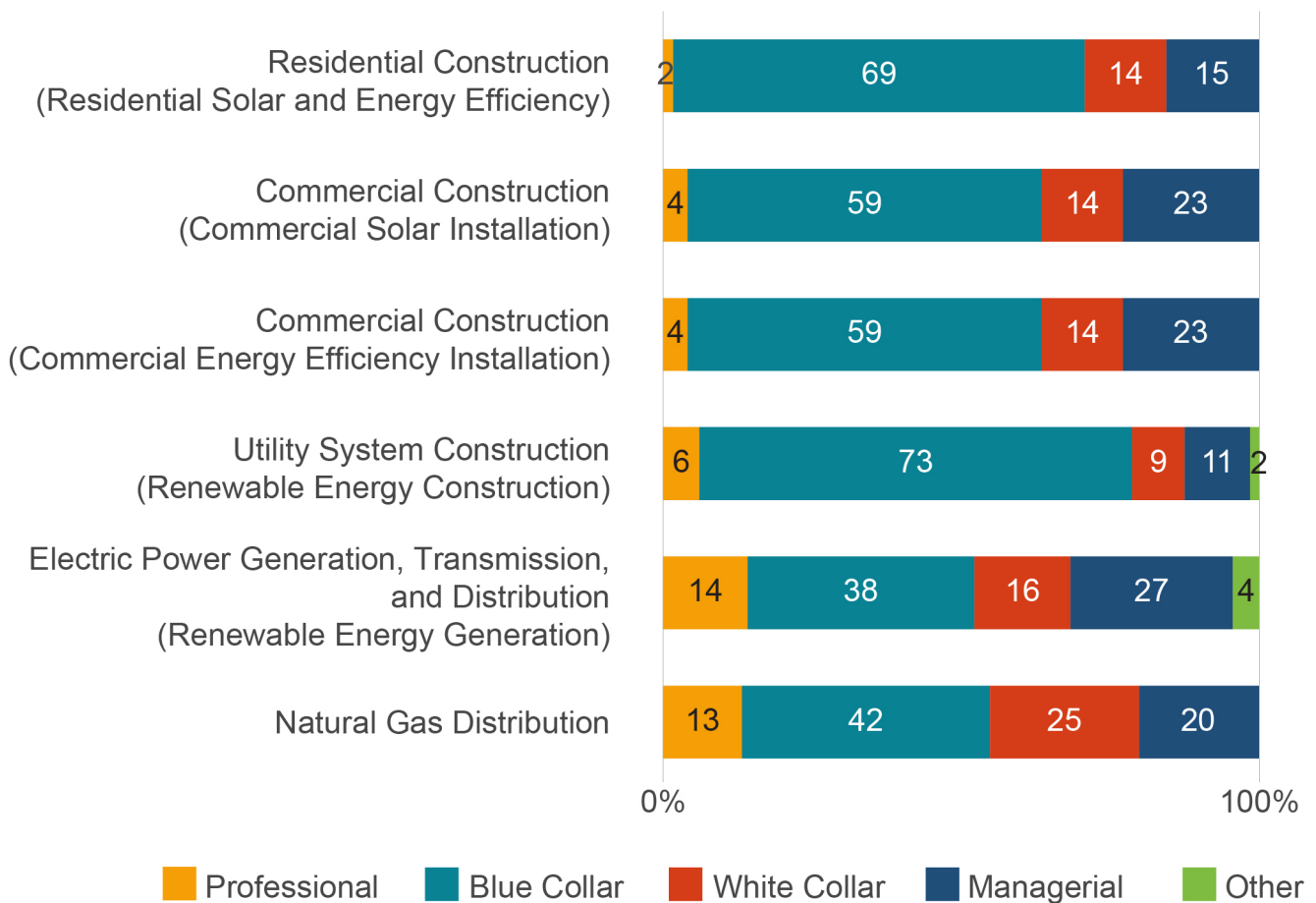
The utility industry is responsible for the operation of power plants, the transmission and distribution of electricity via the grid, the distribution of natural gas, and the sale of electricity and natural gas to consumers. Until very recently, the three large investor-owned utilities (PG&E, Southern California Edison, and Sempra which is the parent company of San Diego Gas & Electric and SoCalGas) provided three-quarters of the state's power, with the rest supplied by publicly-owned utilities (POUs), such as the Los Angeles Department of Water and Power (LADWP), Sacramento Municipal Utility District (SMUD), and several smaller local utilities supplying power in their jurisdiction. In the last several years, community choice aggregators (CCAs, local government agencies that can directly develop and/or buy electricity on behalf of their customers) have grown rapidly, with eight in operation in 2017 and seven expected to launch in 2018.²⁰ The rise of CCAs and various forms of distributed generation are rapidly changing the utility industry from one of large, unionized employers to many smaller entities with labor practices still in development.

All segments of low-carbon energy purchase component parts, but very little specific data on the manufacture of parts for clean energy is available. Due to resource constraints, it is beyond the scope of this publication to address jobs in the manufacturing supply chain for low-carbon energy. Future research should address opportunities to promote high-quality manufacturing jobs in California from emerging technologies. For example, Collier (2017) provides suggestions about how the state can promote good jobs in the manufacture of component parts for off-shore wind, and see Chapter 8 for a discussion of low-carbon manufacturing.²¹

Exhibit 6.4 shows the dominance of blue-collar occupations in the low-carbon energy sector.²² The figure shows broad occupational distribution of the industries within which the clean subsectors fit. This report used existing industry studies and expert opinion to place low-carbon activities into the appropriate industry categories as used in the North American Industry Classification System (NAICS). This allowed us to identify the occupations within each industry using the Bureau of Labor Statistics data. Building services occupations, like stationary engineers and custodians or janitors are spread out in many industries, and are therefore not included in the exhibit.



Exhibit 6.4. Occupations by Industry for Low-Carbon Energy Subsectors



Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]

The following analysis uses industry studies to identify the particular occupations engaged in the low-carbon energy measures within each industry at a disaggregated level. For example, for construction of utility-scale solar energy facilities in California, there is a “five trade agreement” in most projects that divides up the blue-collar work between the electrical trades, who have the majority of the work, and the carpenters, laborers, ironworkers and operating engineers who share the rest.²³ Where this disaggregated industry and occupation information is not available, this analysis uses data from the U.S. Bureau of Labor Statistics (BLS) for a more general overview. **Exhibit 6.4** presents the top occupations for each key industry from BLS data at a level of aggregation that includes both lower- and higher-carbon activities in the specific industry discussed. This methodology is explained in more detail in Chapter 5.



III. Workforce Issues in Key Subsectors and Policies

The following sections address the workforce issues stemming from major climate policies in the various subsectors of the energy sector. The chapter first examines available evidence on labor conditions in each subsector and the workforce outcomes from the main climate policies thus far. Then the chapter identifies where and how workforce policy can be aligned with these climate policies. It then identifies complementary demand-side workforce policy levers, described in Chapter 2, that the agencies responsible for implementing the climate policies can use to augment those policies in order to create good jobs and support the demand for skilled labor. This chapter also highlights opportunities to develop, utilize, and leverage the state's workforce development, training, and education infrastructure to prepare workers for the labor market changes that will occur due to the climate policies in this sector, using the recommendations described in Chapter 3.

A. Electricity Generation—Utility Scale

The Renewables Portfolio Standard (RPS) is the main policy driving procurement of utility-scale renewables and their incorporation into the electricity grid. The Cap-and-Trade Program, explained in detail in Chapter 8 also incentivizes the utilities to procure energy from lower-carbon sources. The state has also implemented policies and public investments that promote the adoption of specific emerging renewable energy technologies.

As a policy mandate, the RPS requires utilities and other retail sellers of electricity to procure a specific percentage of their electricity from renewable sources, inducing the replacement of fossil-fuel-based electricity generation with renewable electricity generation in the state's electricity grid. It is a key driver of the dramatic greenhouse gas emission reductions from electricity between 1990 and 2016. Senate Bill 1078 (Sher, Chapter 516, Statutes of 2002)²⁴ established the initial RPS in California in 2002, and Senate Bills 107 (Simitian, Chapter 464, Statutes of 2006)²⁵ and X1-2 (Simitian, Chapter 1, Statutes of 2011)²⁶ accelerated and increased the target. In 2015, SB 350 established the target of 50-percent renewables by 2030, and the state is on track to meet this goal early. The 2017 Scoping Plan is based on the 50-percent RPS in place when the plan was written and identifies the need for only a modest reduction in emissions from electricity compared to earlier Scoping Plans (16 million metric tons CO₂e from 2020-2030). However, now that the state's commitment to clean electricity has once again accelerated due to the passage of SB 100, the electricity sector's importance in meeting the 2030 greenhouse gas emission reductions will likewise expand. The RPS



mandate has created a demand for the construction of new renewable energy-generating facilities along with new transmission infrastructure to integrate these resources into the grid. The state is putting into place a variety of policies, regulatory decisions, and ratepayer and public investments that can help promote the adoption of specific emerging renewable energy resources. As discussed below, these essential supports for emerging technologies could incorporate workforce analysis to help identify priority occupations and skill-upgrade needs and provide a currently missing link to help align climate and workforce policy.

1. Workforce Outcomes

The RPS is California’s most successful climate policy in terms of workforce outcomes and emissions reductions to date. The RPS has spurred the construction of renewable energy plants in California that over the past 10 to 15 years have been built almost exclusively under Project Labor Agreements (PLAs), which have become industry standard even though they are not mandated in policy.²⁷ The use of PLAs has ensured prevailing wages, full health and pension benefits, and payment into and use of the state-certified apprenticeship system. Since industry has already adopted high-road practices, the RPS does not require specific additional workforce policies to ensure job quality at this time. In fact, current practice provides a model for achieving positive outcomes for the workforce throughout the electricity sector.

The investments in renewable energy generation driven by the RPS produce jobs in the construction sector, including professional jobs such as architects and engineers, blue-collar trades jobs, and an assortment of white-collar jobs. These investments also have the potential to affect jobs in the utility industry, as changes in the grid and in the utility business model are shifting the location and content of jobs, altering the profile of employers, and having other impacts. Finally, for some technologies where most of the jobs are in manufacturing rather than installation—such as some battery storage and wind technologies—jobs in manufacturing occupations will be generated, although there is no guarantee that they will be located in California.

a. Job Growth

A number of studies have estimated the job impact of the RPS and/or forecast job impacts of the 50-percent RPS target for 2030.²⁸ As shown in **Exhibit 6.5** (Jones et al., 2016), about 11,000 MW of new in-state renewable generation was built between 2002 and 2015, and California’s RPS is estimated to have generated 32,700 job-years (or an average of about 2,500 jobs per year) in the construction industry for the installation of utility-scale renewable energy. About 78 percent of the construction jobs were blue-collar jobs. Since that study was completed, growth in renewable capacity has accelerated. As of November 1, 2017, the CEC reports a total installed capacity of 17,210 MW.²⁹



Assuming that about 30,000 more MW are needed to get to a 50 percent renewable energy target (SB 100 mandates this interim 50 percent target by December 2026), and using the same mix of renewables and the same average direct jobs per megawatt in **Exhibit 6.5** (approximately 2.9 direct construction jobs per megawatt), another 87,000 job-years could be generated between 2018 and 2026, or an average of 10,875 jobs per year in the construction sector. While these figures are significant, it is important to remember that there were 840,000 construction jobs in California in 2017, so jobs in renewable energy construction are a small portion of the state's construction employment.

Exhibit 6.5. Renewable Energy MW Installed and Construction Jobs Generated, California, 2002-2015

| Type of Renewable Energy | New In-State MW Capacity Built | Total Construction Job-Years | Blue-Collar Construction Job-Years | White-Collar Job-Years per MW | Blue-Collar Job-Years per MW |
|-----------------------------|--------------------------------|------------------------------|------------------------------------|-------------------------------|------------------------------|
| Photovoltaic (PV) | 5,575 | 21,724 | 16,945 | 0.9 | 3.0 |
| Large Commercial (0.25–1MW) | 15 | 88 | 69 | 1.3 | 4.5 |
| Community Scale (1–5 MW) | 618 | 2,405 | 1,876 | 0.9 | 3.0 |
| Utility (>5MW) | 4,942 | 19,231 | 15,000 | 0.9 | 3.0 |
| Concentrated Solar Power | 897 | 6,014 | 4,691 | 1.5 | 5.2 |
| Land-Based Wind Power | 4,226 | 2,754 | 2,148 | 0.1 | 0.5 |
| Geothermal | 105 | 457 | 357 | 1.0 | 3.4 |
| Small Hydro | 48 | 341 | 266 | 1.6 | 5.5 |
| Biomass (+Biogas) | 381 | 1,346 | 1,050 | 0.8 | 2.8 |
| Battery Storage | 2 | NA | NA | NA | NA |
| Total Renewable* | 11,234 | 32,636 | 25,456 | 0.6 | 2.3 |

*May not sum or multiply due to rounding.

Source: Betony Jones, Peter Philips, and Carol Zabin, "The Link Between Good Jobs and a Low Carbon Future" (UC Berkeley Donald Vial Center on Employment in the Green Economy, July 2016), <http://laborcenter.berkeley.edu/the-link-between-good-jobs-and-a-low-carbon-future/>.



b. Job Quality

Job quality in the construction of utility-scale renewables is high, comprising middle-class careers built on skills acquired in the state-certified apprenticeship system. Job quality has been ensured because most utility-scale renewable energy construction projects in California have been governed by collectively bargained project labor agreements (PLAs).³⁰ PLAs are collective bargaining agreements between developers and multiple building trades unions that exchange labor peace for union-scale wages, benefits, apprentice utilization rates, and other terms and conditions of work (see Chapter 2 for a more detailed explanation of PLAs). Under these PLAs, workers have received a compensation package that includes prevailing wage rates, full benefits (pension and family health care), and ongoing funding for the apprenticeship training programs. Wages for journey-level workers averaged about \$37.00 per hour in 2015.³¹ The jobs generated between 2002 and 2015 also contributed nearly \$340 million into blue-collar construction workers' pension funds and almost \$400 million towards health insurance coverage for these workers and their families, both of which are managed jointly by the unions and their employers in Taft-Hartley trust funds. The contributions average \$10,650 for pensions and \$12,500 in health coverage for each worker annually. As a direct consequence of this job creation in the construction of utility-scale renewable energy, the study estimated that \$46.6 million in private-sector industry funds have been invested in apprentice training.³²

Workplace health and safety has recently been examined in utility-scale solar installations, and hazards include exposure to *Coccidioides* fungal spores during installations, as well as exposure to extreme heat and heat transfer liquid leaks.³³

c. Job Access

There is also evidence that significant job opportunities for workers from disadvantaged communities have been created by the RPS. As reported in Luke et al. (2017), considerable ethnic and racial diversity—with improvement over time—is seen in enrollments in the apprenticeship programs of the 16 unions in three skilled trades (electricians, ironworkers, and operating engineers) that have built most of the renewable energy power plants in California.³⁴ The share of people of color (all non-white categories) entering an apprenticeship in these three trades reached 60 percent in 2017, compared to the 56-percent share of people of color in the state's workforce as a whole. Data on electrical workers (the occupation that carries about 60 percent of the work hours) employed on the construction of 27 solar farms in Kern County shows that 43 percent of new entry-level workers were residents of Disadvantaged Communities (DACs, as defined by CalEnviroScreen 3.0). Hiring of workers residing in DACs has been aided by the introduction of a pre-apprenticeship job classification for utility-scale solar installers in the electrical union. In some parts of the state, local hire agreements have been included within the PLAs (converting the PLAs into a Community Workforce Agreement, known as CWAs; see Chapter 2 for an explanation of PLAs and CWAs.)



PROMISING PRACTICE #6.1

Renewables Portfolio Standard

The Renewables Portfolio Standard (RPS) is a powerful example of a state mandate that has been extremely successful in both reducing emissions and creating high-quality career pathways for a diverse pool of applicants. Due to the almost universal use of project labor agreements (PLAs) on utility-scale renewable energy development, construction of renewable energy power plants is performed by highly-trained construction workers, ensuring quality and efficiency in project delivery. In addition, each project built under a PLA contributes funds to apprenticeship programs throughout the county in which it is built and these funds are used to develop additional training opportunities.

Using funds provided through the joint employer/union apprenticeship training partnership in San Diego and Imperial Counties, the National Electrical Contractors Association (NECA) and the International Brotherhood of Electrical Workers (IBEW) Local 569 opened an apprenticeship training facility in 2009 in Imperial County, at a time when the county had lost 60 percent of its construction jobs at the bottom of the Great Recession.³⁵ In Imperial County, the project labor agreements also included local hiring requirements, enabling skilled craftspeople living near the project site to be prioritized in the hiring process. As the utility-scale renewable project pipeline grew in the county as a result of the RPS, jobs were created for a local pool of entry-level workers who were subsequently trained at the IBEW/NECA Imperial Electrical Training Center.

In a 2013 analysis of the impacts of local hiring agreements in Imperial County for IBEW 569 members, the union found that the first four

projects in the renewable development pipeline in Imperial County created a total of 945 jobs, of which 73 percent (693 jobs) were filled by residents of Imperial County.³⁶ The poverty rate in Imperial County is 24.6 percent,³⁷ far higher than the 13.3 percent for California as a whole.³⁸ The cities of Calexico and El Centro supplied 63 percent of the workers hired at these four projects, meaning that 436 people from these two cities with poverty rates at 26 percent and 25 percent respectively³⁹ were hired at family-supporting wages.

One worker impacted by the training program is Alfonso Carmona-Jimenez.⁴⁰ He grew up in Mexicali, but moved to the U.S. when he was 19. He recently moved to Calexico with his family to help care for his sick mother and joined IBEW Local 569 as a pre-apprentice trainee. Because of the large number of jobs created by renewable energy work, Alfonso was able to enroll in the IBEW-NECA five-year apprenticeship program. He subsequently worked on a number of renewable projects including Sunora NRG solar project in Borrego Springs, phase I and phase II of the 8minutenergy Mount Signal solar project, the Pattern Energy Ocotillo Express wind project, and the Sol Orchard Community Solar project on San Diego State University's Brawley campus.⁴¹

According to Alfonso, the “sky’s the limit” when it comes to his career opportunities. He feels that union-built, renewable energy projects in Imperial County have offered his family a good quality of life, and have done so for many others as well. He is happy to see people paying their bills and starting to get ahead. “So many people didn’t have work for so long, and can now pay their mortgage two and three months ahead.”⁴²



d. Workforce Development Infrastructure

Training for the main occupations in the construction of utility-scale renewables occurs almost exclusively via the state-certified apprenticeship system, which is used in all PLAs. As noted above, RPS-driven construction projects have generated an estimated \$46.6 million dollars of private-industry investment in apprenticeship training given that joint labor-management apprenticeship is funded by a small percentage of wages for every hour worked on construction projects. Integration of the state-certified apprenticeship system into renewable energy development ensures the highest quality in training for the skilled trades because it includes both classroom and on-the-job training culminating in a journey card, the “college degree” for construction (see Chapter 3). The IOUs also use apprenticeship to train workers in the operations of the power plants that they manage; information about training in operations of non-IOU power plants was not available.

e. Risk of Job Loss or Job Degradation

The RPS on its own has not resulted in job loss in the electricity sector, but there are areas of concern. In addition to jobs in the construction of renewable energy-generating facilities, there are jobs in the operation and maintenance of power plants. Although these are much smaller in number than the construction jobs, they last for the lifetime of the power plant, as opposed to only during the construction phase. Operating and maintaining natural gas power plants is much more labor intensive than the operation of solar and wind farms, so as the former reduce output or shut down, there will likely be fewer of these jobs in these plants. Jones et al. (2017) assessed the impact on employment in the Inland Empire and showed an estimated net decrease in operations jobs of 1,167 due to the retirement of natural gas power plants.⁴³

❖ Use job impact metrics to measure the impact of utility-scale renewable energy construction on access and inclusion.

While job quality and training are ensured under current practice, inclusion could be fortified. The siting of large-scale renewables in the Southern San Joaquin Valley and the Inland Empire—regions with high unemployment and poverty rates—has facilitated the development of a strong track record of inclusion of workers from disadvantaged communities. In some cases, the PLAs on utility-scale renewable construction include local or targeted hire agreements, turning them into CWAs, as described in Chapter 2. However, this approach has not been universal, and better data on outcomes for inclusion could assess if and when such agreements could be beneficial.⁴⁴



❖ Use inclusive procurement policies for procurement of new renewable generation.

Policy could support more consistent implementation of strategies to improve the inclusion of disadvantaged workers. The CPUC and CEC have influence over the procurement of renewable energy through their oversight of the Integrated Resource Planning process, which requires utilities to enter into contracts with power suppliers in a coordinated manner. Competitive solicitations for procuring renewable energy could be structured to encourage inclusion of workers from disadvantaged communities by giving bidders an opportunity to disclose detailed information about the location, number, and quality of the jobs that would be created, as well as the number of disadvantaged workers to be hired, and incorporating these projected workforce outcomes in the ranking of bids.⁴⁵ Even without specific targeted or local hire language in a contract, the tracking and reporting of hires from disadvantaged communities can make outcomes transparent and influence the behavior of bidders. Tracking and reporting on inclusion is feasible in PLAs and has been done by a number of awarding agencies for public works in California, including the Los Angeles Unified School District.⁴⁶

❖ Incorporate workforce analysis into emerging technology support programs.

The state should identify the skill upgrades that may be needed to encourage the accelerated market adoption of emerging technologies in renewable energy as they mature. California already has a number of programs—ranging from ratepayer-funded research and demonstration projects to pilot incentive programs and small-scale procurement mandates—that could generate information about workforce needs. For example, with regard to battery storage, in 2013 the CPUC adopted an energy storage procurement mandate (1,325 MW by 2020 for the IOUs) that could have incorporated a reporting requirement about the types of occupations involved and any skill gaps that emerged in the pilot installations.⁴⁷ For offshore wind, the CEC is working with the federal Bureau of Ocean Energy Management in an extensive process of research and regulatory action to open Pacific Ocean waters for the development of floating wind farms.⁴⁸ At various points in this process of offshore wind development, the state could carry out workforce analysis and planning, as described in Collier (2017).⁴⁹

Chapter 2 of this report recommends that agencies involved in these supports for emerging technologies incorporate a requirement for workforce analysis in grant solicitations that fund research, demonstration, and pilot incentive or procurement programs. This workforce analysis could identify the key occupations that need to be engaged for successful performance of the emerging technologies and the specific skill gaps, if they exist. Chapter 3 also recommends using this information to provide the workforce development institutions with much clearer signals about upcoming skill-upgrade needs than are currently available.



2. Supply-Side Workforce Development Strategies

Although utility-scale renewables are well served by the state-certified apprenticeship system, as noted above, three training gaps remain: pre-apprenticeship training to support inclusion of workers from disadvantaged communities, skills upgrade training for incumbent workers on emerging renewable technologies, and training as part of a just transition package for workers who may be displaced due to plant closures or contractions.

❖ **Participate in statewide coordinated pre-apprenticeship training to prepare workers from disadvantaged communities for apprenticeship: High Road Construction Careers.**

Pre-apprenticeship can and should be addressed via a statewide strategy, rather than through specific training programs for the RPS. A statewide approach to pre-apprenticeship can overcome the weaknesses of small, uncoordinated programs and offer a service that helps the entire construction industry access a qualified pool of applicants, while also helping workers from disadvantaged communities gain entry into apprenticeship and a middle-class career in the skilled trades. See Chapter 3 and **Promising Practice #6.2** for a description of the state's High Road Construction Careers initiative, which includes a coordinated strategy for pre-apprenticeship for the skilled construction trades.

❖ **Expand upgrade training for incumbent workers for emerging technologies through industry training partnerships.**

Training in new skills and knowledge for emerging technologies will need to be incorporated into apprenticeship or journey upgrade programs and can be addressed through the joint apprenticeship committees that are in charge of curriculum upgrades. See Chapter 3 for the recommendations on curriculum upgrades and instructor training for emerging technologies.

❖ **Support just transition planning and just transition assistance.**

Finally, if natural gas power plants reduce their workforce or there is significant switching away from natural gas as a fuel (for electricity generation and end-uses in homes and businesses), then retraining and other supports for displaced workers may be needed as part of a just transition program, as described in Chapter 4.

In sum, the construction of utility-scale renewables has been a success story for jobs and workforce outcomes. Renewables have produced good family-supporting jobs



and tapped into the state’s robust apprenticeship system for training. Where new skills have been needed, they have been easily incorporated into apprenticeship training, and no skill shortages have been reported. Finally, even without specific mandates or policies, utility-scale renewable installations have been quite inclusive, according to available evidence. More attention to tracking and reporting is needed to assess where improvements are still needed, as the research shows that inclusion varies by trade and union local. Our key recommendations include support for a statewide pre-apprenticeship training strategy and attention to incumbent worker upgrade training for emerging technologies. Finally, the state should consider the tremendous jobs and workforce benefits of the current RPS system when assessing whether or how to promote regional grid integration.

B. Distributed Renewable Energy Generation

In addition to the promotion of utility-scale renewables through the RPS, California state policy has also promoted distributed energy resources. Definitions of the term “distributed generation” vary, but the CEC defines it as smaller-scale renewable energy projects:

Distributed generation is defined here as projects that are 20 MW or smaller—including both self-generation and projects that do not directly serve a home or business and are interconnected “in front of the meter” to generate energy to be sold to load-serving entities or on the wholesale market. Self-generation is defined as distributed generation systems installed at a utility customer’s facility, business, or home. These systems serve primarily on-site load or export excess power back to the grid through net energy metering. As used in this report, behind-the-meter is a subset of self-generation that refers to smaller residential or commercial systems that use net energy metering.⁵⁰

Rooftop solar is the largest category of “behind-the-meter” as defined by the CEC. As of November 2017, about 10,500 MW of distributed energy capacity was installed in the state: the great majority (8,600 MW) is in rooftop solar; the remainder is in small-scale hydro, biomass, wind, and geothermal.⁵¹ The recent CEC decision to require solar rooftop installations on most new residential construction confirms the likelihood that this segment of the industry will continue to grow.⁵²

The two main types of policies used by the state to encourage the development of distributed generation are incentive programs and electricity pricing policies. Incentive programs include the now-terminated California Solar Initiative (CSI) and the recently expanded Self-Generation Incentive Program (SGIP), which provides incentives for a



wide variety of distributed energy technologies, including combined heat and power (CHP), fuel cells, solar PV, and wind turbine systems.⁵³ The primary pricing policy is net energy metering, which requires the utilities to credit owners of solar panels for the excess electricity they produce on site. Net energy metering has been a critical driver of the expansion of distributed generation, as more than 90 percent of customer-sited solar projects in California take advantage of this pricing policy.⁵⁴

The State is addressing concerns raised about the economic disparity in the adoption of rooftop solar—i.e., that higher-income households can more readily adopt and benefit from this clean energy technology. In 2015, for instance, the Legislature passed Assembly Bill 693 (Eggman, Chapter 582, Statutes of 2015) to increase distributed solar generation among low-income households by establishing the Solar Multifamily Affordable Housing (SOMAH) program. The SOMAH program, administered by the CPUC, will invest up to \$100 million annually in distributed solar energy projects, serving low-income renters at existing affordable housing properties across the state. Although not as large as the CSI, the SOMAH program does represent a significant new subsidy for residential distributed generation.

Senate Bill 43 (Wolk, Chapter 413, Statutes of 2013)⁵⁵ is another initiative to improve the equity outcomes for distributed solar. It requires IOUs to expand access to renewable energy resources for ratepayers who do not have the means to access the programs for homeowners by providing easier access to local solar generation through the federal Investment Tax Credit and a Green Tariff Shared Renewables Program administered by IOUs. The statute requires that the IOUs make renewable energy accessible to customers who would not otherwise be able to purchase electricity from renewable sources—renters who cannot install rooftop solar or individuals with low credit scores who do not qualify for renewable installations, for example. SB 43 also requires that one-sixth of the program capacity (100 MW out of 600 MW total) be reserved for projects in the state’s most impacted and disadvantaged communities. Thus far, take-up has been low, and efforts are underway to incorporate virtual net metering, which could increase participation.

1. Workforce Outcomes

a. Job Growth

Projecting job growth in distributed renewable energy is challenging, because of rapid—and sometimes inconsistent—changes in technologies and state policies related to both distributed generation and energy storage. Another challenge to projecting job growth is the uncertainty about the type of distributed generation systems (viz., rooftop solar and community-scale solar) that will be built over time and which have different demands for labor. While estimates of growth in rooftop and community-scale solar may be available, data about the number of jobs created by each new megawatt installed is inconclusive.



b. Job Quality

Job quality is mixed in the distributed renewable energy generation segment of the energy sector. Generally, wages are much lower and career pathways are limited in smaller-scale (<1 MW) residential and commercial customer-sited solar installations, commonly called rooftop solar, compared to wages in utility-scale solar (>20 MW). Wages and benefits also differ within distributed solar depending on market segment and company size. Firms serving institutional or large commercial solar projects tend to compete on the basis of skill and qualifications, and are more likely to be unionized, whereas in the smaller distributed solar market, low-cost is the primary competitive driver among firms. Because of this difference in competitive dynamics, worker pay and benefits and the use of certified apprentices is greater on larger distributed solar projects (1-20 MW).⁵⁶ In addition, large solar projects entirely funded by state or federal dollars typically trigger prevailing wages which provide a floor on wages and benefits.⁵⁷

Wage data that systematically distinguishes between rooftop solar installers and utility-scale solar workers is incomplete, but differences can be inferred by comparing the wages of electricians and solar photovoltaic installers (now a separate occupation in the Bureau of Labor Statistics (BLS) standard occupation code, SOC 47-2231) that explicitly excludes photovoltaic electricians.⁵⁸ Most utility-scale solar workers are union electricians or electrical apprentices⁵⁹ whereas 96% of solar installers work for building contractors, according to BLS data.⁶⁰

Electricians are trained to perform a much broader array of tasks and work on a much wider set of construction projects than workers whose sole task is solar installation, and this is reflected in their respective wages. The BLS Occupational Employment Statistics data for 2017 for California shows a median hourly wage of \$19.97 for photovoltaic installers, compared to \$30.88 for electricians.⁶¹ The National Solar Jobs Census, a widely-cited annual survey by the solar industry, shows an average wage of \$20 per hour for “mid-level” full-time installers nationally in its 2017 edition, but does not report wage data for California.⁶² The solar industry survey also changes what is included in the installer category in its 2018 edition, excluding part-time worker wages and reporting the wages of photovoltaic installers who are and are not electricians separately for the first time. While different definitions and inconsistencies in the Solar Jobs Census preclude comparison with the government data, the 2018 Solar Job Census supports the finding that solar electricians are paid more than installers who are not electricians, reporting a wage premium for electricians ranging from \$4.32 to \$6.48 per hour.⁶³

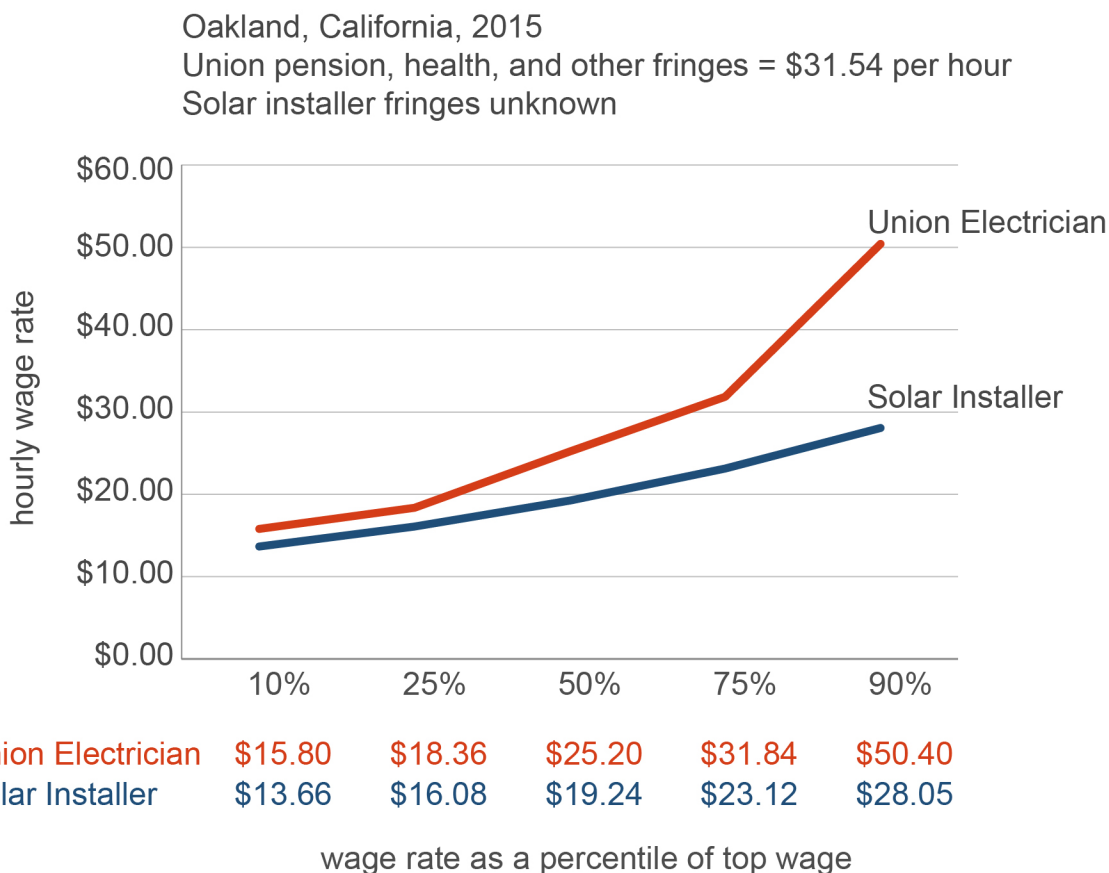
The higher value that the labor market places on the more broadly trained electricians also is reflected in wage mobility. BLS data for California in 2017 shows electricians at the bottom end of the wage distribution were paid \$17.06 and at the top end were paid \$52.36 per hour.⁶⁴ In contrast, solar installers at the bottom end (10th percentile) of the wage distribution were paid \$14.58 per hour, and at the top end (90th percentile) were paid \$30.36 per hour.



Previous research shows an even greater wage and benefits premium and career ladders for union electricians, which are not specifically captured in the BLS data.

Exhibit 6.6 (Jones et al., 2016) shows the wage trajectory of solar installers compared to union electricians, the main workforce for utility-scale solar array construction. Entry-level installers and pre-apprentice electricians start at similar wages, but as pre-apprentices gain experience, their wages rise slightly, and once they enter apprenticeship programs and gain skills, their earnings grow much more quickly and significantly compared to the earnings of solar installers. Once workers start their formal apprenticeship, they receive full benefits, which Jones et al estimated to be valued at \$31.54 per hour at the time of the study.⁶⁵ This difference between electricians and installers widens substantially once apprentices graduate to journey-worker status.

Exhibit 6.6. Comparison of Wages and Wage Trajectories for Rooftop Solar Installers and Union Electricians, example for California Bay Area



Source: Betony Jones, Peter Philips, and Carol Zabin, “The Link Between Good Jobs and a Low Carbon Future” (UC Berkeley Donald Vial Center on Employment in the Green Economy, July 2016), <http://laborcenter.berkeley.edu/the-link-between-good-jobs-and-a-low-carbon-future/>.



c. Job Access

Limited information is available about the racial and ethnic diversity of the workforce in distributed solar. Demographic data for 2017 from the Solar Foundation, an industry association, shows underrepresentation of people of color in the solar industry, with African Americans comprising 7.7 percent, Asians and Pacific Islanders comprising 14.6 percent, and Latinos/Hispanics at 20.9 percent—but these numbers are aggregated averages and include professional, white-collar, and blue-collar workers in both distributed and utility-scale solar.⁶⁶ The solar rooftop installer workforce likely mirrors the overall residential and commercial construction occupations, which are heavily Latino.

In terms of geography, unlike utility-scale solar farms, which require large areas of land, rooftop solar can be sited in populated localities where people live and job needs are critical. A number of urban equity and workforce groups have mobilized to develop specific interventions to ensure that urban rooftop solar projects hire workers with significant and specific barriers to employment. For example, GRID Alternatives—the administrator for the Single-Family Affordable Solar Homes Program launched in 2009 as part of the California Solar Initiative—maintains formal partnerships in a few locales with community-based workforce development organizations (CBOs). These organizations, which include Homeboy Industries and the East LA Skills Center in Los Angeles and Rising Sun Energy Center in the San Francisco East Bay, provide training to formerly incarcerated ex-gang members and other workers facing significant barriers to employment as a first step towards helping them accessing paid entry-level employment.

As discussed in Chapters 2 and 3, improving inclusion in low-wage renewable energy jobs should not be considered a success story unless the entry-level jobs have a robust career trajectory that allows workers to move up as they gain experience and skills. Otherwise, the racial and ethnic hierarchies in the broader labor market are simply replicated in the renewable energy workforce. As shown in **Exhibit 6.6**, this lack of a career ladder is the most significant deficiency of most of the jobs in distributed solar. The lack of career ladders and upward mobility is a structural fact of much of the low-wage labor market in California and the nation, and is a major challenge to organizations that are dedicated to inclusion.⁶⁷ In the construction industry, the most successful inclusion programs for rooftop solar work are those that partner with apprenticeship programs because these programs ensure that the entry-level step leads to a second step into a career.⁶⁸

d. Workforce Training Infrastructure

There are numerous rooftop solar installation training programs in California, although their number has decreased substantially from the heyday of “green jobs” training programs funded by the post-recession American Recovery and Reinvestment Act (ARRA) enacted in 2009.⁶⁹ Community college programs have all but disappeared because graduates were not being placed in career-track jobs. Components of curricula



from these programs have been incorporated in apprenticeship programs that partner with community colleges for the classroom portion of apprentice training.⁷⁰ A number of non-profits serving workers with barriers to employment have solar training programs, the most successful of which serve as pre-apprenticeship programs that are linked to state-certified apprenticeship, such as Richmond BUILD or Rising Sun Energy Center in the Bay Area.

2. Workforce Recommendations

a. Demand-Side Workforce Policy Levers

Low wages and lack of career ladders in many distributed solar jobs is not an inevitable characteristic of the industry, but rather a consequence of the lack of labor standards and/or lack of unionization. A major challenge is the fact that consumer-owned rooftop solar per kilowatt-hour is more expensive than utility-scale solar, as documented in a number of reports.⁷¹ In this context, there is concern that increasing wages for this relatively low-skilled work could raise costs and dampen demand. However, labor costs represent a small fraction of total project costs: even substantial increases in wages will cause only a small percentage increase in project costs. For example, if installation labor represents 20 percent of the total cost of a rooftop solar project, increasing worker compensation by 25 percent would increase total project costs by only 5 percent (and this figure assumes there are no gains in productivity associated with higher wages). Solar costs overall are at an all-time low, so small increases in total project costs are unlikely to alter the growth trajectory of distributed solar energy.⁷²

Distributed solar can be deployed in ways that favor better jobs.⁷³

❖ **Include responsible contractor standards in incentive programs for distributed generation.**

- **Use skill standards in distributed generation incentive programs to ensure safe and proper installation and performance.**
- **Focus resources on program models that operate at larger scale where skilled and trained workforce standards can be incorporated. For distributed generation, these include:**
 - **Installation of Larger Distributed Renewable Projects:** By modifying net metering and subsidy programs like SOMAH to encourage greater scale for distributed generation, it becomes more feasible to pursue better workforce



outcomes while maintaining a robust distributed generation policy. Larger scale projects have a lower cost: the state’s most recent solar statistics show that since 2015, installations below five kW in size have an average cost of more than \$5 per watt, whereas 1,000-kW projects average \$2.24 per watt.⁷⁴

- **Support for Solar Installations in MUSH Markets:** Solar installations on buildings in MUSH markets (municipalities, universities, schools, hospitals) can ensure that California’s solar investments benefit the public at large, rather than just the higher-income segment of the population.⁷⁵ Since contractors on public works projects must pay prevailing wages and utilize apprentices for a minimum percentage of work hours, the jobs created by solar projects in these markets would be family-supporting, career-track jobs. Prop. 39, discussed further on, funds energy efficiency and clean energy projects for K-12 public schools and community colleges; other parts of the MUSH sector are also viable targets for distributed solar.
- **Focus on Community-Shared Solar and Explore Bundling of Individual Rooftop Solar Projects:** Community-shared solar is an emerging model for solar deployment with the potential to advance good jobs and expand the solar-market customer base dramatically. Breaking out of the mold of either utility-scale solar arrays or individual solar rooftop projects, community-shared solar projects are usually in the mid-sized range (one to five MW). This scale represents an underdeveloped “sweet spot” for advancing distributed generation. The larger-scale, lower-cost procurement models can serve larger groups of users because projects are not tied to individual property owners and can achieve greater economies of scale than individual rooftop projects. Moreover, community solar projects usually involve a competitive solicitation for the installation that is administered by a professional rather than negotiated by individual home or business owners. All of these attributes also make it easier to incorporate the wage and training standards common to utility-scale solar projects. A promising California model is a shared solar pilot being developed by the Los Angeles Department of Water and Power (LADWP) for a 10-MW project on public buildings and parking lots that will enroll up to 13,000 renters and provide subsidies for low-income renters.⁷⁶ The program will include the same training strategy and labor standards as the LADWP weatherization program, a best-practice program described below in the energy efficiency section of this chapter. Bundling individual solar rooftop projects into a single contract is another possible means of promoting distributed generation at a scale large enough to incorporate skilled and trained workforce standards.



❖ **Incorporate workforce analysis into emerging technology support programs.**

As for utility-scale renewables, agencies involved in supports for emerging technologies have the opportunity to incorporate a requirement for workforce analysis in grant solicitations that fund research, demonstration, and pilot incentive or procurement programs. This workforce analysis could identify the key occupations that need to be engaged for successful performance of the emerging technologies and the specific skill gaps, if they exist. Chapter 3 also recommends using this information to provide the workforce development institutions with much clearer signals about upcoming skill-upgrade needs than are currently available.

❖ **Use job impact metrics to measure the impact of distributed renewable energy construction on access and inclusion.**

There is very little systematic information about the job quality and job access impacts of the state's various distributed generation policies. Tracking and reporting on the job impacts of climate policy is necessary to measure progress over time.

b. Supply-Side Workforce Development Strategies

The lessons of previous rooftop solar training indicate that state resources should support broad occupational training rather than technology-specific training. The broader approach gives workers the foundational training of a skilled trade and prepares them to quickly adapt as new technologies mature and are deployed. Because rooftop solar is construction work and the state has robust certified apprenticeship programs in the skilled trades, the best opportunity for solar training occurs when it is incorporated into pre-apprenticeship training that leads to apprenticeship in a skilled trade, as in the case of Rising Sun Energy Center. The training curriculum may include knowledge and skills related to solar (or other new technologies), but as discussed in Chapter 3, pre-apprenticeship programs encompass an in-depth, multi-craft curriculum that provides basic training needed to enter apprenticeship in any number of building and construction trades. For entry-level workers from disadvantaged communities, social enterprises like Homeboy Industries and on-the-job training through certain job classifications (e.g., the electrical trade's "solar panel installers") can also provide much more extensive work experience than generally found in a short pre-apprenticeship program, which makes it more likely that they will get into an apprenticeship program and be successful once they become an apprentice in a state-certified program.



❖ Fund and participate in the pre-apprenticeship training strategy embodied in the statewide High Road Construction Careers initiative.

For programs targeting solar rooftop installation for low-income households, such as GGRF solar programs administered by the California Department of Community Services and Development (CSD) or the SOMAH program administered by the IOUs, there is an important opportunity to use solar rooftop installation as on-the-job training linked to pre-apprenticeship training programs. Essentially, training needs to be closely connected to jobs through structured partnerships that include employers. In the case of construction occupations, like solar installers, programs are much more effective when linked to apprenticeship programs that always include employer funding and involvement in curriculum. Apprenticeship remains the most important route to a middle-class career in construction. See Chapter 3 for an in-depth explanation of pre-apprenticeship and apprenticeship.

C. Energy Efficiency

Energy efficiency is a major part of the 2020-2030 Scoping Plan, accounting for slightly more than 10 percent (64 out of 621 MMTCO₂e) of the reductions of greenhouse gas emissions needed to meet the state's 2030 target.⁷⁷ The key role of energy efficiency is codified in SB 350, which directs the California Energy Commission (CEC) to establish energy efficiency targets that achieve a statewide, cumulative doubling of energy efficiency savings in electricity and natural gas final end uses by 2030.⁷⁸ The CEC has calculated that this is equal to about 83,000 gigawatt hours of electricity savings and roughly 1 billion therms of natural gas savings in the year 2029, the last full year before the SB 350 deadline.⁷⁹

Neither the legislation nor the Scoping Plan prescribes specific policies or regulations on *how* to achieve this target. Instead, the Scoping Plan relies on the numerous policies and wide-ranging set of programs that already exist and that are mostly identified in the Existing Buildings Energy Efficiency Action Plan (EBEE Action Plan), which serves as the state's roadmap to meet the doubling of energy efficiency savings.⁸⁰ The energy efficiency programs are designed to encourage the owners of existing building stock and industrial and agricultural facilities to lower their energy use and to mandate that new homes, buildings, and other infrastructure investments incorporate specific requirements for materials and building systems that will lower energy use in the built environment.

Energy efficiency programs and policies fall into three major categories: 1) publicly- and ratepayer-funded investments that fully subsidize building energy retrofits (e.g., the state-funded Prop. 39 school retrofit program, utility ratepayer-funded low-income



weatherization programs administered by the IOUs, and the similar low-income weatherization program administered by CSD with funds from the state's Greenhouse Gas Reduction Fund (GGRF) and federal sources); 2) ratepayer-funded incentives that encourage private investment in energy efficiency retrofits by providing rebates or other assistance to lower project costs; and 3) energy-saving requirements embedded in Title 20 Appliance Energy Efficiency Standards and Title 24 Building Energy Efficiency Standards.⁸¹ The IOU programs are designed to facilitate market adoption of new practices and technologies to achieve savings, which are then mandated in building codes and appliance standards once market adoption without subsidies is deemed feasible.

The largest source of incentives and subsidies to encourage energy efficiency retrofits derives from ratepayers, who pay a fee on their utility bills that adds up to approximately \$1.2 billion per year for energy efficiency programs, not including the low-income weatherization program addressed below. These funds are administered by the state's IOUs. Utility programs are expected to deliver about 44 percent of the total electricity savings required under SB 350.⁸² These funds are largely dedicated to incentivizing private-sector investment in energy efficiency through rebates, marketing and education, and technical advice, with about \$30 million per year for workforce training and education.

In addition to the IOU incentive programs, the state has several grant programs that do not require participant contributions. Prop. 39, passed in 2012, has provided approximately \$350 million per year for retrofits in California K-12 schools and community colleges.⁸³ CSD and the IOUs have low-income weatherization programs; the IOUs allocated a total of \$201.6 million to these programs in 2017, while CSD's program was allocated \$18 million that year from the GGRF.⁸⁴ Low-income weatherization programs are fully subsidized investments, rather than incentives that pay only partial costs.

The state's building codes and appliance standards (Title 20 and 24, respectively) are expected to deliver about 29 percent of savings needed to achieve the SB 350 mandate, mostly by affecting new building construction but also applicable to major renovations and remodels. Finally, there are a set of policies embodied in AB 758 (Skinner, Chapter 470, Statutes of 2009) and AB 802 (Williams, Chapter 590, Statutes of 2015)⁸⁵ aimed at overcoming barriers to market adoption of energy efficiency through benchmarking, utility data transparency, and other means to create market transparency and thereby spur investment.⁸⁶ While these policies aim to prime the market and generate job growth, they themselves are unlikely to influence job quality and job access in energy efficiency and therefore will not be addressed here.

To meet energy savings targets in SB 350 through the entire suite of policies and programs described below, an estimated 50,000 jobs will be generated per year. This jobs projection is based on estimates of the amount of investment needed to achieve cumulative 83,000 gigawatt hours of electricity savings and 1 billion therms of natural



gas savings by 2030.⁸⁷ The EBEE Action Plan has calculated that about \$8 billion dollars would be needed annually to achieve the 2030 target. The jobs projection is derived using a “jobs factor” (i.e., the jobs generated per million dollars of investment in energy efficiency upgrades), reported by Zabin and Scott (2013) in their literature review of studies that forecast or estimate the impact of specific energy efficiency programs on jobs per year.⁸⁸ In their analysis, they find that every \$1 million of investment in energy efficiency retrofits generates 6.2 direct job-years (one job-year equals 2,080 hours, or one FTE for one year). If these figures are applied to the CEC estimate of an \$8-billion-per-year investment needed to achieve the target of doubling savings, such investments would produce roughly 50,000 full-time equivalent jobs every year through 2030.

C1. IOU Energy Efficiency Programs

Workforce issues have received significant attention in the energy efficiency arena, especially in the IOU programs, and this extensive prior work informs the analysis in this section.⁸⁹

1. Workforce Outcomes

a. Job Growth

Using the same jobs per million dollars of investment of 6.2 million direct job-years, the IOU ratepayer investment would yield approximately 15,800 jobs per year. This calculation is based on energy efficiency budgets of about 1.2 billion dollars per year as well as estimated customer investments, since customers must invest their own resources to be eligible for rebates and other incentives.⁹⁰

b. Job Quality and Job Access

There is limited information on job quality and job access for workers carrying out energy efficiency work in the IOU-administered energy efficiency programs. The IOUs do not collect data on their programs’ job quality or access outcomes. However, two comprehensive studies of workforce issues in energy efficiency commissioned by the California Public Utilities Commission, the 2011 California Workforce Education and Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response (Needs Assessment) and the 2014 Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan (Guidance Plan), surfaced concerns about job quality based on information gathered from workers, contractors, training providers assisting graduates with job placements, and industry experts.⁹¹ The Needs Assessment found qualitative evidence of low wages paid by some residential and HVAC contractors that participate in IOU-administered energy efficiency



programs, as well as very little participation of union contractors. Both studies concluded that the IOU programs pay limited attention to both job quality and work quality. With the exception of a handful of programs, contractors can qualify for participation in IOU incentive programs as long as they self-report that they have acquired the basic licensing required by law. The studies concluded that contractors who carry out energy efficiency retrofits face similar market conditions and similar patterns of wage disparities, and pockets of wage and hour violations, that occur in the general private construction labor market.

The California Public Utilities Commission (CPUC) ordered the IOUs' low-income Energy Savings Assistance (ESA) program and the broader energy efficiency programs to collect data on the jobs and workforce outcomes of the programs, but this data collection has not yet been performed.⁹² The IOUs have also been directed to develop inclusion programs in a number of decisions, e.g., Decision 12-11-015, which states: "The utilities should develop pilot approaches collaboratively with stakeholders to incorporate workforce diversity and inclusion goals into their third-party contractor selection process."⁹³ The IOUs have taken some very small initial steps to address inclusion through labor-demand mechanisms in programs, but these actions have been minimal.⁹⁴ They have identified the low-income weatherization programs as being the best fit to serve as the main route for inclusion, but this would limit inclusion to the lowest tier of jobs supported by the IOU energy efficiency programs. As stated in Chapter 3, successful inclusion programs must target career-track jobs that offer mobility as skills are acquired; otherwise, they simply replicate the gender and racial hierarchies that already exist in the labor market.

c. Workforce Development Infrastructure

Each year, the IOUs invest about \$30 million a year of ratepayer funds in workforce education and training, most of it funding the eight IOU Energy Training Centers located throughout the state, and a smaller amount dedicated to educational programs for K-12 schools. As reported in the 2011 California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response (Needs Assessment), which performed an exhaustive review of these programs, the Energy Training Centers offer a variety of programs: classes, information dissemination, customized demonstrations and consultations, and equipment lending libraries. By far the most predominant activities are very short "one-off" classes on specific topics related to energy efficiency and related demand-side management activities. **Exhibit 6.7** summarizes key features of the eight IOU Energy Training Centers.



Exhibit 6.7. Summary of Energy Training Centers in California, 2012

| Utility | Training Center | Location | Primary Audience | No. Sessions Offered | 2010-2012 Budget | No. Attendees 2009 |
|------------------------------------|--|---------------|--|----------------------|-----------------------|--------------------|
| Pacific Gas & Electric (PG&E) | Pacific Energy Center (PEC) | San Francisco | Commercial and Industrial Professionals | 164 | \$34 million | 7,716 |
| | Energy Training Center (ETC) | Stockton | Residential Sector Professionals | 90 | | 8,662 |
| | Food Service Technology Center (FSTC) | San Ramon | Commercial and Industrial Professionals | — | | — |
| Southern California Edison (SCE) | Customer Technology Application Center (CTAC) | Irwindale | Commercial and Industrial Professionals | 211 | \$21 million | 8,634 |
| | Agricultural Technology Application Center (AgTAC) | Tulare | Agricultural and Industrial Sector Professionals | 146 | | 2,272 |
| Southern California Gas (SCG) | Energy Resource Center (ERC) | Downey | Commercial and Industrial Professionals | 140 | \$8.8 million | 9,485 |
| San Diego Gas and Electric (SDG&E) | Energy Resource Center (ERC) | San Diego | Commercial and Industrial Professionals | 84 | \$12 million | 6,385 |
| | California Center for Sustainable Energy (CCSE) | San Diego | Residential Sector Professionals | 195 | | 9,194 |
| Total | | | | | \$75.8 million | 42,863 |

Source: Carol Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response” (UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011), <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.



The Needs Assessment and the Guidance Plan concluded that while the Energy Centers provide technical information for contractors and consultants, the IOU workforce development strategy overall is largely ineffective for advancing the goal of improving the skills of the workforce involved in energy efficiency work. The predominance of one-off classes that are not connected to career training paths, the lack of coordination and integration with the main institutions that train workers in this field, the minimal success in developing industry-led training programs all detract from program effectiveness. Due to lack of workforce development expertise, the programs also fall short in effectively supporting their stated goal of improving inclusion of workers from disadvantaged communities into careers related to energy efficiency. The technical energy efficiency expertise of the staff is a valuable asset, but it would be better deployed in advising industry training partnerships, state-certified apprenticeship programs, and community college and four-year university departments.⁹⁵

IOU support and collaboration with the apprenticeship programs and the community colleges should be greatly expanded, since these institutions train the bulk of the workforce that will actually impact energy use in buildings. The IOUs have begun to revise their programs to promote greater alignment and collaboration with the main post-secondary training institutions instead of creating their own niche programs. For example, the IOUs supported curriculum development for the California Advanced Lighting Controls Training Program (CALCTP) certification described below and helped the sheet metal apprenticeship program incorporate best-practice installation training in their HVAC programs.

2. Workforce Recommendations

a. Demand-Side Workforce Policy Levers

The use of ratepayer incentives and subsidies to encourage energy savings offers an opportunity to insert a variety of workforce standards to improve job quality. Recent decisions by policymakers support this approach. SB 350 required the development of a responsible contractor policy for IOU energy efficiency incentive programs, and discussions are underway about what this policy should contain. A recent CPUC decision orders the IOUs to require workforce skill standards for their incentive programs for the first time.⁹⁶ This recent recognition of the value of workforce standards supports and aligns with the following specific recommendations, drawn largely from the 2014 Guidance Plan.



❖ **Include responsible contractor standards in all IOU energy efficiency incentive programs.**

The CPUC should adopt a responsible contractor policy whereby contractors participating in energy efficiency incentive programs must meet a baseline set of standards. The specific policy recommendation includes compliance with existing legal requirements and safety measures, and for individual projects exceeding \$100,000 or contracts for multiple projects exceeding \$1,000,000, contractors comply with a skilled workforce requirement based on state-certified apprenticeship.

❖ **Incorporate skilled and trained workforce standards for contractors participating in IOU incentive programs.**

Specifically, the Guidance Plan recommended that contractors ensure that 60 percent of the jobsite workforce is comprised of journey-level workers or apprentices from a state-certified apprenticeship program or provide other proof of skilled workforce. This approach is similar to the skilled and trained workforce requirements found in Senate Bill 54 (Hancock, Chapter 795, Statutes of 2013)⁹⁷ for refinery upgrade workers and several housing laws. See Chapter 2 for an explanation of these requirements.

❖ **Utilize specialized certifications for emerging technologies, such as advanced lighting and other building controls.**

The CPUC should require skill certifications for emerging or advanced technologies that require specialized skills. Key criteria that certifications should meet include endorsement by experts, industry recognition, and link as an upgrade to an existing occupational training pathway rather than a stand-alone training with no prerequisites. The CPUC's decision is now requiring one example of this type of specialized certification: the California Advanced Lighting Controls Training Program (CALCTP) and its corresponding certification. CALCTP is an upgrade certification that can only be obtained by certified electricians who have the foundational training and competency needed to gain the specialized skills for this new technology.

The discussions about workforce issues in the CPUC proceedings on IOU energy efficiency programs have centered on incorporating skill standards into IOU programs for the purpose of realizing energy savings by ensuring effective installation, operations, and maintenance of energy efficiency equipment. This approach requires that participating contractors and workers have the skills necessary to ensure quality work (i.e., to make certain that equipment is properly installed, commissioned, and maintained and that buildings are designed, constructed, and retrofitted consistent with best practice and



technical specifications for energy efficiency). This concern emerged from the substantial evidence of poor-quality installations of energy-efficient HVAC and other equipment and building systems, resulting in incomplete energy savings.

Numerous studies highlight poor-quality installation as a significant factor in the failure to obtain expected energy savings from more efficient lighting or HVAC systems, which in turn slowed market adoption.⁹⁸ For example, a CEC study found that poor-quality installation of cooling systems results in a 20- to 30-percent increase in energy use.⁹⁹ The IOUs' recently proposed Energy Efficiency Business Plans for 2018-2025 confirm that workers installing HVAC systems rarely have the technical knowledge, skills, or abilities necessary to implement industry standards for HVAC quality installation, and as a result, there are "high failure rates for job performance on routine tasks."¹⁰⁰ There is also evidence that utility customers strongly support the utilities taking a role in pre-screening and certifying contractors to ensure both consumer protection and quality work.¹⁰¹

In general, improvements in job quality is a secondary benefit of a focus on skill standards and certifications. In the construction industry in particular, apprenticeship skill standards are, in fact, tied to prevailing wage standards set by the California Department of Industrial Relations (DIR). The DIR actually establishes the wage ladders for apprentices as they progress through their three- to five-year apprenticeship program, culminating in the journey-level prevailing wage upon graduation. Therefore, the recommendation for using workforce skill standards to help ensure quality work gives rise to a "high-road" strategy that will result in quality jobs, as well. See Chapter 2 for a discussion of prevailing wages and apprenticeship.

The undervaluing of workforce standards in IOU energy efficiency incentive programs is compounded by the requirement that they meet a narrowly defined cost-effectiveness test, which focuses heavily on the direct and immediate financial costs and benefits to the IOUs and incentive program participants. Environmentalists, consumer advocates and others have critiqued the state's methodology for evaluating the costs and benefits that go into this test, questioning particularly their limited definition of benefits.¹⁰² One of these benefits that hasn't yet been considered is the market transformation effects of building a pool of qualified workers and contractors. This impact transcends individual ratepayer subsidized projects because the same contractors and workers will also work on non-subsidized projects. In addition, despite the significant impact that installation quality has on actual energy savings outcomes, the IOUs' cost-effectiveness calculations are generally based on "claimed" savings from engineering estimates rather than actual, verified energy savings.¹⁰³ By failing to take a broader view of the costs and benefits of energy efficiency programs, current cost-effectiveness calculation requirements can create an artificial barrier to the implementation of workforce skill standards. Any discussion of reforming the cost-effectiveness test should include workforce issues along with the other concerns that have already been raised.



- ❖ **Phase incentives so that they first target those segments of the industry, such as the MUSH market, that have both higher emissions reductions per dollar invested and better workforce outcomes.**

The IOUs should create a focused program on the MUSH markets (including subsidized multi-family residential buildings), which represent a prime opportunity for promoting deep retrofits, good jobs, public benefits, and increased opportunities for workers from disadvantaged communities. Projects in MUSH markets are usually already subject to prevailing wage and apprenticeship requirements because they are subject to public works labor code. They also generally include larger projects and more complex work requiring higher skills (and higher wages). Public ownership of buildings also offers opportunities for deeper retrofits that require longer payback periods. While Prop. 39 has provided significant funding for the schools segment of the MUSH market, there remains a sizable cost-effective investment opportunity that can lower greenhouse gas emissions, provide benefits in disadvantaged communities, generate good jobs with benefits, and broaden opportunities for entry-level workers from disadvantaged communities. This does not mean neglecting the residential market, but rather de-emphasizing single family homes until better targets have been exhausted.

- ❖ **Expand the use of community workforce agreements (CWAs) for agencies or other government entities that fund large-scale construction projects.**

The IOUs should adopt strategies to increase local and disadvantaged hiring across the portfolio of IOU programs; so far, such strategies have been aimed at only low-income weatherization programs. The IOUs should encourage the use of CWAs wherever possible, particularly with the funds they administer via third-party contracts and government partnerships. The targeted and local hire requirements in CWAs are key to broadening career opportunities for workers from underrepresented and disadvantaged communities. Scale is an issue here, since some of the projects are too small to accommodate a local or targeted hire strategy (see Chapter 2 on CWAs).

- ❖ **Use job impact metrics to measure the impact of IOU energy efficiency programs on access and inclusion.**

There is very little information about the job quality and job access impacts of the IOU energy efficiency programs. Tracking and reporting on the job impacts of climate policy is necessary to measure progress over time.



❖ **Incorporate workforce analysis into emerging technology support programs.**

Chapter 2 of this report recommends that agencies involved in supports for emerging technologies incorporate a requirement for workforce analysis in grant solicitations that fund research, demonstration, and pilot incentive or procurement programs. The IOUs should require workforce analysis in their multiple emerging technologies programs to identify the key occupations that need to be engaged for successful performance and the specific skill gaps, if they exist.

b. Supply-Side Workforce Training

The IOUs currently manage a training fund of about \$30 million annually from their ratepayer-funded energy efficiency budget, very little of which goes to support the workforce training strategies outlined in Chapter 3. These ratepayer funds could be put to better use if they supported a collaborative interagency approach that included the state’s workforce and energy agencies. The key role of the IOUs would be to identify emerging technologies that may require skill upgrades—as well as the specific knowledge and skills needed—rather than directly administering training programs.

❖ **Fund and participate in the statewide pre-apprenticeship training strategy.**

The IOUs have a commitment to improving inclusion for disadvantaged workers in energy efficiency activities, yet have little experience in doing so. Since these activities are largely in the construction industry, the IOUs should use their funding for inclusion to support the statewide pre-apprenticeship strategy that is a key component of the High Road Construction Careers Initiative, rather than create their own programs.

❖ **Expand upgrade training for incumbent workers for emerging technologies through industry training partnerships.**

Training in new skills and knowledge for emerging technologies will need to be incorporated into apprenticeship or journey upgrade programs. The IOUs should support and advise the joint apprenticeship committees that are in charge of curriculum upgrades. See Chapter 3 for the recommendations on curriculum upgrades and instructor training for emerging technologies.



❖ Support the development of high-road training partnerships in operations and maintenance.

In addition to the installation of energy efficient equipment through retrofits, the maintenance and operations of that equipment in buildings and industry is often carried out by operations workers rather than construction industry workers. Stationary engineers, building operators, and maintenance workers, janitors and custodial workers all play a role in maximizing energy savings. Supporting high-road training partnerships in this arena is also important. See the **Promising Practice #3.3: Green Janitors Education Program** in Chapter 3.

C2. Prop. 39 California Clean Energy Jobs Act

The California Clean Energy Jobs Act (CCEJA) was created under Prop. 39 in 2012, and enabling legislation was produced in Senate Bill 73 (Committee on Budget and Fiscal Review, Chapter 29, Statutes of 2013).¹⁰⁴ The CCEJA is the state’s second-largest source of funding for energy efficiency retrofits. It is a set of programs focused on improving energy efficiency and promoting clean energy projects and jobs in California’s public schools and community colleges. These programs fall into three categories: 1) direct grants for energy audits, retrofits, and renewable energy installations (administered by the California Energy Commission for K-12 schools and the California Community College Chancellor’s Office for community colleges); 2) loans and technical assistance to support these projects (administered through existing loan programs of the California Energy Commission); and 3) job training and workforce development programs intended to grow and maintain the state’s pool of construction workers qualified to perform clean energy upgrades (administered through the California Community Colleges Chancellor’s Office, the California Workforce Development Board (CWDB), and the California Conservation Corps). Prop. 39 explicitly states that funds should “create good-paying energy efficiency and clean energy jobs in California” and should support training and employment for disadvantaged youth, veterans, and others in jobs on these projects. Reporting on these training and employment outcomes was part of the legislative mandate.

1. Workforce Outcomes

a. Job Growth

The 2016 Prop. 39 Jobs Report¹⁰⁵ found that the program created about 4,400 direct jobs from an estimated public investment of \$752 million in grant funds in K-12 school retrofits, from 2014 to 2016, at an estimated 5.9 jobs per \$1 million of investment in energy efficiency retrofits.¹⁰⁶ If the program continues current funding trends of about \$350 million per year through 2030, the program will create about 2,100 jobs per year and a total of about 25,000 job-years.



b. Job Quality

Because the CCEJA program is funded with general fund revenues, it is considered a public work and requires the full suite of labor standards embedded in public works labor code. Contractors must pay prevailing wages, thereby ensuring high job quality, including family-supporting wages and benefits. The Department of Industrial Relations determines prevailing wages for journey-level workers as well as for apprentices, whose wages increase as they advance in their training (see Chapter 3).

c. Job Access

Data on job access is currently incomplete but provides more insight into job access than is available for other programs. The Prop. 39 Jobs Report documents that apprentices performed 18 percent of the work on CCEJA K-12 projects.¹⁰⁷ This finding is in line with the apprenticeship ratios required in public works and represents a significant incorporation of trainees into job-site work.

Statistics from the Division of Apprenticeship Standards shows that more than 60 percent of apprentices in the construction trades statewide are people of color, but these are overall numbers for the state rather than specific information about workers on Prop. 39 projects. The Department of Industrial Relations, which enforces prevailing wage law and has the authority to access home addresses of workers, is in the process of developing an online system to collect detailed information from certified payroll data. When that becomes available, it may be possible to match addresses of workers with information from the CalEnviroScreen tool, one of the main tools available to measure the level of inclusion of disadvantaged workers, as described in Chapter 1. The CalEnviroScreen could then be used to track the percentage of workers who reside in disadvantaged communities.

d. Workforce Development Infrastructure

The CCEJA also committed funding for workforce training through three sub-programs: funding for training in the community colleges as part of the allocation for retrofits on community college buildings, funding for pre-apprenticeship training administered by the CWDB, and funding for the California Conservation Corps.¹⁰⁸

The Community College Program received \$6.29 million for FY 2016-17 for workforce development, with funds for grants for community colleges to purchase new equipment, create and improve student curriculum, and provide professional development for faculty to prepare students for jobs in the clean energy sector, as well as funds to support regional collaboration in the energy, construction, and utility sectors, including the development of partnerships and networks to support continued student and faculty success.¹⁰⁹



The community college industry partnerships funded by CCEJA workforce training allocations has incorporated new knowledge and skills in training programs for credentials in traditional occupations that impact energy use. With CCEJA workforce training funds, the community colleges have embarked on a proactive curriculum upgrade for priority occupations, which includes working with businesses engaged in building automation and other emerging technologies.

For example, through their “sector navigator program”¹¹⁰ the community colleges identified facility managers as a key occupation in implementing energy efficiency efforts in commercial buildings and found unfilled job openings due to an aging workforce and a lack of qualified applicants to replace retirees. In collaboration with the International Facility Management Association (IFMA), they identified 11 core competencies, which were mostly aligned with business management degree requirements. The colleges then created a specialization within business management degrees for a facility manager’s credential, which included developing a new three-unit course on energy efficiency and offering internships provided by IFMA.¹¹¹ The community colleges are using the same approach for other critical technical occupations in the energy efficiency space.

The CWDB-administered pre-apprenticeship program (see **Promising Practice #6.2: Pre-Apprenticeship Programs for Structured Pathways Into Apprenticeship**) boasts high job-placement rates and now serves as a model for a statewide pre-apprenticeship strategy with funding from a variety of other state sources. The elements of the Prop. 39 pre-apprenticeship grant program are now being incorporated into the dedicated funding guidelines for pre-apprenticeship training in Senate Bill 1 (Beall, Chapter 5, Statutes of 2017),¹¹² the transportation funding bill, and are an essential component of the statewide High Road Construction Careers initiative.

It is important to note, however, that participants from the CWDB training programs were not usually placed into Prop. 39 energy retrofit projects. As explained in the recommendation for a statewide strategy for pre-apprenticeship in Chapter 3, it does not make sense for each clean energy program to have its own training program. Instead, the goal of pre-apprenticeship programs should be to place graduates in an apprenticeship program, no matter what construction projects they end up working on. Timing is everything in construction, and union dispatch halls place apprentices into whichever construction project needs them at that moment. There is no reason to expect that those who graduate from pre-apprenticeship training programs funded by Prop. 39 and succeed in entering an apprenticeship program would be channeled into Prop. 39 projects specifically, especially since these form a miniscule portion of public works construction in the state at any point in time. Prop. 39 projects can contribute to inclusion when they are implemented in schools where a community workforce agreement (CWA, described above and in Chapter 2) is already in place, or is newly created to cover the retrofit projects.



The California Conservation Corps' (CCC) Energy Corps training program serves at-risk youth and veterans providing job readiness skills and training in entry-level energy efficiency skills. Since program inception, 708 Corps members have learned to conduct basic energy surveys, while another 408 Corps members have trained to carry out simple energy efficiency retrofits such as lighting replacements. The CCC trainees completed more than 1,300 energy surveys that provide an inventory of building equipment and compilation of data use in t K-12 Schools, which the California Energy Commission used in its planning for the K-12 retrofits.¹¹³

2. Workforce Recommendations

a. Demand-Side Workforce Policy Levers

- ❖ **Use community workforce agreements (CWAs) in all Prop. 39 funded school retrofits over \$1 million or if there is already a PLA or CWA for construction in the school district.**

Prop. 39 already incorporates labor standards, including prevailing wages and apprenticeship standards. By using CWAs (as described in Chapter 2), Prop. 39 funded retrofit projects would also include targeted and/or local hire provisions that make it feasible to create career pipelines for disadvantaged workers, from pre-apprenticeship to state-certified apprenticeship—the best career pathway to help entry-level workers gain skills, receive wage increases as skills are acquired, and advance to a middle-class career as a skilled tradesperson.

b. Supply-Side Workforce Training

- ❖ **Participate in state-wide pre-apprenticeship strategy.**

It is much more effective for clean energy/energy efficiency programs to participate in the pre-apprenticeship strategy that is a key component of the statewide High Road Construction Careers initiative, as described Chapter 3 and below, in **Promising Practice #6.2**, than for each program to create its own new pre-apprenticeship program. The High Road Construction Careers framework can apply to all construction sector pre-apprenticeship initiatives in California, regardless of funding source and purpose. One opportunity that is unique to energy efficiency, but did not come to fruition when the training funds for the CCEJA were available, is the training of building services workers such as custodial staff and, in larger facilities, stationary engineers. These workers can play a significant role in behavioral changes that can reduce energy use in buildings (See **Promising Practice #3.3: Green Janitors Education Program** in Chapter 3).



PROMISING PRACTICE #6.2

Pre-Apprenticeship Programs for Structured Pathways Into Apprenticeship

Under the High Road Construction Careers (HRCC) initiative, the California Workforce Development Board (CWDB) oversees a suite of investments and policy initiatives to advance construction careers as a reliable pathway to the middle class for disadvantaged Californians. Through Prop 39 (California Clean Energy Jobs Act), SB 1 (Road Repair and Accountability Act), and related state programs, CWDB is investing nearly \$40 million in pre-apprenticeship partnerships across the state. These training partnerships link local building trades councils to workforce boards, community colleges, and community-based organizations, creating structured pathways—with a standard core curriculum and critical supportive services—to state-certified apprenticeships in a variety of skilled construction crafts. CWDB is working to connect such programs directly to regional labor market demand through expanded use of Community Workforce Agreements, which wrap targeted hire provisions into public climate and infrastructure projects. Beyond expanding access to registered apprenticeship, these efforts build systems and policies that directly advance the State Workforce Plan goals of equity (access to skills and economic opportunity) and job quality (connections to careers with decent wages and benefits).

There are many successful outcomes of pre-apprenticeship. For many, the ideal outcome

is placement into state-certified apprenticeship in the construction trades. For others, different jobs in the construction sector or pursuing higher education are the best outcome. Employment outside of the construction sector may be ideal for some who wish to pursue different careers altogether.

From 2014-2018, CWDB invested \$13.3 million in Prop 39 program funds to develop 12 construction pre-apprenticeship partnerships throughout the state that serve Californians with barriers to employment, including formerly incarcerated workers, veterans, and women. These pre-apprenticeship pilot programs included basic skills for construction as well as introductory material on energy efficiency that prepared participants to apply for, enter, and successfully complete a building trade apprenticeship program. The Prop 39 pilots have trained over 2,000 Californians and placed more than 1,300 Californians into construction career paths, with nearly half currently serving in state-certified apprenticeships. Note that this data is a snapshot in time; graduates move into apprenticeship slots over time, depending on demand and hiring calendar, which varies by trade. The outcome data from these pilots show extremely high job-placement rates, averaging 68 percent of the participants who completed training, as shown in **Exhibit 6.8**.



Exhibit 6.8. Performance Snapshot of High Road Construction Careers/Prop. 39 Pre-apprenticeship Program (2014-18)*

| Grantee | Enrolled (% of target) | Trained (% of enrolled) | Placed (% of trained) |
|---|---------------------------|----------------------------|--------------------------|
| Flintridge Center | 90% | 73% | 77% |
| Fresno | 88% | 92% | 61% |
| LA Trade Tech College | 96% | 66% | 51% |
| Marin/North Bay | 107% | 77% | 59% |
| Monterey | 104% | 79% | 78% |
| North Central Counties Consortium | 103% | 79% | 73% |
| Richmond Build | 100% | 100% | 73% |
| Rising Sun Energy | 102% | 85% | 96% |
| Sacramento Employment & Training Agency | 115% | 82% | 60% |
| San Francisco Conservation Corps | 96% | 65% | 50% |
| Urban Corps of San Diego | 123% | 68% | 100% |
| Work2Future (Bay Peninsula) | 106% | 86% | 74% |
| Total | 101% | 80% | 68% |

* Performance outcomes provided by CWDB.

This high success rate is presumably due to CWDB efforts to design a competitive solicitation for pre-apprenticeship investment using the best practices identified by the federal Department of Labor and others, including an emphasis on creating structured pathways into state-certified apprenticeship.¹¹⁴ The grants required that applicants:

- Use a standardized, core curriculum that leads to an industry-recognized credential, viz., the Multi-Craft Core Curriculum (MC3) and MC3 certificate;
- Include sponsorship by the local building trades councils to garner support and assistance from multiple trades;
- Be built on partnership agreements with local apprenticeship programs; community-based, community college or union training providers; employers/contractors; community-based

organizations; and local workforce development boards to assist in various pre-apprenticeship activities, from targeted recruitment and screening to training, supportive services, and placement;

- Calibrate training slots to realistic assessment of the demand for construction workers generally, and new apprentices specifically;
- Provide career pipeline support services that begin at recruitment and continue with mentoring for retention after placement; and
- Employ contextualized learning and other techniques appropriate for adult learners.

See **Promising Practice Example #3.1** in Chapter 3 for a description of one of the funded programs, Flintridge, which serves formerly incarcerated workers, and further discussion of pre-apprenticeship.



The model of training partnerships to deliver construction pre-apprenticeship under Prop. 39 now guides CWDB efforts to build a statewide system of construction pre-apprenticeship with funding from SB 1. Also known as the Road and Repair and Accountability Act, SB 1 will generate \$52.1 billion for numerous transportation improvements statewide through increases in the fuel tax and vehicle fees.¹¹⁵ SB 1 also mandates CWDB to develop guidelines for state and local agencies (in particular, agencies receiving funds from the Road Repair & Maintenance Account) to participate or invest in new or existing pre-apprenticeship programs. In addition, the Legislature appropriated \$5 million annually from fiscal year 2017-18 through FY 2021-22 to CWDB to invest in and expand high-road pre-apprenticeship training programs and partnerships.¹¹⁶ CWDB aims to invest in regionally-coordinated, MC3-based pre-apprenticeship partnerships aligned with construction demand, in each of the state's 14 labor regions.

Training partnerships will focus on building pathways to state-certified apprenticeship in the construction trades; apprentices are then hired and dispatched to any number of construction projects. The advantage of this approach, rather than seeking to place pre-apprenticeship graduates on SB 1-funded projects alone, is the leveraging of apprenticeship as a robust system of training and hiring/dispatch that provides for a life-long career in construction as opposed to one-off or temporary employment. The SB 1 Workforce Guidelines and investment to expand pre-apprenticeship programs will build upon CWDB's efforts under Prop 39, which resulted in placement rates and wage improvements that were high, especially compared with previous, entry-level training programs for energy efficiency and related activities.¹¹⁷

C3. IOU and CSD Low-Income Programs

Low-income weatherization programs are designed to save energy and lower energy costs for low-income families who may not be able to participate in incentive-based energy efficiency programs. In California, there are several different weatherization programs, each with its own funding stream. By far the largest low-income energy efficiency program is the IOU ratepayer-funded Energy Savings Assistance Program (ESA), which spent almost \$240 million in 2016 to weatherize some 190,000 homes.¹¹⁸ The federal weatherization program is the oldest program but is smaller and operates under slightly different rules and regulations than the IOU programs. Administered by the state Department of Community Services and Development (CSD), it provides about \$6.2 million per year for weatherization projects that are carried out by nonprofit providers around the state.¹¹⁹ Finally, the GGRF has provided a total of \$200 million of funding for low-income energy efficiency and distributed generation to the CSD to expand their weatherization program, but funding declined from about \$75 million per year in 2014-2016 to \$10 million in 2018-2019.¹²⁰ The CSD programs funded by the GGRF operate under looser rules than those attached to the federal funding, allowing CSD to experiment with alternative program design. Improving workforce outcomes has been articulated as one of the goals of the GGRF-funded efforts.



1. Workforce Outcomes

a. Job Growth

Our estimates of annual jobs from the low-income programs are based on an assumption of funding levels holding steady through 2030 for the IOU- and GGRF-funded programs. For the IOUs, spending about \$240 million per year yields more than 2,136 jobs per year, using a multiplier of 8.9 jobs per million dollars for weatherization programs. For the GGRF-funded CSD programs, if funding remains at the 2018-2019 level of only \$10 million per year, only about another 90 jobs would be created annually.

b. Job Quality

There is no official data on wages in the various low-income weatherization programs, but qualitative research has indicated that the IOU weatherization programs generate lower-wage jobs and have very limited career paths. The exception is the Los Angeles Department of Water and Power's low-income weatherization program, which directly hires weatherization workers, pays a living wage and full benefits, and provides training to create a pipeline into family-supporting careers. This program is described in detail below in **Promising Practice #6.3**. In contrast, the 2011 Needs Assessment found minimum wage jobs in the IOU weatherization programs, and unearthed evidence of sub-minimum wages paid in some piece rate jobs that pay workers by completion of tasks rather than by an hourly wage.¹²¹

Currently, no published studies have examined CSD weatherization workers' wages or career ladders, but the similarity of the IOU and CSD programs suggests that the same problems likely exist in both programs. Notably, CSD contracts out weatherization work to small non-profit organizations (some of whom have contracts with the IOUs as well), which constrains the agency's ability to provide upward mobility for weatherization workers.¹²² CSD has sought assistance from workforce development specialists on how to improve career outcomes for weatherization workers, and recommendations will be available from a commissioned report in 2019.¹²³ As of fall of 2018, CSD requires reporting on jobs and wages for contracted work funded by the GGRF, as stipulated in CARB's new reporting guidelines, but data will not be available until the FY 2018-19 program cycle is complete at the earliest.¹²⁴

c. Job Access

Although there is no quantitative data on inclusion of workers from disadvantaged communities, there are indications that the CSD and IOU programs have diverse workforces, largely because many of the non-profit organizations that are contractors for this work are situated in low-income communities and draw workers from their local constituencies. Assembly Bill 1393 (Wright, Chapter 700, Statutes of 1999)¹²⁵ supported inclusion in the ESA program by establishing competitive bidding criteria that



includes the bidder's ability to employ local residents, provide job training, and generally benefit the local low-income communities in which ESA is deployed.¹²⁶ However, the bill does not address job quality, and as emphasized throughout this report, inclusion efforts in programs in which the jobs are low wage simply replicate the racial and ethnic hierarchies in the labor market and do not lift workers from disadvantaged communities into career-track employment.

d. Workforce Development Infrastructure

The IOUs and CSD both provide a short two-week training program for their weatherization workers when they are hired. This class is designed to ensure that employees can meet the quality assurance standard for the weatherization programs. Training is not designed to provide the support, structured scope, and sequencing necessary for successful career development programs. The IOUs have also experimented with funding community colleges for weatherization training, but these collaborations were short-lived because the IOU need for inexpensive training for their weatherization contractors was incompatible with the community college mission of setting students on a training path into a family-supporting career.¹²⁷

The low-income weatherization program of the Los Angeles Department of Water and Power (LADWP) provides a starkly different model for how these programs can work, with much superior outcomes for workers. This program was explicitly designed to support both job quality and inclusion, as well as provide a service to LADWP's low-income customers.

The basic features of LADWP's Utility Pre-Craft Training (UPCT) program model can be applied in other low-income residential weatherization programs currently administered by POUs, IOUs, and state agencies, as well as non-low-income energy efficiency programs. These core features are, first, to mandate a living wage floor for workers employed by weatherization contractors and, second, to ensure that the contractors are linked to a pre-apprenticeship program with a track record of placing graduates in state-certified apprenticeship programs, so that weatherization work serves as the on-the-job component of that training.

These requirements can be incorporated into the solicitations that CSD or the IOUs use to contract with a program administrator or directly with weatherization contractors. If all contractors are required to provide a living wage floor, wages are taken out of competition, and contractors will not have the incentive to lower wages in order to win the bid. The 2014 Guidance Plan estimated the increase in cost for the IOU ESA program of implementing a wage floor, calculating that a wage floor of \$16.00 per hour would add less than 3 percent to the cost of weatherization projects, while significantly increasing incomes for low-wage weatherization workers.¹²⁸

Since many current weatherization contractors have not yet developed partnerships with apprenticeship programs in their region, the CSD or IOU solicitation process can



also be flexible enough to reward best-in-class contractors. Where there already are weatherization contractors who partner with or serve as pre-apprenticeship programs, these will receive higher scores in the solicitation for their region. But in regions where there are no available contractors that already have incorporated robust pipelines, contractors will be encouraged to develop these best practices but will not be excluded from contracts. As the CWDB did with the Prop. 39 grantees, the CSD and IOUs could set up Communities of Practice—i.e., workshops with grantees to share best practices and advance the field.

PROMISING PRACTICE #6.3 LADWP Utility Pre-Craft Training Program

The LADWP Utility Pre-Craft Training Program provides a best practice model that combines demand-side workforce policy with a robust training program to prepare and train disadvantaged workers. The program has a wage floor (\$16 per hour) and a career ladder, essentially using the training and work experience doing weatherization work as a pipeline into career-track utility work in trades. It was designed to expand the utility’s greenhouse gas emission reduction efforts by funding energy efficiency retrofits in low-income households while generating paid training and employment for entry-level utility workers.¹²⁹

The LADWP in-sourced weatherization work that had previously been performed by subcontractors. The utility created a new job classification and corresponding training program called the Utility Pre-Craft Training (UPCT) program. As an earn-while-you-learn pre-apprenticeship training program, UPCT works as a pipeline into a family-supporting career. The program recruits entry-level workers from disadvantaged communities who may lack the background needed to score high enough on civil service exams to be considered for direct, permanent employment in the public utility.

Once accepted into the program, pre-apprenticeship trainees become union members, even though they are “exempt” from civil service that is required for permanent public employees. As union members, UPCT trainees work as full-time, paid weatherization installers in LADWP’s low-income-targeted residential weatherization program, while receiving classroom and on-the-job training as well as online instruction to prep for civil service exams so that they can become eligible for permanent employment. The program established a wage floor of \$16.00 per hour with full family health benefits in 2012, when the minimum wage was \$8.00.¹³⁰

Participants also gain experience working in other parts of the utility, including in the warehouse and the water system. Once they are hired into an apprentice-level civil service position, graduates of the UPCT program are in the pipeline for many occupations, including line-worker, electrical mechanic, and steam plant operator. UPCT thus channels people into long-term careers with family-supporting wages and benefits, including health care, pension, and career training.



2. Workforce Recommendations

a. Demand-Side Workforce Policy Levers

❖ Use inclusive procurement policies for public procurement weatherization contracts.

Competitive solicitations for procuring weatherization contractors could be structured to encourage improvements in job quality by giving bidders an opportunity to disclose detailed information about the location, number, and quality of the jobs that would be created, as well as the number of disadvantaged workers to be hired, and incorporating these projected workforce outcomes in the ranking of bids.¹³¹

➤ Mandate wage floor for contractors.

The CSD and the IOUs should incorporate labor standards in their program requirements for contractors. This can be done by adopting a responsible contractor policy that includes a mandate of a living wage floor for contractors. Although there has been concern that a living wage floor will add to program costs, analysis shows that significant wage increases can be absorbed at very little additional overall cost. A wage floor would take wages out of competition between contractors and ensure that programs fully subsidized by public or ratepayer funds do not produce jobs with poverty-level wages.

➤ Give preference to contractors that use weatherization as on-the-job training in a pre-apprenticeship framework.

In solicitations for contracts to carry out weatherization work, the CSD and the IOUs have the opportunity to give preference to contractors that use weatherization as on-the-job training in a pre-apprenticeship framework. By providing added points in the ranking of bids to contractors who partner with apprenticeship programs, the CSD and the IOUs can encourage this best practice. Not all regions of California have robust pre-apprenticeship organizations with the capacity to integrate weatherization work, but where they exist, they should be supported and encouraged.

❖ Use insourcing (utility employees) for low-income programs.

Where feasible, utilities should use their own employees to carry out weatherization work and combine this work with a training program to create pipelines for disadvantaged workers into utility work, using the model developed by the LADWP's best-practice weatherization program, described above.



b. Supply-Side Workforce Development Strategies

❖ Participate in the statewide pre-apprenticeship training strategy.

Encourage weatherization contractors to participate in the statewide High Road Construction Careers initiative's pre-apprenticeship strategy by using weatherization work as on-the-job training for pre-apprenticeship, as outlined in the distributed generation recommendations above.

C4. Title 20 Appliance Efficiency and Title 24 Green Building Standards Codes

Building codes and appliance standards are also key to meeting the state's goal of doubling energy savings by 2030. As identified in the CEC's Existing Building Energy Efficiency Action Plan, codes and standards are responsible for meeting more than 25 percent of electricity savings, while more than one-third of the savings in natural gas is projected to come from codes and standards.¹³² Title 20, which governs appliance standards, is unlikely to impact jobs since the standards simply induce the replacement of older equipment with more efficient models without affecting installation work. The Title 24 Green Building Standards Code, which identifies the technical specifications for correct installation of more efficient equipment or materials in the built environment, has a more complex link to workforce.

The Title 24 Green Building Standards Code is designed to work in coordination with the utility incentive programs in the following way. The utility incentive programs help overcome cost and other barriers to voluntary adoption of energy efficient equipment, materials, and processes by buying down their cost for consumers; when there is sufficient voluntary adoption by the private market, the changes are mandated in building code instead of simply encouraged via rebate. The IOU programs thus shape the evolution of the market, cultivating a pool of contractors that then is positioned to capture the work once requirements are put into code. If those contractors are high-road employers that invest in a skilled workforce, the industry is more likely to evolve as a high-road industry, but if the pool of contractors that captures the rebate market compete more on cost than on quality, a low-road business model likely will persist as mandates replace rebates.

As a mandate on the whole private market, building codes do not directly address job quality or job access. In principle, building codes should ensure work quality, but in practice, lack of enforcement, lack of resources in local building inspection departments, and lack of workforce standards all can undermine work quality and, as described above, lower the amount of savings that could otherwise be achieved if technical specifications in installation were met.



In limited cases, codes require workforce standards. For example, in response to gaps between the engineering estimates and the ex-post realized energy savings from complex building energy systems, the CEC introduced a requirement for “acceptance testing” that provides additional testing and inspection to ensure compliance of energy efficiency standards for lighting and mechanical systems in non-residential buildings. Workforce qualifications are now required for the acceptance testers who perform the work. For example, acceptance testers for advanced lighting control systems are required to have specific skill certifications, either through the CALCTP, highlighted as a best practice in this and other reports, or the National Lighting Contractors Association of America.¹³³ The introduction of acceptance testing by qualified testers has partially rectified previous shortcomings of under-performing energy system upgrades and retrofits.

Building code compliance, acceptance testing, and workforce standards can all work together to ensure that quality work is performed. Such standards would increase the demand for workers with appropriate skills. This approach would likely have a positive impact on job quality, as well, since it will increase the demand for workers trained in the certified apprenticeship programs, the state’s best asset for construction sector training.

Our recommendations for skill standards are directed towards the IOU incentive programs rather than Title 24 code, except in unusual circumstances where more thorough inspection is needed for complex building energy systems, such as through acceptance testing.

D. Natural Gas

The scoping plan identifies natural gas as an important greenhouse gas, not just in natural gas power plants but also in end uses for space heating, water heating, cooling, and cooking, and due to the leakage of methane in natural gas extraction and transport through pipelines.¹³⁴ Given these various sources of greenhouse gas emissions from natural gas, the state is committed to multiple approaches for their reduction. The most important categories are: 1) increasing energy efficiency in natural gas end uses; 2) decreasing fugitive methane emissions; and 3) fuel switching away from fossil natural gas to both electrification and renewable natural gas. These strategies are embodied in a variety of recent and older laws and regulations. The same programs and policies governing energy efficiency measures in electricity cover natural gas efficiency as well, and since they were covered above, they will not be addressed here.

The electrification of heating, cooling, cooking, and other equipment in buildings that currently use natural gas—commonly referred to as building electrification—is a major focus for the State in its strategy to reduce greenhouse gas emissions from natural gas. A recent study on building electrification in California estimates that the electrification of



95 percent of all end uses in the building sector that currently rely on natural gas would eliminate between 10,600 and 14,200 jobs in natural gas extraction, transportation and distribution and generate about 11,400 jobs in electricity generation, transmission and distribution over a 30-year time frame.¹³⁵ Assessing the impacts on job quality and access from measures aimed at reducing natural gas usage and associated greenhouse gas emissions is difficult at this time, in part due to a lack of clear policy signals, particularly pertaining to building electrification and replacement of fossil natural gas with renewable natural gas; lack of research on the employment impacts of reducing fugitive methane emissions is also an issue. Nonetheless, concerns about lower job quality, training and skill standards, and less attention to increasing access for disadvantaged workers are likely to emerge as the natural gas sector undergoes changes that could end up diminishing the role of utility companies as the primary employer.

Jobs in natural gas transmission, distribution, and retail delivery are unionized and have decent wage floors, robust internal training, and career ladders. Maintaining these jobs in the utilities ensures job quality. Utility commitments to hiring from the local communities that they serve is likely to ensure inclusion, though lack of data precludes a conclusive assessment. Pipeline programs, like the LADWP Utility Pre-Craft Training Program described above, could be replicated in the natural gas occupations. The longevity of these jobs—for methane leakage abatement, in particular—should be assessed, however, before new inclusion programs are initiated. Finally, if natural gas power plants reduce their workforce or there is significant switching away from natural gas as a fuel for water heating, space heating, and cooking, then retraining and other supports for displaced workers may be needed as part of a just transition program, as described in Chapter 4.

IV. Other Major Transformations of the Electricity Sector

The electricity sector is undergoing major transformations that are disrupting the traditional utility model and the regulatory framework that has governed the electricity market for many decades. The increasing competitiveness of distributed energy resources and the rapid expansion of community choice aggregators (CCAs) and private providers have the potential to result in profound changes for workers in the industry, with changes in jobs, employers, wages, and working conditions. The social contract with workers in the form of robust investment in skills and family-sustaining wages and benefits is a major aspect of the public accountability that regulation has engendered, and yet its significance has been missing from many policy discussions of the changing utility model. The need for a holistic approach to ensure public accountability on this issue as well as on reliability, equity, and environmental impact suggests the need for an



industrial planning process that includes labor, community, and other stakeholders to ensure the development of a regulatory framework that can evolve as the industry itself evolves.

The possible integration of California’s grid with other states also has important implications for labor. Grid regionalization might lower the costs of the transition to low-carbon electricity, but it could also impact the number of jobs for California workers, the quality of the jobs, and the progress the state has made to ensure pipelines into good jobs for workers from historically marginalized communities. Outcomes depend, in part, on the amount of electricity that California imports from and exports to other states, as well as the labor standards in those states with which California’s grid is integrated. Consistent labor standards across jurisdictions would help maintain the commitment that California has made to a skilled, middle-class construction workforce that contributes to the local economy, performs quality work, and can adapt to innovation and technological change.

V. Key Recommendations for Low-Carbon Energy

Exhibit 6.9. Key Recommendations for Low-Carbon Energy

| Demand Side | |
|---------------------------------|---|
| Utility-Scale Renewables | <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement of large capital equipment, for contracts for public services, and in grants programs to incentivize Community Workforce Agreements on utility power purchase contracts. |
| Distributed Generation | <ul style="list-style-type: none"> ❖ Use skill standards in distributed generation incentive programs to ensure safe and proper performance. ❖ Focus resources on program models that operate at larger scale where skilled and trained workforce standards can be incorporated. For distributed generation, these include: <ul style="list-style-type: none"> ● Installation of larger distributed renewable projects; ● Support for solar installations in MUSH markets; and ● Focus on community-shared solar and explore bundling of individual rooftop solar projects. |



| Demand Side | |
|---|---|
| Utility Energy Efficiency Programs | <ul style="list-style-type: none"> ❖ Include responsible contractor standards in all IOU energy efficiency incentive programs. <ul style="list-style-type: none"> ● Incorporate skilled and trained workforce standards for contractors participating in IOU incentive programs. ● Utilize specialized certifications for emerging technologies, such as advanced lighting and other building controls. ❖ Phase incentives so that they first target those segments of the industry, such as the MUSH market, that have both higher emissions reductions per dollar invested and better workforce outcomes. ❖ Identify program models that increase the scale of projects, for example by targeting multi-family residential retrofits and district building electrification over models that only target single-family houses. Expand the use of community workforce agreements (CWAs) in IOU third party and local government contracts. ❖ Incorporate workforce analysis into emerging technology support programs. |
| Prop. 39 K-12 School Energy Retrofits | <ul style="list-style-type: none"> ❖ Use community workforce agreements (CWAs) in all Prop 39 funded school retrofits over \$1 million or if there is already a PLA or CWA for other construction in the school district. |
| Low-Income IOU and CSD Weatherization Programs | <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement weatherization contracts. <ul style="list-style-type: none"> ● Mandate wage floor for contractors. ● Give preference to contractors that use weatherization as on-the-job training in a pre-apprenticeship framework as in the High Road Construction Careers initiative. |
| Natural Gas | <ul style="list-style-type: none"> ❖ Develop a Just Transition plan if workers are at risk of displacement. |



| Demand Side | |
|---|--|
| Transformation of Electricity Sector | <ul style="list-style-type: none"> ❖ Incorporate in-state jobs, job quality, and job access as explicit goals in key proceedings and take steps to ensure that changes in the electricity system do not result in the degradation of wages and working conditions. ❖ Include labor unions and other worker representatives in industrial planning “tables” to address transformative changes in the electricity sector, including grid integration, distributed energy resources, CCAs, new regulatory models for a decentralized grid, etc. |
| All Energy Sub-Sectors | <ul style="list-style-type: none"> ❖ Incorporate workforce analysis into emerging technology support programs. ❖ Use job impact metrics to measure the impact of renewable energy and energy efficiency incentive and investment programs on quantity of jobs, job quality, and job access. |

| Supply Side | |
|--------------------------|---|
| All Energy Sector | <ul style="list-style-type: none"> ❖ Fund and participate in the pre-apprenticeship training strategy that is a key component of the statewide High Road Construction Careers initiative. <ul style="list-style-type: none"> ● Use solar rooftop and weatherization, and other low-skilled activities as on-the-job training for apprenticeship preparation. ❖ Support the development of skill-upgrade programs for incumbent workers through journey upgrade programs. ❖ Support the development of High Road Training Partnerships in Operations and Maintenance. <ul style="list-style-type: none"> ● Expand the Green Janitors Program to the MUSH sector. ● Support other industry training partnerships for stationary engineers and other operations of buildings and electricity generation. ❖ Track training program outcomes for graduation rates, attainment of Industry-recognized credentials, job placement, retention, wages and wage progression. |



Endnotes

- 1 California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2016: Trends of Emissions and Other Indicators,” 2018, https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.
- 2 Kevin de León, “SB-100 California Renewables Portfolio Standard Program: Emissions of Greenhouse Gases,” Chapter 312, Statutes of 2018 § (2018), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100.
- 3 Susan Eggman, “AB-693 Multifamily Affordable Housing Solar Roofs Program.,” Chapter 582, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB693.
- 4 Mike Gatto, “AB-2868 Energy Storage,” Chapter 681, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB2868.
- 5 Sam Blakeslee, “AB-1613 Energy: Waste Heat and Carbon Emissions Reduction Act,” Chapter 713, Statutes of 2007 § (2007), http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200720080AB1613.
- 6 Kevin Murray, “SB-1 Electricity: Solar Energy: Net Metering,” Chapter 132, Statutes of 2006 § (2006), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060SB1.
- 7 California Public Utilities Commission, “California Solar Initiative,” accessed January 2, 2019, <http://www.cpuc.ca.gov/General.aspx?id=6043>.
- 8 Go Solar California, “What Is The New Solar Homes Partnership?,” accessed January 2, 2019, <https://gosolarcalifornia.org/about/ns hp.php>.
- 9 Go Solar California, “Solar Incentive Programs by Utility,” accessed April 4, 2019, <https://www.gosolarcalifornia.org/utilities/munis.php>.
- 10 Jared Huffman, “AB-1470 Solar Energy: Solar Water Heating and Efficiency Act of 2007,” Chapter 536, Statutes of 2007 § (2007), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080AB1470.
- 11 Kevin de León, “SB-350 Clean Energy and Pollution Reduction Act of 2015,” Chapter 547, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.
- 12 Nancy Skinner, “AB-758 Energy: Energy Audit,” Chapter 470, Statutes of 2009 § (2009), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100AB758.



- 13 Mark Leno, “SB-1371 Natural Gas: Leakage Abatement,” Chapter 525, Statutes of 2014 § (2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1371.
- 14 Ben Hueso, “SB-1440 Energy: Biomethane: Biomethane Procurement,” Chapter 739, Statutes of 2018 § (2018), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1440.
- 15 Tim Grayson, “AB-3187 Biomethane: Gas Corporations: Rates: Interconnection,” Chapter 598, Statutes of 2018 § (2018), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB3187.
- 16 Maritza Correa et al., “Renewable Natural Gas: Insights and Recommendations for California” (TomKat Center for Sustainable Energy, Stanford University, April 2018), <https://stanford.app.box.com/s/6lfnipidxeoeuc4ix4rwg1xz7w0m8tdq>.
- 17 Betony Jones, Peter Philips, and Carol Zabin, “The Link Between Good Jobs and a Low Carbon Future” (UC Berkeley Donald Vial Center on Employment in the Green Economy, July 2016), <http://laborcenter.berkeley.edu/the-link-between-good-jobs-and-a-low-carbon-future/>.
- 18 Nikki Luke et al., “Diversity in California’s Clean Energy Workforce: Access to Jobs for Disadvantaged Workers in Renewable Energy Construction” (UC Berkeley Center for Labor Research and Education, August 31, 2017), <http://laborcenter.berkeley.edu/diversity-in-californias-clean-energy-workforce/>.
- 19 The Solar Foundation, “Solar Jobs Census 2017,” accessed November 12, 2018, <https://www.solarstates.org/#states/solar-jobs/2017>.
- 20 J.R. DeShazo, Julien Gattaciecceca, and Kelly Trumbull, “The Promises and Challenges of Community Choice Aggregation in California” (UCLA Luskin Center for Innovation, July 2017), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/The_Promises_and_Challenges_of_Community_Choice_Aggregation_in_CA.pdf.
- 21 Robert Collier, “High Road for Deep Water” (UC Berkeley Center for Labor Research and Education, November 2017), <http://laborcenter.berkeley.edu/pdf/2017/High-Road-for-Deep-Water.pdf>.
- 22 See Appendix A, Mapping Sectors to Industries and Occupations, for a list of the occupations classified as blue collar, professional, white collar, and managerial.
- 23 Luke et al., “Diversity in California’s Clean Energy Workforce.”
- 24 Byron Sher, “SB-1078 Renewable Energy: California Renewables Portfolio Standard Program,” Chapter 516, Statutes of 2002 § (2002), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200120020SB1078.



- 25 Joe Simitian, “SB-107 Renewable Energy: Public Interest Energy Research, Demonstration, and Development Program,” Chapter 464, Statutes of 2006 § (2006), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200520060SB107.
- 26 Joe Simitian, “SBX1-2 Energy: Renewable Energy Resources,” Chapter 1, Statutes of 2011 § (2011), http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.html.
- 27 Luke et al., “Diversity in California’s Clean Energy Workforce.”
- 28 The number of jobs per megawatt of renewable energy construction in the published studies varies enormously; we use the conservative estimates for both utility-scale and distributed renewables that are shown and explained in Jones, Philips, and Zabin, “The Link Between Good Jobs and a Low Carbon Future.”
- 29 California Energy Commission, “Tracking Progress,” accessed November 12, 2018, https://www.energy.ca.gov/renewables/tracking_progress/.
- 30 Jones, Philips, and Zabin.
- 31 Jones, Philips, and Zabin.
- 32 Jones, Philips, and Zabin.
- 33 Laura Buckley, Linda Rudolph, and Neil Maizlish, “Public Health Research Roadmap on Emerging Electricity Systems” (California Energy Commission, November 2017), <https://www.energy.ca.gov/2017publications/CEC-500-2017-035/CEC-500-2017-035.pdf>.
- 34 Luke et al., “Diversity in California’s Clean Energy Workforce.”
- 35 U.S. Department of Labor, Bureau of Labor Statistics, “Quarterly Census of Employment and Wages,” accessed January 2, 2019, <https://www.bls.gov/cew/>; IBEW Local 569, “IBEW and NECA to Strengthen Imperial County Green Energy Economy with New Electrical Training Center,” May 6, 2010, <http://www.ibew569.org/news/ibew-and-neca-strengthen-imperial-county-green-energy-economy-new-electrical-training-center?articleid=79&zoneid=3>.
- 36 IBEW Local 569, “Local Hire Successes: Imperial Clean Energy Projects,” June 4, 2013, 569.
- 37 U.S. Census Bureau, “QuickFacts: Imperial County, California; United States,” accessed November 26, 2018, <https://www.census.gov/quickfacts/fact/table/imperial-countycalifornia,US/PST045217>.



38 U.S. Census Bureau, “QuickFacts: California; Imperial County, California,” accessed November 26, 2018, <https://www.census.gov/quickfacts/fact/table/CA,imperial-countycalifornia/PST045218#viewtop>.

39 U.S. Census Bureau, “QuickFacts: Calexico City, California; United States,” accessed November 26, 2018, <https://www.census.gov/quickfacts/fact/table/calexicocity-california,US/PST045217>.

40 This vignette is taken from Peter Philips, “Environmental and Economic Benefits of Building Solar in California: Quality Careers — Cleaner Lives” (UC Berkeley Donald Vial Center on Employment in the Green Economy, November 10, 2014), <http://laborcenter.berkeley.edu/environmental-and-economic-benefits-of-building-solar-in-california-quality-careers-cleaner-lives/>. Information was updated by Micah Mitrosky, Environmental Organizer IBEW Local 569, Personal Communication, November 13, 2018.

41 Philips, 40.

42 Philips, 40.

43 Betony Jones et al., “The Net Economic Impacts of California’s Major Climate Programs in the Inland Empire: Analysis of 2010-2016 and Beyond” (Next 10, August 2017), <https://www.law.berkeley.edu/wp-content/uploads/2017/08/InlandEmpireNetImpacts.pdf>.

44 As noted above, there is some evidence that significant opportunities for disadvantaged workers have been created even without the full CWA language, especially through the use of the solar panel installer job classification that facilitates the expanded hiring of entry-level workers in the electrical trades. Other crafts may also have introduced similar entry-level job classifications, and analysis of the work trajectories of these entry-level workers is also important. It should be noted, however, that the solar panel classification is by far the most numerous of entry-level jobs in the construction of renewable energy plants, due both to the predominance of solar PV in the state’s mix of renewables and the predominance of the electrical trades in the construction of solar farms.

45 Jobs to Move America, “U.S. Employment Plan Fact Sheet,” October 2015, <https://metro council.org/getdoc/6a488e92-1879-4811-8cf8-9fc32ed636a5/BusinessItem.aspx>.

46 Uyen Le, “Project Labor Agreements: Pathways to Business Ownership and Workforce Development in Los Angeles” (UCLA Labor Center California Construction Academy, November 2011), <http://docplayer.net/1112166-Project-labor-agreements-pathways-to-business-ownership-and-workforce-development-in-los-angeles.html>.

47 California Public Utilities Commission, “Energy Storage,” accessed October 4, 2018, <http://www.cpuc.ca.gov/General.aspx?id=3462>.



- 48 U.S. Bureau of Ocean Energy Management, “California Activities - Offshore Wind,” 2018, <https://www.boem.gov/California/>.
- 49 Collier, “High Road for Deep Water.”
- 50 California Energy Commission, “Tracking Progress.”
- 51 California Energy Commission.
- 52 California Energy Commission, “Energy Commission Adopts Standards Requiring Solar Systems for New Homes, First in Nation,” May 9, 2018, http://www.energy.ca.gov/releases/2018_releases/2018-05-09_building_standards_adopted_nr.html.
- 53 Itron Consulting, “2017 SGIP Advanced Energy Storage Impact Evaluation” (California Public Utilities Commission, September 7, 2018), http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/Customer_Gen_and_Storage/2017_SGIP_AES_Impact_Evaluation.pdf.
- 54 Asal Esfahani et al., “California Solar Initiative—Annual Program Assessment” (California Public Utilities Commission, June 2018), http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/Energy_Programs/2018%20CSI%20APA_FINAL.PDF.
- 55 Lois Wolk, “SB-43 Electricity: Green Tariff Shared Renewables Program,” Chapter 413, Statutes of 2013 § (2013), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB43.
- 56 Jones, Philips, and Zabin.
- 57 Betony Jones and Carol Zabin, “Are Solar Energy Jobs Good Jobs?,” *Raising the Bar: UC Berkeley Labor Center Blog* (blog), July 2, 2015, <http://laborcenter.berkeley.edu/are-solar-energy-jobs-good-jobs/>.
- 58 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Employment and Wages, May 2017 47-2231 Solar Photovoltaic Installers,” Occupational Employment Statistics, accessed June 20, 2019, <https://www.bls.gov/oes/2017/may/oes472231.htm#ind>.
- 59 Philips, “Environmental and Economic Benefits of Building Solar in California”; Luke et al., “Diversity in California’s Clean Energy Workforce.”
- 60 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Employment and Wages, May 2017 47-2231 Solar Photovoltaic Installers.”



61 U.S. Department of Labor, Bureau of Labor Statistics, “California - May 2017 OES State Occupational Employment and Wage Estimates,” Occupational Employment Statistics, accessed June 24, 2019, https://www.bls.gov/oes/2017/may/oes_ca.htm, see 47-2231 Solar Photovoltaic Installers and 47-2111 Electricians.

62 The Solar Foundation, “2017 National Solar Jobs Census,” accessed November 26, 2018, <https://www.thesolarfoundation.org/national/>.

63 The Solar Foundation, “2018 National Solar Jobs Census,” 53, accessed June 24, 2019, <https://www.thesolarfoundation.org/national/>.

64 U.S. Department of Labor, Bureau of Labor Statistics, “California - May 2017 OES State Occupational Employment and Wage Estimates,” see 47-2231 Solar Photovoltaic Installers and 47-2111 Electricians

65 Jones, Philips, and Zabin, “The Link Between Good Jobs and a Low Carbon Future.”

66 The Solar Foundation, “Solar Jobs Census 2017.”

67 David J. Maume and George Wilson, “Determinants of Declining Wage Mobility in the New Economy,” *Work and Occupations* 42, no. 1 (February 1, 2015): 35–72, <https://journals.sagepub.com/doi/10.1177/0730888414552707>.

68 Carol Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014), <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>; Carol Zabin et al., “Advancing Equity in California Climate Policy: A New Social Contract for Low-Carbon Transition” (UC Berkeley Donald Vial Center on Employment in the Green Economy, September 13, 2016), <http://laborcenter.berkeley.edu/advancing-equity/>.

69 Carol Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response” (UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011), <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.

70 “Personal Communication with Jim Caldwell, Sector Navigator for Energy, Utilities and Construction, Chancellor’s Office, California Community Colleges,” November 17, 2017.

71 Costs of utility-scale solar power purchase agreements in 2015 were mostly in the range of \$0.05 per kWh, and some as low as \$0.03, as reported in Mark Bolinger and Joachim Seel, “Utility-Scale Solar 2015: An Empirical Analysis of Project Cost,



Performance, and Pricing Trends in the United States” (Lawrence Berkeley National Laborator, August 2016), http://eta-publications.lbl.gov/sites/default/files/lbni-1006037_report.pdf. Also, research done by the Brattle Group for First Solar shows that the cost of utility-scale solar comes to between \$0.066 and \$0.117 per KWh, customer-owned rooftop solar is between \$0.123 and \$0.193 per KWh, and for customer-leased rooftop solar, the cost is reportedly between \$0.14 and \$0.237 per KWh; see Bruce Tsuchida et al., “Comparative Generation Costs of Utility-Scale and Residential-Scale PV in Xcel Energy Colorado’s Service Area” (The Brattle Group, July 2015), <https://www.brattle.com/news-and-knowledge/publications/comparative-generation-costs-of-utility-scale-and-residential-scale-pv-in-xcel-energy-colorados-service-area>.

72 Go Solar California, “California Solar Statistics,” accessed November 26, 2018, https://www.californiasolarstatistics.ca.gov/reports/cost_vs_system_size/.

73 Betony Jones, “Creating Opportunities for Good Jobs in Distributed Solar,” *Raising the Bar: UC Berkeley Labor Center Blog* (blog), August 27, 2015, <http://laborcenter.berkeley.edu/creating-opportunities-for-good-jobs-in-distributed-solar/>.

74 Go Solar California, “California Solar Statistics.”

75 Severin Borenstein and Lucas Davis, “The Distributional Effects of U.S. Clean Energy Tax Credits,” *NBER Tax Policy and the Economy* 30, no. 1 (June 2016): 191–234.

76 Los Angeles Department of Water and Power, “LADWP Approves New Community Solar Power Program for Renters,” September 26, 2018, <http://www.ladwpnews.com/ladwp-approves-new-community-solar-power-program-for-renters/>.

77 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan”; Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”

78 California Energy Commission, “Doubling Energy Efficiency Savings,” accessed July 17, 2019, https://ww2.energy.ca.gov/sb350/doubling_efficiency_savings/.

79 Melissa Jones et al., “Senate Bill 350: Doubling Energy Efficiency Savings by 2030” (California Energy Commission, 2017), http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN221631_20171026T102305_Senate_Bill_350_Doubling_Energy_Efficiency_Savings_by_2030.pdf.

80 California Energy Commission, “2016 Existing Buildings Energy Efficiency Action Plan Update December 2016,” December 14, 2016, https://ww2.energy.ca.gov/efficiency/existing_buildings/16-EBP-01/.

81 California Energy Commission, “Tracking Progress.” Building codes also can mandate code compliance in existing buildings when triggered by permit requests for non-energy-related retrofits or remodeling.



- 82 Jones et al., “Senate Bill 350: Doubling Energy Efficiency Savings by 2030.”
- 83 California Energy Commission, “The California Clean Energy Jobs Act (Proposition 39 K-12 Program),” accessed December 5, 2018, <http://www.energy.ca.gov/efficiency/proposition39>
- 84 California Public Utilities Commission, “Income Qualified Assistance Programs,” accessed December 5, 2018, <http://www.cpuc.ca.gov/iqap/>; California Department of Community Services and Development, “Low-Income Weatherization Program Guidelines: Fiscal Year 2015-16 Appropriation Procurements: Single-Family Energy Efficiency; Single-Family Solar Photovoltaics,” November 30, 2017, http://www.csd.ca.gov/Portals/0/Documents/LIWP/LIWP-SF_ProgramGuidelines2015-16_FINAL_Amended_113017.pdf; Committee on Budget and Fiscal Review, “SB-101 Budget Act of 2015,” Pub. L. No. Chapter 321, Statutes of 2015 (2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB101; Committee on Budget, “AB-1613 Budget Act of 2016.,” Pub. L. No. Chapter 370, Statutes of 2016 (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB1613; Philip Ting, “AB-109 Budget Act of 2017,” Chapter 249, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB109.
- 85 Das Williams, “AB-802 Energy Efficiency,” Chapter 590, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB802.
- 86 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan Appendix H Major Climate Statutes and Regulations,” November 2017, https://www.arb.ca.gov/cc/scopingplan/2030sp_apph_climatestatutesref_final.pdf; see section H1: Low Carbon Energy Sector.
- 87 California Energy Commission, “2016 Existing Buildings Energy Efficiency Action Plan Update December 2016.”
- 88 Carol Zabin and Megan Emiko Scott, “Proposition 39: Jobs and Training for California’s Workforce” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2013), <http://laborcenter.berkeley.edu/proposition-39-jobs-and-training-for-californias-workforce/>.
- 89 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”
- 90 We used the customer contribution in IOU programs found in Betony Jones et al., “The Economic Impacts of California’s Major Climate Programs on the San Joaquin Valley” (Next 10, 2017), <http://laborcenter.berkeley.edu/the-economic-impacts-of-californias-major-climate-programs-on-the-san-joaquin-valley/>.



91 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response”; Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”

92 California Public Utilities Commission, “Decision on Large Investor-Owned Utilities’ 2012-2014 Energy Savings Assistance (ESA) (Formerly Referred to as Low Income Energy Efficiency or LIEE) and California Alternate Rates for Energy (CARE) Applications,” August 23, 2012, http://docs.cpuc.ca.gov/word_pdf/AGENDA_DECISION/172767.pdf; California Public Utilities Commission, “Decision Approving 2013-2014 Energy Efficiency Programs and Budgets,” November 8, 2012, <http://docs.cpuc.ca.gov/publisheddocs/published/g000/m034/k299/34299795.pdf>.

93 California Public Utilities Commission, “Decision Approving 2013-2014 Energy Efficiency Programs and Budgets,” 89–92 and 126-27.

94 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”

95 The 2014 WE&T Guidance Plan set forth a series of recommendations for redirecting IOU training funds, which largely mirrors the recommendations laid out in Chapter 3 in this report. These include:

- A program for curriculum upgrades and teacher training in apprenticeship and community colleges in occupations linked to priority emerging technologies:
- A program to support industry training partnerships focused on incumbent worker and new hire training; and
- A program to support a statewide strategy for pre-apprenticeship built on best practice inclusion programs in partnership with organizations with expertise in supporting disadvantaged workers.

96 California Public Utilities Commission, “Decision Addressing Energy Efficiency Business Plans,” May 31, 2018, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K706/215706139.PDF>.

97 Loni Hancock, “SB-54 Hazardous Materials Management: Stationary Sources: Skilled and Trained Workforce,” Chapter 795, Statutes of 2013 § (2013), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB54.

98 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan),” Appendix 2B, 9.

99 Michael Messenger, “Strategic Plan to Reduce the Energy Impact of Air Conditioners” (California Energy Commission, June 2008), <http://www.energy.ca.gov/2008publications/CEC-400-2008-010/CEC-400-2008-010.PDF>.



100 Southern California Edison Company, “Southern California Edison Company’s Energy Efficiency Rolling Portfolio Business Plan for 2018-2025,” January 17, 2017, 63, https://docs.wixstatic.com/ugd/0c9650_a0b40f88a30c4f0ab7b02d35f2360591.pdf; San Diego Gas & Electric Company, “Application of San Diego Gas & Electric Company (U 902-M) to Adopt Energy Efficiency Rolling Portfolio Business Plan,” January 17, 2017, 420, https://www.sdge.com/sites/default/files/SDGE%2520EE%2520BP%2520Application%2520FINAL%2520with%2520BP_2.PDF; Pacific Gas and Electric Company, “Energy Efficiency Business Plan 2018-2025,” 30, accessed July 31, 2018, https://docs.wixstatic.com/ugd/0c9650_cbeb1d9e14cf4575845e8d5cd6bce57f.pdf.

101 Primen and The Response Center, “California Residential California Residential Remodeling/ Renovation Remodeling/ Renovation Market Study Market Study,” July 2001, <http://www.calmac.org/startDownload.asp?Name=CA+RemodelES.pdf&Size=2685KB>.

102 American Council for an Energy Efficient Economy, “Cost-Effectiveness Tests: Overview of State Approaches to Account for Health and Environmental Benefits of Energy Efficiency,” ACEEE Topic Brief, December 2018, <https://aceee.org/sites/default/files/he-ce-tests-121318.pdf>.

103 Coalition for Energy Efficiency, “Final Comments on the SCE, PG&E, SDG&E and SoCalGas Business Plan Proposals” (California Public Utilities Commission, September 25, 2017), <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M196/K814/196814922.PDF>, at p. 16 (Citing SCE Response to CEE Data Request Question 44 [a-d] [Exhibit 4 to Comments]; Coalition for Energy Efficiency, “Final Comments on the SCE, PG&E, SDG&E and SoCalGas Business Plan Proposals Attachment 2” [California Public Utilities Commission, September 25, 2017], <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M196/K769/196769699.PDF>, SDG&E Responses to CEE Data Request Questions 9, 10 & 11 [Exhibit 3 to Final Comments]; PG&E Responses to CEE Data Request Questions 42 & 43 [Exhibit 1 to Final Comments]; SoCalGas Response to CEE Data Request Question 40 [Exhibit 2 to Final Comments]. September 25, 2017], <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M196/K769/196769699.PDF>.

104 Committee on Budget and Fiscal Review, “SB-73 Energy: Proposition 39 Implementation,” Chapter 29, Statutes of 2013 § (2013), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB73.

105 Carol Zabin, Kevin Duncan, and Erica Paul, “Proposition 39 Job Creation & Quality, 2014-2018: A Report to the Citizens Oversight Board of the California Clean Energy Jobs Act” (California Workforce Development Board, 2019), https://www.energy.ca.gov/efficiency/proposition39/citizens_oversight_board/documents/2019_COB_Final_Report/APPENDIX_D-CALIFORNIA_WORKFORCE_DEVELOPMENT_BOARD_PROPOSITION_39_JOBS_REPORTING_METHODODOLOGY_AND_INNOVATION_REPORT.pdf.



106 Because this program was created by closing a tax loophole and actually brought new money into the state, a full jobs accounting (including indirect and induced spending) was justified, and the result was 10,056 jobs.

107 Zabin, Duncan, and Paul, “Proposition 39 Job Creation & Quality, 2014-2018: A Report to the Citizens Oversight Board of the California Clean Energy Jobs Act,” 39.

108 Funding also was allocated to the California Conservation Corps to carry out an inventory of energy systems in the K-12 schools; this could be considered a training program. See references to the CCC in Chapter 3 on pipeline programs and Chapter 11 on forestry services.

109 California’s Citizens Oversight Board, “Proposition 39 Clean Energy Jobs Act Report to the Legislature,” March 2018, https://www.energy.ca.gov/efficiency/proposition39/citizens_oversight_board/documents/3rd_annual_report/CCOB_3rd_Annual_Report_2018_With_Appendices.pdf.

110 California Community Colleges, “Strong Workforce Program,” accessed November 15, 2018, <http://doingwhatmatters.cccco.edu/strongworkforce.aspx>.

111 Jim Caldwell, “The Facility Management Talent Pipeline: California Statewide Plan” (California Community Colleges - Energy, Construction, & Utilities Sector, February 16, 2016), <https://foundation.ifma.org/docs/default-source/gwi-resources/california-state-wide-plan-for-the-facility-management-talent-pipeline-02-2017.pdf?sfvrsn=2>.

112 James Beall, “SB-1 Transportation Funding,” Chapter 5, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billStatusClient.xhtml?bill_id=201720180SB1.

113 California’s Citizens Oversight Board, “Proposition 39 Clean Energy Jobs Act Report to the Legislature.”

114 California Department of Industrial Relations, Division of Apprenticeship Standards, “Best Practices: Preparation for Apprenticeship Training,” accessed November 13, 2018, <https://www.dir.ca.gov/das/BP-Pre-Apprenticeship.pdf>; Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response”; Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).”

115 California Department of Transportation, “SB 1 Overview,” Rebuilding California SB1, accessed November 14, 2018, <http://rebuildingca.ca.gov/overview.html>.

116 Metropolitan Transportation Commission, “MTC Overview of SB 1 (Beall and Frazier),” May 3, 2017, https://mtc.ca.gov/sites/default/files/MTC_SB_1_Bill_Summary_5-3-17.pdf.

117 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response,” 178.



118 California Public Utilities Commission, “CPUC Low Income Energy Programs California Alternate Rates for Energy Fact Sheet,” April 20, 2017, <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442453786>.

119 California Department of Community Services and Development, “Weatherization Assistance Program for Low-Income Persons: Amended Draft 2017 State Plan and Application to the U.S. Department of Energy,” May 15, 2018, available via Internet archive at <https://web.archive.org/web/20190601020538/http://www.csd.ca.gov/Portals/0/Documents/Public%20Notices/2017%20DOE%20WAP%20State%20Plan.pdf>.

120 California Air Resources Board, “Greenhouse Gas Reduction Fund Appropriations by Fiscal Year (As of August 31, 2018),” August 31, 2018, available via Internet archive at https://web.archive.org/web/20190228191421/https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/detail_appropriation_8_31_18.pdf/.

121 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.” This information was obtained through interviews with contractors, former workers, and training providers for this program, but did not carry out a representative survey.

122 For overlap in Southern California, for example, see the list of contractors for Southern California Gas Company: Southern California Gas Company, “Authorized Contractors,” SoCalGas, accessed June 24, 2019, <https://www.socalgas.com/save-money-and-energy/assistance-programs/authorized-contractors>; and the CSD contractors here: California Department of Community Services and Development, “Energy Services Providers; Community Services Providers,” accessed June 24, 2019, available via Internet archive at [https://web.archive.org/web/20190601015418/https://www.csd.ca.gov/Services/FindServicesinYourArea/SanDiego\(CUI\).aspx](https://web.archive.org/web/20190601015418/https://www.csd.ca.gov/Services/FindServicesinYourArea/SanDiego(CUI).aspx).

123 California Department of Community Services and Development and Low Income Weatherization Program Regional Administrators RFP, “Building Workforce Partnerships,” November 15, 2016, available via Internet archive at <https://web.archive.org/web/20161216194800/http://www.csd.ca.gov/Portals/0/Documents/LIWP/Bidders%20Library/Presentations/CSD%20-%20Workforce%20Partnerships%20161115%20FINAL.pdf>.

124 California Air Resources Board, “CCI Quantification, Benefits, and Reporting Materials,” accessed May 23, 2019, <https://ww2.arb.ca.gov/resources/documents/cci-quantification-benefits-and-reporting-materials>.

125 Rod Wright, “AB-1393 Low-Income Electric and Gas Customers,” Pub. L. No. Chapter 700, § 2790, 327, 381.5, Public Utilities Code (1999), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=199920000AB1393.

126 Wright.



- 127 Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”
- 128 Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan),” Appendix 4B, 94.
- 129 Ellen Avis and Carol Zabin, “Training for the Future, Workforce Development for a 21st Century Utility Los Angeles’s Utility Pre-Craft Trainee Program” (UC Berkeley Donald Vial Center on Employment in the Green Economy, 2013), http://laborcenter.berkeley.edu/pdf/2013/training_future13.pdf.
- 130 California Department of Industrial Relations, Industrial Welfare Commission, “History of California Minimum Wage,” accessed December 5, 2018, <https://www.dir.ca.gov/iwc/MinimumWageHistory.htm>.
- 131 Jobs to Move America, “U.S. Employment Plan Fact Sheet.”
- 132 California Energy Commission, “2016 Existing Buildings Energy Efficiency Action Plan Update December 2016.”
- 133 California Energy Commission, “Acceptance Test Technician Certification Providers,” accessed November 13, 2018, <https://www.energy.ca.gov/title24/attcp/providers.html>.
- 134 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan.”
- 135 Betony Jones et al., “Employment Impacts and Just Transition Considerations Related to the Electrification of California Buildings,” forthcoming.



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Chapter 7: Sustainable Transportation

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I. Overview of the Sector and Key Climate Policies

A. Overview of the Sector

California's transportation sector is the state's largest source of greenhouse gas emissions, accounting for 39 percent of the statewide total.¹ It is also the largest source of criteria air pollutants and toxic diesel particulate matter emissions in the state. At the same time, the transportation system underpins our economy. The freight system moves trillions of dollars of goods each year, supporting nearly one-third of the state economy and more than 5 million jobs. In addition, passenger vehicles move people a total of 342,000 miles per day.² The state's transportation sector depends largely on petroleum-based fuels, with 91 percent of the roughly 29.8 million vehicles in the state relying exclusively on either gasoline or diesel for fuel.³ The central role of sustainable transportation in mitigating climate change underscores the importance of addressing workforce issues in order to deliver skills to employers in this industry and ensure positive outcomes for workers as the transition to low-carbon transportation proceeds. With emissions from the transportation sector continuing to rise despite increases in fuel efficiency and decreases in the carbon content of fuel, California will not achieve the necessary greenhouse gas emissions reductions to meet mandates for 2030 and beyond without significant changes to how communities and transportation systems are planned, funded, and built.⁴

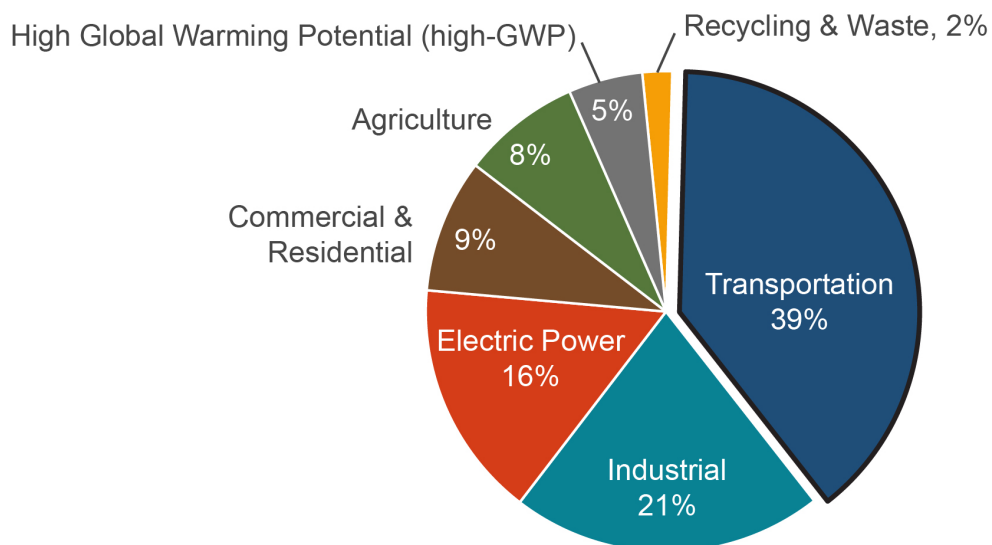
Exhibit 7.1 shows the current emissions from transportation as a portion of the state's total emissions.

Exhibit 7.2 shows the trends in emissions (in million metric tons of carbon dioxide equivalent, or MMTCO₂e) from transportation over time: first for 1990, the reference year for percentage reductions; for 2017, the most recent data at the time of writing; and finally, the estimated range of emissions in 2030 from implementing the measures identified in the Scoping Plan. Missing from this figure are the expected emission reductions from the Cap-and-Trade Program. Since this market-based program covers all large sources of greenhouse gas emissions across sectors and does not predetermine where emission reductions will occur, its projected impact in each sector cannot be specified.

The transportation sector involves both goods movement and people movement. In general, these two subsectors have quite different dynamics and will be treated separately in this chapter when these differences affect jobs and workers. The term "light-duty" vehicles refers to cars, pick-up trucks, and minivans, which are still mostly operated by individual owners for their personal use, while the terms "medium-duty" and "heavy-duty" vehicles refer to trucks, buses, and other vehicles that are operated for commercial and public purposes.

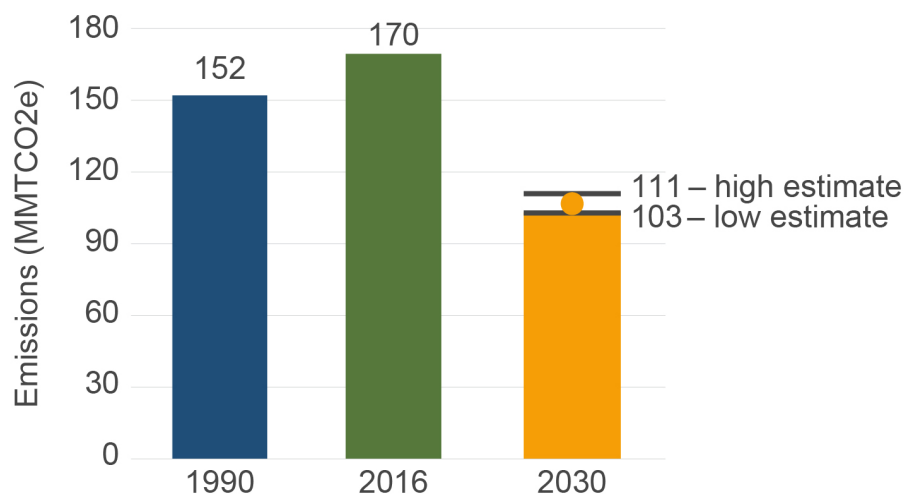


Exhibit 7.1. Transportation Sector Emissions (MMTCO₂E) as of 2017



Source: California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019, https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf.

Exhibit 7.2. Transportation Sector Emissions, 1990 and 2017, and Expected Range of Emissions in 2030 after Implementation of Scoping Plan Measures



Sources: 1990 levels and 2030 GHG emissions targets: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” page 31, table 3, November 2017, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf; 2017 levels from: California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.



Passenger travel accounts for 70 percent of all greenhouse gas emissions within the state's transportation sector. It is mostly characterized by individual drivers and household car ownership, although a small portion of passenger travel is by public transit, taxis, or transportation network companies (TNCs). In 2017, the state had 25.4 million registered automobiles and 26.9 million licensed drivers.⁵

In 2014, freight-dependent businesses generated an estimated \$740 billion in revenue and employed more than 5 million people.⁶ Trucking is the primary mode of goods movement within California and serves as a critical link between other freight transportation modes (e.g., rail, air, and ship). While medium- and heavy-duty vehicles make up a small number of the total vehicles in the state—just under 1 million out of 30 million, or around 3 percent—they account for 22 percent of the state's on-road greenhouse gas emissions because of their size, extensive usage (mileage and hours of operation), and almost complete reliance on petroleum-based fuels, primarily diesel fuel.⁷ Because truck freight accounts for most of the demand for cargo movement, developing and deploying zero- and low-emission technologies in trucking is a major priority in reducing greenhouse gas emissions from transportation. Ports, railroads, and warehouse/distribution centers also play vital roles in California's multi-modal freight system and the state's economy. Due to resource constraints, however, this report only addresses trucking; more comprehensive research on the entire multi-modal freight sector and its component parts should be investigated in future studies.

As in other sectors, job quality and job access outcomes vary significantly among the subsectors identified in the Scoping Plan transportation sector. Some subsector entities, including public transit agencies and some vehicle manufacturing businesses, invest in training and provide family-supporting jobs to a diverse workforce. Others, such as short-haul port trucking and last mile delivery, have some of the worst labor conditions in California, and these low-road practices create obstacles for climate policy implementation, as discussed in the section on trucking. This chapter highlights current efforts to support high-road labor practices and offer recommendations on expanding their application and replication where feasible.

B. Key Climate Policies

To meet California's greenhouse gas emission reduction targets and enhance economic competitiveness, the state has prioritized a comprehensive set of sustainable transportation strategies. These strategies, which include various policies and programs, fall into three broad, but interrelated categories:

1. Supporting the manufacture and purchase of cleaner vehicles;
2. Promoting the development, production, and large-scale use of cleaner fuels; and
3. Reducing the number of vehicle miles traveled through coordinated transportation, housing, and land use planning.



This report focuses on the following select policies, which are included in *California's 2017 Climate Change Scoping Plan*:⁸

❖ **Cleaner Vehicles**

➤ **Advanced Clean Cars Program [people-moving subsector]**

Adopted by the California Air Resources Board (CARB) in 2012, the Advanced Clean Cars Program is a suite of regulations that aim to reduce greenhouse gas emissions and smog-forming pollutants by setting phased emission reduction standards for vehicles for sale in the state. The program's Low Emission Vehicle (LEV) standards set targets for automakers for cars sold in California to reduce smog-forming pollutants by 75 percent and cut greenhouse gas emissions by 35 percent by 2025.⁹ The policy also establishes mandates for the adoption of zero-emission vehicles (ZEVs) by requiring automakers to produce a growing number of zero-emission passenger cars and light-duty trucks. The ZEV Regulation sets annual sales targets, which are calculated as credits. Automakers can comply with the regulation by earning credits for the ZEVs they produced by purchasing credits from a different manufacturer.¹⁰

➤ **Low Carbon Transportation Investments and Air Quality Improvement Program (AQIP) [both people-moving and goods-moving subsectors]**

These programs offer incentives and other financial assistance that help consumers and businesses purchase low-emission, advanced technology vehicles and help ease the transition to the State's various policy and regulatory mandates. Some programs provide grants to support the development and deployment of emerging clean vehicle technologies, particularly in the medium- and heavy-duty classes.¹¹

With over \$2 billion appropriated by the Legislature (not all of which has been implemented yet) since fiscal year 2013-14, Low Carbon Transportation Investments have supported the following programs: Clean Vehicle Rebate Project (CVRP), Enhanced Fleet Modernization Program (EFMP) Plus-Up, Clean Mobility Options for Disadvantaged Communities, Financing Assistance for Lower-Income Consumers, Agricultural Worker Vanpools, Clean Truck & Bus Vouchers, Advanced Technology Freight Demonstrations, the Rural School Bus Pilot Project, and others.

AQIP has funded \$362 million worth of investments since fiscal year 2008-09, and had supported a number of different programs prior to the establishment of the aforementioned Low Carbon Transportation Investments. In the last few years, AQIP funding has been dedicated to the Truck Loan Assistance Program,



which helps small-business fleet owners (i.e., fleets with no more than 10 trucks) affected by CARB's In-Use Truck & Bus Regulation secure financing for newer, lower-emission model trucks or diesel exhaust retrofits.¹² Implemented through a partnership between CARB and the California Pollution Control Financing Authority (CPCFA), this loan assistance program is dedicated to serving small business truck owners that do not meet conventional lending criteria and therefore cannot qualify for traditional financing for cleaner truck purchases or retrofits.

Within the State's broader Low Carbon Transportation Investments portfolio, Senate Bill 1204 (Lara, Chapter 524, Statutes of 2014)¹³ sets forth the State's approach to developing and commercializing heavy-duty vehicles specifically. CARB's Technology Program develops the SB 1204 ZEV Heavy Duty strategy with the mission of "develop[ing]...a sequenced roadmap, one that recognizes the different stages of the commercialization process for each technology." This strategy identifies beachhead technologies, notably zero-emission transit buses, medium-duty trucks, and later drayage trucks, as key products that can advance the market, with the aim of enabling future development of strategies to adopt ZEVs in heavier duty markets, where technologies are less ready and market conditions are more challenging.

➤ **Federal Phase 2 Heavy-Duty Greenhouse Gas Standards [goods-moving subsector]**

Federal Phase 2 heavy-duty greenhouse gas standards are emission standards on medium- and heavy-duty vehicles sold in California. Often referred to simply as Phase 2 standards, these rules cover tractors, trailers, vocational vehicles, heavy-duty pickups, and vans. Phase 2 continues the improvements in engine and vehicle efficiency that were initiated by the Phase 1 efficiency standards, incorporating increasingly stringent requirements that are made possible over time as new technologies become available.

California will largely harmonize with the 2016 Federal Phase 2 greenhouse gas emission standards issued by the Obama Administration. If permissible, the state may go beyond the federal standards in several areas, in particular to encourage the use of zero-emission vehicles (ZEVs) and to set stricter vehicle emissions standards for local trucks, a critical necessity given the growth in last-mile delivery as a result of e-commerce.¹⁴

➤ **Mobile Source Strategy [both subsectors] and Sustainable Freight Action Plan [goods-moving subsector]**

The Mobile Source Strategy (MSS) is a 2016 CARB plan aimed at attainment of federal air quality standards primarily, while aligned with and helping California



to achieve state mandates and targets for reducing greenhouse gas emissions, including short-lived climate pollutants (e.g., methane and black carbon), over the next 15 years. The strategy is a coordinated set of efforts to foster cleaner technologies and fuels and greater efficiencies in the freight sector, and many of the state strategies are still in development. The MSS as a whole encompasses engine emissions standards, including the Phase 2 standards, durability and inspection requirements, sales requirements for new technology, funding for demonstration projects, and consumer and business incentives. A very wide range of technology and fuel options can be drawn upon to achieve the MSS goals, from electric vehicles to cleaner diesel engines. Key provisions for trucks include new standards for 90-percent reduction in emissions of nitrogen oxides (NOx) by 2024 and the introduction of zero-emission vehicles. One major planning tool to carry out the Mobile Source Strategy is the California Sustainable Freight Action Plan, which identifies pathways to transition California freight equipment to zero-emission operation, improve freight system efficiency, and increase the competitiveness of California's freight sector.¹⁵

❖ **Cleaner Fuels**

➤ **Low-Carbon Fuel Standard [both subsectors]**

The Low-Carbon Fuel Standard (LCFS) aims to shift California from petroleum-based transportation fuels to low-carbon alternatives through mandates on the carbon intensity of fuels. The program requires a reduction in the carbon intensity of transportation fuels of at least 7.5 percent by 2020 and at least 20 percent by 2030, as compared to 2010 levels. Carbon intensity refers to the amount of greenhouse gas emissions associated with all steps of producing, transporting, and consuming a fuel, measured in grams of carbon dioxide per megajoule of energy. This approach accounts for the full life cycle of a fuel, from well to wheels.¹⁶

LCFS sets an average carbon intensity standard that declines annually throughout the term of the program, and it uses a credit system to facilitate the least-cost approach to achieving the targets. LCFS is a market-based mechanism, which allows fuel suppliers to develop blends in response to consumer demand. Low-carbon fuel use has increased.¹⁷

The reductions in carbon intensity of fuel have come from two main sources: the electrification of vehicles replacing gasoline and increased use of biomass-based fuels in the diesel sector. Electricity use in California grew from less than 0.5 million gasoline gallons equivalent (gge) in 2011 to 96 million gge in 2018.¹⁸ Electrification requires the installation of electric vehicle charging infrastructure



(including charging stations), and modifications to the LCFS now allow credits to be earned for charging infrastructure that is built.¹⁹ Biomass-based diesel—i.e., biodiesel and renewable diesel—use in California grew from 14 million gallons in 2011, rising markedly to 568 million gallons in 2018.²⁰

➤ **Alternative and Renewable Fuel and Vehicle Technology Program [both subsectors]**

The Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) is a funding program administered by the California Energy Commission (CEC) targeting both cleaner fuels and cleaner vehicles. The program directs nearly \$100 million in annual funds to demonstrate advanced, clean fuel and vehicle technologies. Through this program, the CEC has been the state's principal investor in charging and refueling infrastructure for zero-emission vehicles in California, particularly electric vehicle charging stations.²¹ The funding areas for ARFVTP include: electric vehicle charging infrastructure; hydrogen refueling infrastructure; research, development and demonstration projects for renewable natural gas and biofuels; clean vehicle and equipment manufacturing; and workforce development.

➤ **Clean Energy and Pollution Reduction Act (Senate Bill 350) [both subsectors]**

Senate Bill 350 (de León, Chapter 547, Statutes of 2015)²² is a comprehensive climate law that emphasizes widespread transportation electrification as a means of achieving California's 2030 greenhouse gas emission reduction target; the law also advances clean energy deployment in the state as described in Chapter 6. The law includes a requirement to increase access to the use of electricity as a transportation fuel for all mobile sources by directing the large electric utilities to consider transportation electrification in their integrated resource planning, including ensuring sufficient development of electric vehicle charging infrastructure.

➤ **Cap-and-Trade Program (Assembly Bill 32 and Assembly Bill 398) [both subsectors]**

In 2015, California's Cap-and-Trade Program began to cover transportation fuels, requiring fuel sellers to lower emissions or purchase emission allowances. Assembly Bill 398 (E. Garcia, Chapter 135, Statutes of 2017)²³ codified the state's Cap-and-Trade Program for the 2021-2030 period. This ensures that the program will continue and will constitute a strong incentive to move away from petroleum-based transportation fuels via electrification and other changes in transportation systems and technologies.



❖ Reduced Vehicle Miles Traveled (VMT)

➤ Sustainable Communities Act (Senate Bill 375) [people-moving subsector]

Senate Bill 375 (Steinberg, Chapter 728, Statutes of 2008)²⁴ supports the State’s climate goals by helping reduce transportation-sector emissions through coordinated transportation, housing, and land use planning. SB 375 requires each of California’s metropolitan planning organizations (MPOs) to create a Sustainable Communities Strategy (SCS) as an element in Regional Transportation Plans (RTPs). Each SCS must document the regional strategies governments will use to meet 2020 and 2035 greenhouse gas reduction targets set by CARB.²⁵

SB 375 supports transportation, housing, and land use strategies and projects that help reduce the number of passenger vehicle miles traveled by light-duty vehicles. The two primary approaches include mode shift from single-occupancy vehicles to active transportation, including walking, bicycling, and public transit, and infill and transit-oriented development to reduce the distance between homes and non-residential areas and increase access to public transit service. Additionally, SB 375 provides California Environmental Quality Act (CEQA) streamlining incentives available to regional and local jurisdictions that demonstrate consistency with the targets for transit priority projects (TPPs) that include the following characteristics: 1) a mix of land uses; 2) a minimum density of at least 20 dwelling units per acre; and 3) close proximity (i.e., within one half-mile) to a major transit stop.²⁶

➤ Senate Bill 743 (Environmental Quality & Transit-Oriented Infill Projects) [people-moving subsector]

Signed into law in 2013, Senate Bill 743 (Steinberg, Chapter 386, Statutes of 2013)²⁷ alters the process for conducting transportation impact analyses for developments under CEQA review. These changes aim to help achieve statewide goals related to promoting infill development, public health, and reduced greenhouse gas emissions by streamlining the approvals process for developments that support transit and non-motorized travel.²⁸

The law shifts the primary metric for transportation impact analyses from level-of-service (LOS) to vehicle miles traveled (VMT). Under new guidance, local jurisdictions are now required to incorporate the impact on VMT in their consideration of alternative development projects. This requirement is made operational by assuming that certain developments (e.g., residential, retail, mixed-use, and office buildings) located within a half-mile of a major transit stop or within a high-quality transit corridor “will have a less-than-significant impact on VMT” if they meet higher density and reduced parking requirements.²⁹



➤ **Active Transportation Program (Senate Bill 99) [people-moving subsector]**

The Active Transportation Program, (Senate Bill 99, Committee on Budget and Fiscal Review, Chapter 359, Statutes of 2013)³⁰ aims to increase the share of trips made using non-motorized (or active) transportation, like walking and bicycling. The program's total funding for fiscal year 2017-18 was \$190 million. This includes 5, Statutes of 2017)³¹ that will ensure a reliable on-going funding source.³² In the program's first two-year cycle, it awarded slightly more than \$350 million for 267 projects throughout the state.³³ Eligible projects include: 1) infrastructure improvements that increase safety for people who walk and bike; 2) non-infrastructure improvements that focus on education and training; and 3) planning for community-wide bicycle and pedestrian improvements.³⁴

II. Industries and Occupations

To reduce transportation-sector emissions and build sustainable transportation systems, public and private dollars will need to be invested in new and cleaner vehicles, cleaner fuel distribution systems, and planning and infrastructure upgrades that increase public transit use and promote more sustainable land use patterns. For cleaner vehicles and fuels, the state supports this transition through a combination of mandates on the production of vehicles and fuels complemented by subsidies for consumers and businesses who purchase and operate vehicles. For example, the ZEV regulation in the Advance Clean Cars Program requires automakers to produce a certain number of ZEVs based on their total annual vehicle sales in the state. The Low Carbon Transportation Investments and Air Quality Improvement Program (AQIP) then offer rebates, vouchers, grants, and low-interest loans to individuals and fleets to lower the purchase cost of low- and zero-emission vehicles. To reduce vehicle miles traveled, the state uses a combination of public and private infrastructure investment and changes in local transportation and land-use regulations and practices in collaboration with local jurisdictions and private entities such as insurance and development companies.

In terms of overall investment, it is important to note that the state's suite of policies to support cleaner vehicles, cleaner fuels, and reduced vehicle miles traveled represents a fraction of all such investments in California. According to the most recent estimate available, the private sector provided 91 percent of the total investment in alternative and renewable fuels and cleaner vehicle technologies in 2012, dwarfing public investment in these two areas at that time.³⁵ Still, public investments present unique opportunities to implement policies that promote better labor outcomes and support high-road employers in key advanced transportation industry sectors, including construction, transit and ground passenger transportation,³⁶ alternative motor vehicles and equipment, alternative



fuels, alternative fueling infrastructure, energy storage, and freight logistics.³⁷ The next few years present a particularly important window for developing high road ZEV policies across sectors.

This report addresses the following industries that are the main focus of the Scoping Plan transportation sector. Due to resource constraints, this report does not address freight rail, maritime, and air transport.

❖ **Vehicle Manufacturing**

- **Light-, Medium-, and Heavy-Duty Vehicle Manufacturing**

❖ **Trucking Operations and Maintenance**

- **Short- and Long-Haul Truck Driving**
- **Truck Repair and Maintenance**

❖ **Transit and Ground Passenger Transportation**

- **Public Transit**
- **Private Passenger Mobility Services (Transportation Network Companies, i.e., ride-sourcing platforms)**
- **Vehicle Repair and Maintenance**

❖ **Construction**

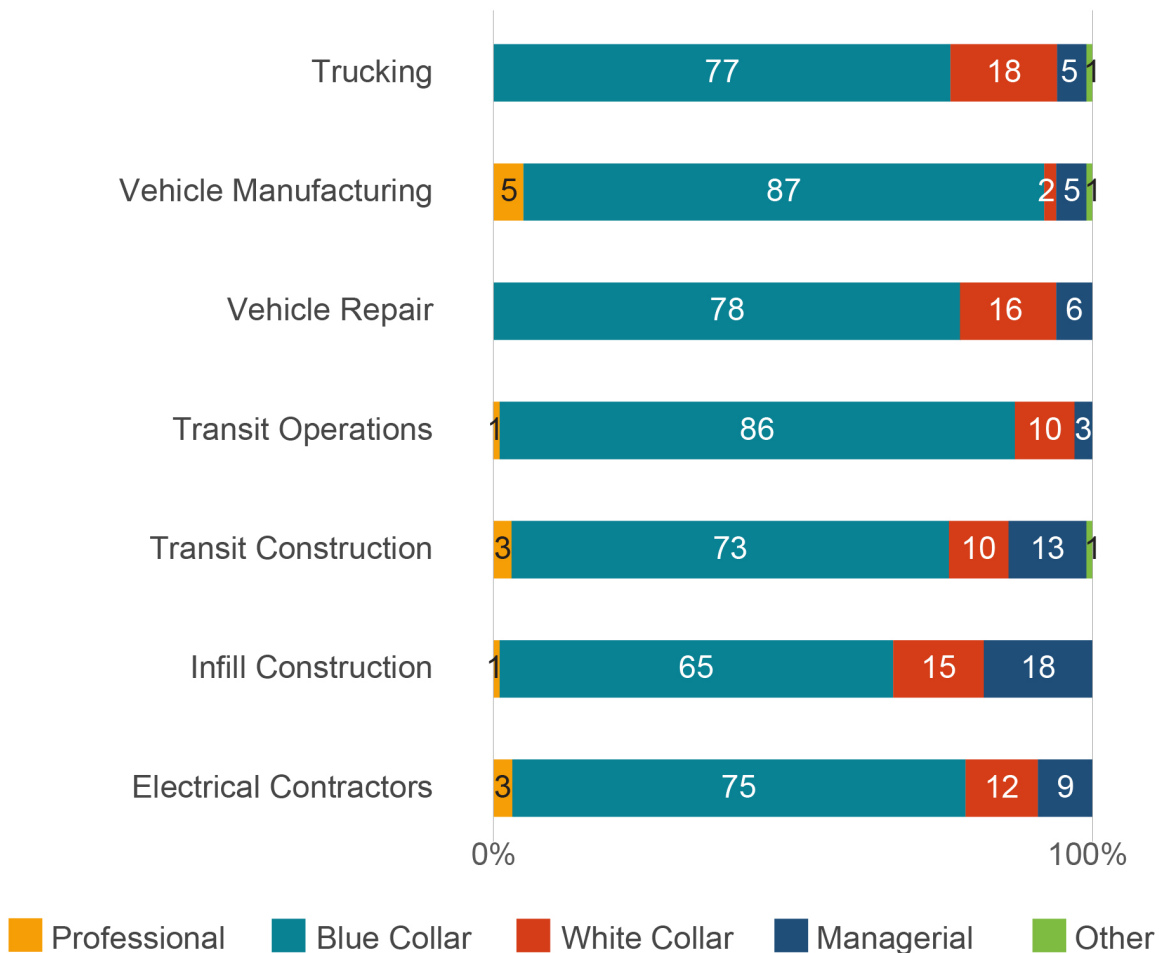
- **Public Transit Infrastructure Construction**
- **Electric Vehicle Charging Infrastructure**
- **Infill and Transit-Oriented Construction**

For each of these industries, the majority of the workforce is comprised of blue-collar jobs, as shown in **Exhibit 7.3**, and defined in Chapter 5.³⁸ These blue-collar workers are employed in a range of areas, predominantly in the following Standard Occupation Classification (SOC) codes: production occupations, construction and extraction



occupations, installation, maintenance, and repair occupations, and transportation and material moving occupations. The figure includes electrical contractors, who install electric vehicle charging stations, the fastest growing segment of clean fuels investment, but other alternative fuel infrastructure businesses were not included due to insufficient information.

Exhibit 7.3. Industries and Occupations in the Transportation Sector



Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



III. Key Subsectors

A. Clean Vehicle Manufacturing

Policy mandates that increase the adoption of zero- and low-emission vehicles will impact jobs in the vehicle manufacturing industry. The state's long-term vehicle standards, commercialization strategies, and other policies discussed above establish targets and create incentives that can drive the development and adoption of cleaner vehicle technologies. Innovations in hardware and software technologies that reduce pollution and improve fuel economy are found in final assembly and engine manufacturing, and throughout the full supply chain involved in vehicle manufacturing.³⁹

1. Workforce Outcomes

a. Job Growth

Vehicle manufacturing employs 288,000 workers nationwide in more than 1,200 firms. In California, there are currently only 14,000 workers in automobile manufacturing, but there are 120,000 workers in the entire transportation equipment manufacturing industry in the state. This total includes parts manufacturing and all forms of transportation equipment, with most of these workers in the aerospace industry.⁴⁰

Industry data on the “Clean Transportation Industry Cluster” suggest a total of about 20,000 jobs in California, although this figure includes 3,000 jobs in liquid fuel production and 1,000 jobs in electric vehicle charging infrastructure. The largest zero-emission vehicle manufacturer by employment in California is Tesla, and there are a growing number of ZEV and LEV bus and truck manufacturers.⁴¹ Electric vehicle manufacturers that have built plants in the state include BYD, Proterra, Motiv Power Systems, GreenPower Bus, and Karma. There are also electric powertrain manufacturers in the state.⁴² After a decade of very little investment in new automotive plants anywhere in the United States, this new investment constitutes an important new development. Additionally, key technology companies are also investing in clean vehicles, including Apple, which is developing an electric car; Google, which is investing in autonomous vehicle technology; and Lucid Motors (formerly Atieva), a battery company that is investing in car manufacturing.⁴³

Overall, it is difficult to determine the cumulative effect of clean vehicle adoption on job displacement and creation in the vehicle manufacturing sector. There are some concerns voiced in the media that the increased adoption of zero-emission vehicles will lead to lower labor intensity in auto manufacturing and repair jobs, because the propulsion



systems for ZEVs have fewer moving parts and require less maintenance than internal combustion engine vehicles.⁴⁴ A study from the European Union found the potential for job losses as part of the transition to zero-emission vehicles to be “highly uncertain.”⁴⁵ The study notes that the shift to ZEVs will upset the market, create uncertainty, redistribute power within the industry, and require new strategic orientations as well as stable, forward-looking policies.⁴⁶

b. Job Quality

Manufacturing jobs were once a reliable source of family-supporting wages, but low-wage jobs in manufacturing have grown in recent decades.⁴⁷ Job quality within the clean vehicle manufacturing sector appears mixed in California. Concerns about the labor practices of ZEV manufacturers have been raised. Several firms, in both light- and heavy-duty ZEV manufacturing, have been found to have violations pertaining to unpaid wage claims, lax workplace health and safety, and employer retaliation against workers exercising their legally-protected rights; many additional cases are still under investigation by the California Department of Industrial Relations.⁴⁸ On the other hand, some zero-emission bus and rail manufacturers in California have unionized workforces, which generally indicates higher job quality (including higher average earnings and better health and retirement benefits) compared to non-unionized workforces.⁴⁹

Two of these heavy-duty ZEV manufacturers with unionized workforces in California have also made commitments to inclusive hiring goals, with one making significant investments in training as well.⁵⁰ The Los Angeles Metropolitan Transit Authority (LA Metro) created incentives for these commitments to good labor practices by inserting inclusive procurement language into its competitive solicitations for bus purchases, which helps promote better job outcomes as described in the **Promising Practice #7.1**. A similar approach to include labor practices or standards in EV incentive programs—for both light- and heavy-duty vehicles—could further advance high-road employment outcomes throughout California’s growing clean vehicle manufacturing sector in California.

c. Job Access

No specific information about the demographic profile of workers in clean transportation manufacturing businesses is available. As part of the inclusive procurement policies mentioned above, agencies can encourage bidders to commit to hiring disadvantaged and/or under-represented workers in order to expand access to jobs for historically marginalized groups.⁵¹ To support goal of inclusive hiring, training initiatives are often launched or strengthened to assist employers in recruiting and preparing new workers. These efforts often involve collaboration among employers, community-based organizations, and labor unions, and are a form of “high-road industry training



partnerships.” The combination of legally-enforceable commitments to high quality jobs and hiring targets for disadvantaged and/or under-represented workers, along with investment in industry training partnerships to prepare a pool of qualified applicants from disadvantaged communities, has been a successful mechanism for achieving greater economic equity by expanding job access, as described below.

PROMISING PRACTICE #7.1 Heavy-Duty Transit Vehicle Manufacturing—Procurement for the Public Good

The Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP, a CCI program administered by CARB) incentivizes the purchase of hybrid and zero-emission heavy-duty vehicles to accelerate “early market penetration of clean technologies.”⁵² For the public transit sector, HVIP represents one of the state’s efforts to induce and assist California’s more than 200 transit agencies, which utilize about 10,000 transit buses, to transition to zero-emission fleets. The transition to a fully zero-emission transit bus fleet statewide (by 2040) is now mandated by the State’s Innovative Clean Transit Rule (ICT Rule) adopted by CARB in December 2018. Furthermore, in adopting the rule, CARB also addressed employment and training in the ZEB sector and committed to investing additional resources to increase access to jobs in the manufacture and operation of zero-emission transit buses.

CARB’s regulatory and incentive measures have helped support a growing zero-emission bus manufacturing sector in California. BYD, Ebus, GreenPower Bus, and Proterra are zero-emission bus (ZEB) manufacturers that have recently established production and

assembly facilities in the state, in anticipation of a growing ZEB market in California and beyond.⁵³ More than 100 zero-emission transit buses are currently in use in California, and there are more than 300 more on order.⁵⁴

Using procurement policies that explicitly value job creation, job quality, and job access has allowed transit agencies to use their heavy-duty clean vehicle purchases as a tool to help ensure better job quality and local employment outcomes for manufacturing workers. These procurement policies include incorporating solicitation language that incentivizes “bus and rail manufacturers to commit to creating good manufacturing jobs, investing in new or existing manufacturing facilities, and establishing pathways into the industry for people facing barriers to employment.”⁵⁵

The U.S. Employment Plan (USEP) developed by the nonprofit Jobs to Move America provides a template to incorporate workforce policies and practices into competitive solicitations for public procurement. The USEP involves including procurement language that asks bidders to voluntarily make commitments



and specify plans for job creation, job quality (e.g., wage and benefit levels), and job access (e.g., training partnerships and targeted hiring practices). Agencies responsible for the procurement then score applications to reward applicants that make concrete commitments to creating family-supportive jobs and expanding job access. After comparing the proposals in full and determining which one offers the best overall value (e.g., assessing price, technical specifications, and past performance, as well as job commitments), agencies can then determine which bidder to award the contract.

To ensure job-related commitments detailed in the USEP are actually achieved, agencies can request regular reporting from awarded contractors/vendors to track the key outcomes, namely the quantity and quality of, and access to, new or sustained jobs. The agency can utilize a menu of commonly-used corrective actions to assist the contractor/vendor fulfill its commitments, if the agency determines a company does not reach certain milestones or has fallen out of compliance with its USEP commitments.

Transit agencies like the Los Angeles County Metropolitan Transportation Authority (LA Metro) have permanent U.S. Employment Plan policies, in which all future procurements of new manufactured vehicles and equipment above \$100 million will include the USEP. Companies bidding on future LA Metro

contracts can now improve their competitive advantage by committing to job quality and job access targets. In LA Metro's competitive solicitation in 2016 for the procurement of new zero-emission buses, the bidders were given the opportunity to commit up front to hiring targets as part of their application, and job benefits were an explicit part of the ranking of bids.

One of the bidding ZEB manufacturers (BYD, a company with manufacturing facilities in Lancaster, CA) sought to make their proposal more competitive by committing to a community hiring program and pre-hire program under a Community Benefits Agreement (CBA) with the Jobs to Move America coalition. These targeted hire programs have helped expand job access to BYD's transit bus manufacturing jobs. Specifically, BYD committed to a target of recruiting and hiring 40 percent of its workers from populations facing significant barriers to employment (e.g., veterans and formerly-incarcerated individuals) under the negotiated CBA. Accordingly, the USEP incentivizes companies to enter into CBAs that both increase the competitiveness of their applications and ultimately help strengthen their training and hiring practices to ensure job-seekers that have faced barriers to stable, family-sustaining jobs have a clear pathway into a high-road manufacturing industry.⁵⁶



2. Workforce Recommendations

a. *Demand-Side Workforce Policy Levers for Job Quality*

- ❖ **Use inclusive procurement policies for public procurement of buses and other fleet vehicles purchased by state and local government and public agencies.**

The promising practice workforce intervention described above can be replicated and scaled up throughout the vehicle manufacturing sector. For procurement of publicly-owned fleets (e.g., public transit and commuter buses and rail cars, local government vehicles, and public utility and port vehicles), the procurement strategies developed by Jobs to Move America can be incorporated in all solicitations for new zero- and low-emission vehicles. These requirements can help build the high road for the manufacture of public fleet vehicles by setting a standard that can then be a template for the future adoption of heavy-duty fleet LEVs or ZEVs, in line with SB 1204 (Lara, Chapter 524, Statutes of 2014) requirements.

b. *Supply-Side Workforce Development Strategies*

- ❖ **Support high-road industry training partnerships.**

High-road industry training partnerships (see Chapter 3) can be developed, particularly when businesses establish workforce commitments as part of their bids in inclusive procurement solicitations. In the example described in **Promising Practice #7.1**, the zero-emission bus manufacturer BYD and its labor partner, SMART Local 105, developed an apprenticeship program for production workers who manufacture zero-emission buses. Tesla, a light-duty ZEV manufacturer, has also developed a state-certified apprenticeship program (for tool and die specialists, a type of machinist occupation). It is an employer-sponsored apprenticeship program whereas the one co-sponsored by BYD and SMART Local 105 is a joint labor-management program.

There is a wealth of experience in high-road industry training partnerships in manufacturing in the U.S. Midwest, both in creating pipelines into good jobs for historically excluded workers and upgrading the skills of incumbent workers as manufacturing processes evolve.⁵⁷ Recent developments there include the creation of a new registered apprenticeship program that results in a certification for industrial manufacturing technicians for workers in a wide variety of companies in vehicle parts and other manufacturing companies.⁵⁸ Often high-road industry training partnerships collaborate with community-based organizations (CBOs) with deep ties to disadvantaged



communities or populations. CBOs take on the role of helping recruit and support potential applicants and working with training organizations to mentor participants before and after hiring (see Chapter 3). The apprenticeship model ensures on-going employer investment in training and agreements that wages will rise as workers acquire more skills.

B. Trucking

The commercial trucking industry is a major contributor to air and climate pollutant emissions and a critical and challenging industry for climate policy. Medium- and heavy-duty vehicles make up only 3 percent of the total vehicles registered in California, but account for 22 percent of the state's on-road greenhouse gas emissions.⁵⁹ Here, low-road labor practices impede the implementation of climate policy and create the conditions whereby climate policy can hurt an already vulnerable workforce. This section describes the likely impact of climate policy on the workforce, and discusses the environmental costs of current labor practices. Finally, this section presents strategies that could support efforts both to improve workforce and environmental outcomes in the trucking sector.

The main strategy to lower emissions in the trucking sector is to increase vehicle and engine standards to improve fuel efficiency and reduce emissions. CARB worked jointly with the U.S. Environmental Protection Agency (U.S. EPA) and the National Highway Traffic Safety Administration (NHTSA) on the most recent phase of federal greenhouse gas emission standards for medium- and heavy-duty vehicles, often referred to as Federal Phase 2 or simply Phase 2. The Phase 2 standards are projected to reduce fuel consumption and CO₂ emissions of medium- and heavy-duty trucks by about 25 percent.⁶⁰ California will largely follow the Federal Phase 2 greenhouse gas standards, which cover tractors, trailers, vocational vehicles, heavy-duty pickups, and vans. The state may exceed the targets set in Phase 2 through its portfolio of policies and programs to spur the transition to zero-emission vehicles (ZEVs) in the medium- and heavy-duty sector. A key opportunity is in the short-haul trucking subsector, where electrification is feasible and where growth in demand for last-mile delivery has accelerated as a result of e-commerce.⁶¹

Phase 2 standards are likely to increase the purchase or lease price of new, lower-emission trucks. Some of the higher purchase price will be recouped via fuel cost savings over the lifetime of the truck as a result of fuel efficiency improvements under Phase 2 rules. However, the additional Phase 2 emission regulations for NO_x and particulate matter (PM) may increase maintenance costs and could reduce rather than improve fuel efficiency, as some contend occurred with the 2007 EPA rules on these pollutants.⁶² Cleaner fuels will likely play a greater role in lowering emissions from trucking, when alternatives to petroleum-based diesel (e.g., biodiesel, renewable diesel,



hydrogen, biogas and renewable natural gas, compressed and liquefied natural gas, and propane) begin displacing increasing shares of diesel usage in long-haul trucking. The price signals in the LCFS and Cap-and-Trade Program are designed to accelerate innovation in cleaner fuels. However, diesel will likely remain the dominant fuel source for long-haul trucking in the state. During that time, Federal Phase 2 standards and additional air pollutant restrictions will increase vehicle costs due to the new technologies required. These standards work to internalize the social costs, in the form of pollution and emissions that diesel-powered trucks produce.

While standards on the manufacture of new vehicles can ensure the shift to cleaner trucks over time, reducing greenhouse gas emissions from trucking also requires removing high-emission trucks that are currently on the road, retrofitting trucks where feasible, and accelerating the purchase of cleaner trucks so that it occurs more rapidly than the normal turnover of vehicles, which ranges from 8 to 14 years in long-haul trucking and much longer in port drayage trucking. The policy “sticks” (such as emission standards) and policy “carrots” (such as incentive and loan programs) are meant to induce the private trucking industry to make investments that they would otherwise delay or avoid.

1. Workforce Outcomes

a. Job Growth

The main impact of climate policy designed to lower emissions from trucking is an increase in the purchase or lease price of new trucks. Higher truck costs can, in theory, shift the mix of transportation in the goods movement sector away from trucking to rail, air, or other modes, which could slow job growth. However, the demand for trucking is quite inelastic due to the United States’ vast infrastructure of highways and the disadvantage of the fixed location of terminals with other transportation modes.

Other factors affecting the industry make it difficult to predict employment trends. On the one hand, growth in e-commerce has resulted in a rapid rise in demand for both long-haul and last-mile delivery, potentially leading to a swift increase in vehicle miles traveled (VMT) from freight transportation and presumably, greater demand for labor.⁶³ At the same time, the industry is currently facing what may be the most important source of uncertainty since the development of the internal combustion engine: self-driving trucks. If successfully developed, self-driving trucks are likely to have a transformative effect on goods movement, including potential job loss, although the impact on jobs is a matter of debate at this time. Self-driving trucks may present opportunities for lower emissions, if large investments in self-driving trucks are tied to electrification or other emission-lowering innovations. If that occurs, truck drivers and the public may conflate climate policy with job loss in the trucking sector, which may raise fears about the policy, even if the more stringent emission standards *per se* do not cause job loss.



b. Job Quality and Job Access

Wages and working conditions for truck drivers, the largest occupational group in trucking, have steadily declined since the trucking industry was deregulated beginning in the late 1970s. Between long hours and low pay, conditions in some segments are so bad that trucks have been characterized as “sweatshops on wheels.”⁶⁴ For-hire port truck driving and for-hire long-haul truckload driving have been highlighted in particular as areas where minimum wage laws are regularly violated, workers suffer serious health problems due to exposure to diesel exhaust,⁶⁵ and employee misclassification is rampant.⁶⁶ There is ample evidence to suggest that workers in these segments, many of whom are immigrants, are extremely vulnerable⁶⁷ and could bear a disproportionate share of the cost of the state’s climate mandates unless protected by robust and thoughtful policy.

At first glance, efforts to promote cleaner vehicles might not be expected to impact job quality in trucking. After all, truck drivers perform the same tasks regardless of whether they are driving a high- or low-emission truck. In a number of subsectors of the trucking industry, however, drivers play a unique role: they both operate the vehicles and they bear the costs of ownership and maintenance. Deregulation in the trucking industry has led to widespread use of truck drivers who operate their own trucks (i.e., owner-operators), which they either purchase on credit or lease from trucking firms. This arrangement is common in long-haul trucking and endemic in short-haul trucking between and within major freight hubs (e.g., seaports, rail yards, and warehousing and distribution centers), known as drayage trucking. It is also occurring in some parts of last-mile trucking, which mainly involves parcel delivery to individual consumers. Compared to truck drivers who are treated as employees, independent contractor drivers earn lower incomes after deducting the cost of their trucks; they also lack benefits, work long hours, are exposed to higher levels of diesel exhaust, and are excluded from basic labor protections, such as minimum wage and overtime laws, unemployment insurance, and workers’ compensation.⁶⁸

It is an entirely different proposition to mandate increasingly stringent emission standards for trucks owned and managed by large freight-hauling firms whose drivers are employees, than for trucks driven by independently-contracted owner-operators, especially if, under the law, they should be classified as employees. For the economy as a whole, the costs of cleaner trucks is very small. Shipping costs make up 3.6 percent of consumer food prices and 6 percent of overall retail prices, and the incremental cost of cleaner trucks is only a very small percentage of shipping costs.⁶⁹ However, when drivers are misclassified as independent contractors, these costs are not spread over the millions of buyers of trucked cargo but rather, they are borne by truck drivers who lack the market power to raise the price of their services.⁷⁰ Implementation of more stringent emission policies in this case can impose serious cost burdens on low-income drivers



who cannot afford to buy low- or zero-emission trucks. In contrast, when truck drivers are employees, the freight-hauling businesses bear the costs of purchasing and maintaining the trucks and are in a much better position to absorb these costs internally or pass them on to retailers and consumers. When the essential costs of operations are not included in the trucking companies' cost structure but rather pushed on to truck drivers, there is a market failure, similar to the market failure that occurs when businesses do not internalize the social costs of pollution. Greater subsidies for truck drivers to purchase low- and zero-emission trucks is one solution, but this does not solve the more fundamental problem of low-road labor practices under which social and environmental costs are externalized.

The next two sections describe current labor conditions and the impact of climate policies in two key segments of trucking where the independent contractor model predominates—drayage and long-haul trucking—illustrating how low-road labor conditions increase both emissions and the cost of climate policy implementation.⁷¹

B1. Short-Haul Trucking

Short-haul trucking between seaports to railyards, warehousing and distribution centers, and other major freight hubs (“port trucking,” or “drayage” in industry parlance) is a segment of the trucking industry that holds great promise for reducing greenhouse gas emissions through the introduction of zero-emission trucks. Drayage is well-suited to zero-emission vehicle technology—and battery-electric propulsion specifically—given the particular duty cycle in which trucks go relatively short distances in a congested area and return to the same area. Electrification will require substantial investment both in advanced technology trucks to replace the current fleet and in electric charging infrastructure.

Misclassification of drivers is a major, widespread problem in port trucking as firms have shifted from employing workers (largely unionized) to independent contracting since enactment of the Federal Motor Carrier Act in 1980, which abolished the regulatory system for freight rates and truck routing.⁷² Independent contractors either own their truck, or lease it from a freight-hauling firm, and are commonly referred to as independent owner-operators. In port trucking, employee misclassification is rampant and labor conditions are the worst in the entire trucking industry.⁷³ Previous efforts to require the use of cleaner trucks for drayage provide lessons for new initiatives to further reduce emissions when low-road labor conditions predominate. In 2008, the Ports of Los Angeles and Long Beach enacted the Clean Trucks Program, which prohibited older model, high-polluting trucks from entering the port complex. While the program was successful in reducing diesel emissions initially, as trucks fall into disrepair, emissions reductions may not be sustained.



PROMISING PRACTICE #7.2

Clean and Safe Ports Case Study

Efforts to reduce emissions from port drayage trucking at the ports of Los Angeles and Long Beach provide a powerful example of the challenges of implementing climate policy in low-road industries.

In 2008, the ports of Los Angeles and Long Beach launched the Clean Trucks Program, instituting a phased ban of 2,000 older trucks and providing incentives for the purchase of lower-emission trucks.⁷⁴ Community and labor organizations had brought awareness of the terrible conditions under which port truck drivers worked: drivers lacked access to most labor protections, unemployment benefits, disability pay, or workers' compensation, because trucking firms classified them as independent contractors.⁷⁵ To remedy this situation, the City of Los Angeles attempted to insert into the concession program a requirement that companies must own or lease their own trucks and employ their truck drivers. The American Trucking Association sued both ports to stop the entire Clean Trucks Program. After five years of litigation, including numerous appeals, the ports won all the environmental requirements in the program, but the trucking companies prevailed on the employee requirement.⁷⁶ The courts ruled that the ports were preempted by federal deregulatory actions on trucking and did not have the legal authority to require trucking firms to stop using independent contractors.

Consequently, the Clean Trucks Program inadvertently led to drivers, who were already facing low-road conditions, bearing much of the cost of the transition to lower-emission trucks. Trucking companies passed on the costs of complying with the clean truck mandates to the already low-wage truck drivers. The companies paid upfront for clean trucks, but then deducted the costs of the trucks from workers' paychecks

through lease agreements that workers were forced to sign. Other expenses were deducted as well, such as insurance, parking, and gas, leaving some workers with pay far below minimum wage and working up to 20 hours per day; at times, drivers paid the company to work and amassed debt. A major *USA Today* investigation published in June 2017 brought this modern-day indentured servitude to the attention of a national audience.⁷⁷ According to the *USA Today* exposé:

In 2008, California sparked the labor problems at the ports of Los Angeles and Long Beach by banning older trucks from entering the harbor. Companies suddenly faced the prospect of replacing 16,000 aging big rigs with newer, cleaner trucks.

To avoid the \$2.5 billion price tag, the port trucking industry launched a lease-to-own program that pushed the cost onto truckers, most of them independent contractors who had to cover their own expenses. Trucking companies arranged to finance their cleaner fleet, then passed on the cost of each truck to an individual driver.

A yearlong investigation by the USA TODAY Network found that port trucking companies in southern California have spent the past decade forcing drivers to finance their own trucks by taking on debt they could not afford. Companies then used that debt as leverage to extract forced labor and trap drivers in jobs that left them destitute. If a driver quit, the company seized his truck and kept everything he had paid towards owning it. If drivers missed payments, or if they got sick or became too exhausted to go on, their companies fired them and kept everything. Then they turned around and leased the trucks to someone else.⁷⁸



With the help of the Teamsters, port truck drivers have taken the very labor-intensive and lengthy route to win recognition of their employee status and gain the protections this status includes by filing individual claims against trucking companies for misclassification and wage theft. Between 2011 and 2018, 987 drivers filed complaints with the California Division of Labor Standards Enforcement. They also filed complaints with the federal Department of Labor, the state Workers' Compensation Appeals Board, and elsewhere. The California Labor Commissioner has awarded more than \$45 million to at least 400 drivers to date for unlawful deductions from wages and out-of-pocket expenses.⁷⁹ Labor unrest continued, however, as worker misclassification has remained a widespread practice in the industry, affecting the wages owed to drivers.⁸⁰

Elected officials have also recently stepped in to devise policy solutions to help remedy the situation in a more systematic fashion. California Senate Bill 1402 (Lara, Chapter 702, Statutes of 2018)⁸¹ requires the clients of trucking companies, retailers like Target, Amazon, and Walmart, to take responsibility for the labor violations of the trucking companies whose services they use. The law takes effect in January 2019.⁸² In January of 2018, Los Angeles District Attorney Mike Feuer filed lawsuits against three trucking firms that operate at the ports—CMI Transportation, K&R Transportation California, and Cal Cartage Transportation Express—which together are the market leaders at the Los Angeles and Long Beach ports. The lawsuits allege that these trucking companies had engaged in schemes to avoid paying minimum wage and employee benefits by classifying hundreds of workers as independent contractors.⁸³

There have also been renewed efforts to attach labor standards to publicly-funded clean truck incentives. The South Coast Air Quality Management District (SCAQMD), the air pollution

control agency for all of Orange County and parts of Los Angeles and Riverside Counties, adopted rules for district-funded truck replacement projects to address job quality concerns and prevent labor law violations involving district-funded trucks. The rules will require firms to list any labor law violations adjudicated within the past three years in project applications, which may be used to screen applicants; and prohibit lease-to-own arrangements involving district-funded trucks. Firms under contract for truck replacement projects must also follow new processes for disclosure and annual certification related to any labor law violations pertaining to truck drivers, and SCAQMD will conduct audits to verify compliance with these new rules and standards.⁸⁴

The prevailing business model of port trucking continues to place the costs of trucks and truck operations on drivers, rather than internalizing them as a cost, first to the trucking companies, then to retailers who use their services, and finally to the consumers who purchase retail goods that are shipped through ports. Hundreds of millions of public dollars have been invested in lower-emission trucks in California to help buy down the costs of cleaner trucks, but this strategy hasn't helped the port truckers who continue to face low-road conditions.

Moreover, the independent contractor model creates other inefficiencies that impede emission reductions. Maintenance is jettisoned when impoverished workers are expected to pay for it, and expensive trucks are damaged in accidents when over-tired workers are forced to keep driving.⁸⁵ These environmental and public safety externalities are likely insoluble until the industry is rationalized so that port truckers are not bearing all the costs. Time will tell if SB 1402, which is designed to make trucking and retailers accountable for labor and employment violations, is enough to remedy this situation.



B2. Long-Haul Trucking

As in drayage, one effect of the state's cleaner vehicles policies on the long-haul segment of the trucking industry may be an increase in the purchase or lease price of new vehicles that meet stricter emission standards. Also as in drayage, new emission standards will have a differential impact on independent owner-operators compared with employees of trucking firms. Significant vehicle cost increases may affect who can afford to stay in the long-haul trucking business and the incomes of those who do.

While misclassification of independent contractors is not as rampant in long-haul as in short-haul trucking, there are many misclassified single owner-operators and independents, and this trend may be exacerbated as emission standards become more stringent. The increasing prices of trucks lead trucking companies, already inclined to misclassify employees as independent contractors, to shift these additional costs onto workers through leasing arrangements with drivers.⁸⁶

Because many workers in long-haul trucking do not have and cannot raise capital for new trucks without going through large carriers, these workers often find themselves in debt peonage—they end up leasing or renting the more expensive trucks from the carrier they work for. Drivers who lease or own and operate their trucks usually work a full seven-day workweek for three weeks, and then return home and work four or five days in the fourth week during their “off-time.” During that four- or five-day workweek, they are still responsible for making truck payments and covering other costs, which can easily exceed \$1,000 per week. During these “short weeks,” many drivers put in 40 or more hours but receive no take-home pay at all or end up owing money.⁸⁷

Freight-hauling firms also use worker training to support the independent contractor strategy. Most new truck drivers enter the industry through large long-haul trucking companies, which are the most likely to misclassify workers.⁸⁸ These firms receive public funds for workforce training, but also typically charge each worker \$3,000-\$7,000 for training that is necessary in order to obtain a commercial trucking license. During the training period, trucking firms directly employ workers at low wages, with the promise of higher incomes once they are trained.⁸⁹ Trucking companies encourage new drivers to enter lease agreements as soon as they get their licenses, so many drivers become independent contractors shortly after they finish training. The most unscrupulous firms use the loans they provided workers for training as leverage to get workers to become contractors, forgiving the training debt in exchange for the worker leasing the truck they will drive.⁹⁰ Instead of playing a positive role in worker retention and moving workers up a career ladder, the current training scheme is part of the system of low wages, high turnover, and exploitation that has become prevalent since deregulation.⁹¹ Government subsidy of job training by large firms, without any or adequate protection for trainees/workers, depresses wages for existing truckers and allows those subsidized firms to externalize the costs of high worker turnover. High turnover results in less-experienced and less-efficient truck drivers operating the vehicles with the highest emissions per mile.⁹²



The retention of trained and experienced workers is important for the fuel-efficient operation of trucks, which impacts fuel costs and emissions. Some estimates suggest that there can be as much as a 25-percent difference in fuel use between the most and the least efficient drivers, due to disparities in basic operation proficiency and knowledge of local traffic patterns and work scheduling.⁹³ Current labor practices in long-haul trucking mean that turnover is extraordinarily high, with as many as 90 percent of the drivers having less than a year of experience driving a truck.⁹⁴ Since long-haul trucking is amongst the heaviest uses of diesel fuel in the industry, high worker turnover means that the least experienced and least efficient truck drivers are working in the industry segment in which emissions reductions are very critical.

B3. Environmental Costs and Inefficiencies Associated with Independent Contractor Labor Practices

The widespread practice of independent contracting in short- and long-haul trucking creates challenges for efforts to reduce emissions, because it causes inefficiencies in fuel and truck usage. As described above, inexperienced truckers are the norm because of high truck driver turnover due to the poor labor conditions facing independent contractors, and this reduces fuel efficiency.

In addition, the independent contractor model poses obstacles for the efficient use of trucks. Independent contractors are the sole operator of the truck, so scheduling and other operational decisions are in the hands of individual drivers rather than centrally organized and based on the most efficient use of an entire fleet of trucks. When the state asks industry to make new, large private investments in cleaner trucks and provides subsidies to facilitate these purchases, efficiency of trucking operations matters. In order to justify the large financial investments required for lower-emission trucks, making the most efficient and full use of the trucks improves the payback, to the public as well as to industry, for this investment.

For a number of reasons, large firms that hire employees are more able to organize for efficiency than single operators. First, since they move more freight and have more trucks, large firms can plan routes with fewer “deadhead” miles (miles in which a truck travels empty). Just as importantly, large firms have the ability to “slip seat,” which means using multiple drivers for the same truck on different shifts. Large companies are also far more likely to have sophisticated systems for gathering and processing information about fuel and operational efficiency. Often, smaller operators simply don’t know what kind of fuel economy they get or why. Large companies have the tools, skilled labor, and the scale to make investing in efficient technologies profitable.⁹⁵

When trucking companies bear the full costs of the trucks and classify drivers as employees rather than independent contractors, the companies have the incentive



and the capacity to economize on the overall cost of purchasing and operating trucks.⁹⁶ Trucking companies have access to less-expensive capital, allowing them to make upfront investments in newer, cleaner, and higher-priced trucks. They can afford to carry out regular preventative maintenance that low-income drivers must often delay due to the economic imperative of driving to earn more revenue than they owe. Trucking companies can minimize or may even be able to avoid the idling that occurs in the current system by utilizing scheduling software to make efficient use of trucks.⁹⁷ Finally, they can use the trucks more intensively, for more hours per day, which shortens the payback period, compared to the case in a one-driver-one-truck business model. All of these strategies lower the net costs of new, lower-emission trucks.

Poor labor conditions and worker misclassification could slow adoption of and diminish the return on investment in new clean trucks. This in turn could negatively affect the industry's ability to reduce emissions as required and could lead the state to provide larger subsidies for new truck purchases than would be necessary if workers were properly classified.

B4. Truck Maintenance and Repair

There are about 20,000 workers employed as bus and truck mechanics and diesel engine specialists in California, earning an average annual wage of about \$55,000 a year or \$26.47 per hour.⁹⁸

Maintenance and repair jobs in trucking can vary significantly in terms of the skills of workers and the training required. For instance, some lower-skilled maintenance workers may perform regular service on vehicles, such as oil changes or tire replacement. The skill requirements of many of these regular maintenance tasks have not changed much in the recent past. On the other end of the spectrum are a range of technicians and mechanics who work with more advanced technologies on trucks—from increasingly complex diesel engines to communications equipment—and may provide extensive repair and overhaul services. Diesel-powered trucks themselves have become increasingly complex, expensive, and electronically sophisticated over the last several decades, particularly as satellite-linked technologies, emission regulations, hours of service monitoring compliance, numerous safety advances, and concerns about driver health have changed most major systems of the trucks. Much of this training will be transferable to cleaner trucks, and will remain an important component of the broad occupational training needed for skilled truck mechanics.

Most analysts agree that the introduction of lower-emission trucks that do not use diesel (e.g., battery-electric, fuel cell electric, and low-NOx natural gas trucks) will also require significant additional training for truck mechanics, on top of the skills that they already learn. However, the training needs for battery-electric trucks specifically are currently a matter of debate. At present, some potential users expect substantial reductions in



maintenance needs and costs due to the cleaner operation of these zero-emission trucks and fewer moving parts and emission-control needs.

The state is supporting demonstration projects that deploy zero-emission trucks and low-emission, advanced technology trucks, and provides investments in workforce development to ensure a sufficient trained labor supply. The Alternative and Renewable Fuel and Vehicle Technology Program, for instance, provides funding for workforce development. These investments build on partnerships with community colleges to purchase equipment and develop clean transportation workforce training programs, internships, and apprenticeships. The California Workforce Development Board (CWDB) has suggested developing high-road industry partnerships to ensure mechanics are retrained for the new technologies (see Chapter 3).

1. Workforce Recommendations for the Trucking Industry

In order to maximize the return on large financial investments in clean trucks, it will be important to use these trucks as intensively as possible. In this case, restructuring the industry for greater efficiency hinges on solving the labor issues and creating the conditions in which trucking companies must internalize both environmental and social costs.

a. Demand-Side Workforce Policy Levers for Job Quality

The state should focus its subsidies and other assistance on existing high-road trucking companies that classify truck drivers as employees rather than as independent contractors. This will protect workers from disproportionately bearing the cost of cleaner trucks and help sustain emission reductions from newly-purchased cleaner trucks. The following recommendations provide some tools to accomplish this effort.

❖ **Institute a responsible employer policy for rebates, loans, pilot program grants, and other assistance that could include the following requirements:**

- **Require firms receiving public funds for the purchase of clean trucks to operate those trucks with their own employee drivers.**
- **Require firms receiving public funds for the purchase of clean trucks to be free of outstanding judgments against them for unpaid wages or other violations of labor laws.**



❖ **Incorporate a similar responsible employer policy for all public agencies that contract-out trucking services.**

State policy to protect workers should also apply to private companies with procurement contracts with state and municipal governments, in addition to companies receiving grants or subsidies.

b. Supply-Side Workforce Development Strategies

To prevent public workforce training funds from being used to subsidize low-road employers, as was described above:

❖ **Support high-road training partnerships (HRTPs) that work with high-road employers to provide on-the-job training to new truck drivers; redirect funding away from low-road employers who misclassify truck drivers as independent contractors.**

❖ **Support HRTPs to retrain existing diesel mechanics for work on new vehicle technologies as they are deployed.**

C. Public Transit and Private Passenger Transport

This section addresses passenger transit systems, focusing on the operations and maintenance work performed in-house by public transit agencies. The section above on “Clean Vehicle Manufacturing” addressed the procurement of zero-emission buses, and the section below on “New Transit Infrastructure and Infill Development” addresses new investment in light rail, Complete Streets, and other innovative physical infrastructure to reduce vehicle miles traveled.

Because of California’s car culture and the sprawling nature of urban development, public transit has never been as significant a transportation mode in the state as in American cities east of the Mississippi River, and low transit ridership has been an ongoing challenge for transit agencies. Climate policy has largely taken Californians’ dependence on cars as a given and mainly emphasized emission standards on the existing portfolio of vehicles rather than mode shift strategies that enable people to get people out of cars and into public transit. The most notable exception to this approach, in terms of large-scale transportation projects, is the High Speed Rail project, which has the potential to reduce air and vehicle travel between northern and southern California. While GGRF expenditures have supported transit operations, shared transportation services (e.g., farmworker vanpool and car-sharing in disadvantaged communities programs⁹⁹),



and programs to encourage bicycling and walking, these have been a relatively small percentage of the total GGRF expenditures on transportation.

At the same time, public transit is facing an existential crisis of downward spiraling ridership, according to industry analysts, due to a number of factors.¹⁰⁰ Scarce and uncertain transit funding (especially for operations and maintenance that make transit systems reliable), the relatively low cost of gas and car ownership, and the tendency for bus transit to operate in mixed traffic (thus, reducing speeds and reliability) have made it challenging to maintain, let alone increase, public transit service.¹⁰¹ The rise of TNCs (app-based ride hailing services) appears to be another profound threat to public transit systems.¹⁰² Although the taxi industry has been most acutely impacted by TNCs to date, TNCs are also displacing public transit trips due to their relatively low cost, convenience, and reliability, as much as or more than they are substituting for individuals driving their own cars.¹⁰³ Even as cities have taken steps to improve transit and support increased density around transit, the growth of TNCs has caused more driving. One study found that the increase in car trips and vehicle miles traveled (VMT) in transit-rich New York City can be attributed in large part to TNCs.¹⁰⁴ The San Francisco County Transportation Authority found that TNCs now account for 15 percent of all intra-San Francisco vehicle trips.¹⁰⁵ The flat or decreasing transit ridership¹⁰⁶ combined with the rise in TNC use means that any effective greenhouse gas emission reduction strategy that targets VMT must consider the impacts to transit and the externalities associated with TNCs.

TNCs are one component of the “Three Revolutions of Urban Transportation”: 1) electrification; 2) mobility as a service; and 3) automation.¹⁰⁷ Together, these emerging technologies and business models hold the possibility of reducing travel costs, greenhouse gas emissions, and congestion.¹⁰⁸ However, their positive impacts are not guaranteed.

TNCs are already on the forefront of emerging vehicle technology development, including self-driving cars, electric vehicles, and the software that allows them to take a role similar to transit. As such, it is critical that TNCs are regulated in a manner that supports wider public benefits and safeguards workers. One such effort underway is implementation of Senate Bill 1014 (2018), which established the Clean Miles Standard and Incentive Program. This regulation will be developed by the California Air Resources Board and implemented by the California Public Utilities Commission. By January, 2021, annual GHG targets will be set for TNCs to reduce grams of carbon dioxide per passenger mile traveled. Absent forward-thinking policymaking, the “Three Revolutions” have the potential to exacerbate existing inequities in the transportation system, generate low-wage jobs, encourage unsustainable development patterns, and increase—rather than reduce—VMT.¹⁰⁹

Some nascent efforts are underway by transit agencies and others to influence the three transportation revolutions so that the private sector innovations also meet other



public objectives besides individual consumer cost and convenience. Much of this effort addresses how to make public transit and TNCs complementary, with app-based rides providing “first-mile and last-mile connections from home/work to transit stations” so that more, rather than fewer, people use public transit.¹¹⁰

Far less attention has been paid to the labor impacts of declining transit ridership and utilization. Various responses from taxi drivers, ranging from collective organizing to, tragically, driver suicides in response to income loss from TNCs, have been widely covered in the press¹¹¹—but there has been virtually nothing written about the effects on the public transit workforce.¹¹² In addition, there is no central agency or organizing body that can direct a comprehensive industrial planning in this sector. TNCs are currently regulated by the California Public Utilities Commission (CPUC), while automated vehicle (AV) development, also being led by TNCs and technology companies, is regulated by the California Department of Motor Vehicles, the National Highway Traffic Safety Administration, and other bodies, which are largely focused on safety issues and not well positioned to consider other public benefits.

1. Workforce Outcomes in Public Transit

a. Job Quality and Job Access

Public transit in California provides some of the best wages and benefits for workers with no postsecondary education. **Exhibit 7.4** shows the wages for key occupations in public transit.

Exhibit 7.4. Wages for Key Occupations in Public Transit Operations, 2017

| SOC Code | Occupational Title | Employment | 25th Percentile Hourly Wage | 50th Percentile (Median) Hourly Wage | 75th Percentile Hourly Wage |
|----------|------------------------------------|------------|-----------------------------|--------------------------------------|-----------------------------|
| 53-3021 | Bus Drivers, Transit and Intercity | 23,350 | \$16.21 | \$21.83 | \$27.98 |
| 53-4041 | Subway and Streetcar Operators | 3,930 | \$27.77 | \$30.49 | \$33.41 |

Source: May 2017 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Since these are largely unionized public-sector jobs, benefit packages are comprehensive and continue to include pensions and retiree health care.¹¹³ They have also provided access to family-supporting jobs for women and people of color.¹¹⁴

b. Workforce Development Infrastructure

With an aging workforce, transit agencies have initiated new efforts to build pipelines into transit-sector careers for disadvantaged workers. Labor-management training partnerships have been initiated in many bus transit agencies across California, for example. These high road training partnerships cover transit operators (drivers), as well as maintenance and repair workers who are also public-sector employees of transit agencies. These skilled workers are trained to work on internal combustion engines and need skill-upgrade training to be able to maintain and repair zero-emission and hybrid technology vehicles. Transit agencies with hybrid buses have the unique advantage of a pool of maintenance workers trained in servicing both internal combustion and battery-electric propulsion systems. These labor-management training partnerships, funded in part through the CWDB's High Road Training Partnership (H RTP) initiative, are discussed as in **Promising Practice #7.3**, below.

PROMISING PRACTICE #7.3

Transit Vehicle Operators and Maintenance Workers— Labor-Management Partnerships

The San Jose-based Amalgamated Transit Union (ATU) Local 265 and the Santa Clara Valley Transportation Authority (VTA) implemented a joint workforce investment partnership in 2008.¹¹⁵ This worker-centered job training and mentorship program evolved into the Transit Apprenticeship for Professional Career Advancement (TAPCA).¹¹⁶

Now operating as a partnership between the Santa Clara VTA, ATU Local 265, and Mission College, TAPCA trains participants to advance their careers in the transit industry while earning wages and college credit.¹¹⁷ The program relies on the expertise of veteran transit operators and mechanics, with experienced workers providing

entry-level and incumbent employees with job training and mentorship to improve technical and interpersonal skills.¹¹⁸

Under TAPCA, coach operators, track workers, overhead line workers, and service mechanics receive training that provides linkages from entry-level employment to supervisory roles in VTA's operations and maintenance departments.¹¹⁹ The program helps prepare a new generation of skilled transit workers in anticipation of a wave of retirements at Santa Clara VTA. As of December 2017, the program has graduated 84 apprentices.¹²⁰



c. Risk of Job Loss or Job Degradation

If the trends impacting transit service continue, public transit ridership may continue to decline, leading to a contraction of transit’s role as a public service, as an important source of family-supporting, inclusive public sector jobs, and as a key strategy for greenhouse gas emissions reductions.

2. Workforce Outcomes for TNCs

a. Job Quality and Job Access

In contrast to public transit’s family-supporting wages, employer-provided benefits and nascent apprenticeship training infrastructure, jobs in TNCs are of much poorer quality.¹²¹ Job growth is high for TNCs, although many workers in TNCs hold other primary jobs and use this “gig” work to supplement with very part-time hours.¹²² The threshold for entry into the TNC workforce is low—requiring only that drivers have a driver’s license, a smartphone and a qualifying vehicle. TNC drivers are currently treated as independent contractors and therefore are responsible for the costs associated with driving, including vehicle operation and maintenance costs, as in some segments of the trucking industry. Consequently, drivers do not receive labor protections afforded to typical employees, such as minimum wage, unemployment insurance, or mandatory breaks.¹²³

Currently, the CPUC regulates TNCs, but limits its requirements to mandated background checks and annual reports that include data on accessibility, service by zip code, reported problems with drivers, hours and miles logged by drivers, and the number of drivers who have completed a driver training course. To address the externalities associated with this growing industry and meet California’s climate targets, CARB and CPUC are beginning to implement the California Clean Miles Standard and Incentive Program established by Senate Bill 1014 (SB 1014, Skinner, Chapter 369, Statutes of 2018). To that end, CARB will establish a baseline of greenhouse gas emissions for vehicles used on TNC platforms and set annual emission reduction targets and goals that the CPUC must then implement or oversee; TNCs are now required to develop and regularly update plans for achieving the greenhouse gas emission reduction targets and goals. CARB, the TNCs, and other businesses and stakeholders will also evaluate the role of Clean Vehicle Rebate Project (CVRP) incentives in relation to the California Clean Miles Standard and Incentive Program. Importantly, SB 1014 further mandates that CARB, CPUC, and the California Energy Commission (CEC) “ensure minimal negative impact on low-income and moderate-income drivers” in implementing the law.¹²⁴

For public agencies that contract with TNCs to augment transit services, procurement policies and practices can ensure better labor outcomes. For example, public agencies contracting with private entities to provide small-scale, flexible transit service—often



operating with smart-phone platforms and known as micro-transit—can require contractors to meet wage, benefit, and training standards. Agencies may also opt to provide these private entities with vehicle operators and repair services using the agency’s employees; this strategy ensures that labor classification, wage, benefit, and safety standards comply with existing agency rules. The Los Angeles County Metropolitan Transportation Authority has proposed doing the latter as part of its micro-transit pilot project.¹²⁵

3. Recommendations for Public Transit and Passenger Transport

Public transit is an important part of the state’s climate action plan: it is key to moving more people more miles with fewer emissions, especially once transit vehicles are zero-emission. In addition, its public mission and public ownership give public transit a central role in shaping a future of mobility that meets the state’s climate objectives, while also serving transit-dependent riders and providing family-supporting jobs. Room for improvement and innovation notwithstanding, the public transit sector remains an anchor for the state’s sustainable and equitable transportation system.

However, as noted above, transit ridership is down across the state, in part because of the increase in TNCs as an alternative transportation option in many cities. TNCs have the potential to transform the transportation sector and may spur massive capital investments that support zero-emission technologies along with other changes in mobility services. Where public funds are being expended to expand or regulate these TNC services, the state has an opportunity to shape the industry for the public good, including incorporating the goals of improved job quality and job access.

- ❖ **Support funding for public transit operations overall, including for innovative public transit programs that incorporate ride-sourcing and micro-transit services for first- and last-mile trips as part of public transit systems.**
- ❖ **Incorporate inclusive procurement policies in programs where public transit agencies contract with TNCs and micro-transit services for first- and last-mile mobility. This effort could include rules or program guidelines that create parity with public transit operator wage, benefit, and safety standards.**



- ❖ **Incorporate worker protections and labor standards in comprehensive regulations of TNCs that also address congestion and VMT, through various policy levers (e.g., licensing or rules and fees on access to curb space and public streets).**
- ❖ **Incorporate workforce goals in regional or state planning efforts (e.g., Regional Transportation Plan Guidelines) to shape the Three Revolutions in transportations for broader public benefit.**
- ❖ **If incentives for ZEVs are made available to TNCs (specifically, if incentives are provided to private companies buying vehicles for use on a TNC platform), ensure that all relevant labor and employment laws and protections are strictly enforced.**
- ❖ **Support funding for professional development and capacity building at public transit agencies and regional transportation planning authorities, including technical assistance for innovative contracting to integrate first- and last-mile travel in transit systems.**

D. Clean Fuels Infrastructure

The California Energy Commission (CEC) forecasts that between 1.5 million and 2.4 million zero-emission vehicles (ZEVs) will be on California roads by 2025; most will be battery-electric vehicles powered by electricity while a smaller portion of ZEVs will be fuel cell electric vehicles powered by hydrogen.¹²⁶ The CEC expects most of the initial ZEVs in the state to be plug-in electric vehicles,¹²⁷ with more than 388,000 sold through March 2018.¹²⁸ Likewise, the state expects 37,000 fuel cell electric vehicles using hydrogen fuel on California roads by 2023.¹²⁹ Apart from electricity, natural gas, and hydrogen, biofuels¹³⁰ (e.g., renewable diesel, ethanol, and bio-methane) represent the largest existing stock of alternative fuel in the California transportation sector.¹³¹ Although still less than 10 percent of the total vehicles on the road, reaching California's ZEV targets requires investments in fueling infrastructure so that drivers can confidently purchase vehicles that use alternative fuels.

The investments needed for electrification in transportation create an opportunity to employ certified electricians who can upgrade their skills to install, maintain, and retrofit



electrical vehicle supply equipment (EVSE, more commonly referred to as an EV charging station). Skill upgrades via certifications like the Electric Vehicle Infrastructure Training Program (EVITP), modeled after the CALCTP certification discussed in Chapter 6, build upon certified electricians' foundational skills, rather than train for one specific technology as a one-off training. The EVITP curriculum was developed based on evidence of worker and public safety risk associated with the installation and maintenance of EV charging stations.¹³² Because the EVITP is aligned with the state-certified electrical apprenticeship programs, it is part of the best training system in the state for skilled construction trades workers, for reasons explained in detail in Chapter 3.¹³³

Similar to EV charging station expansion, investments in other alternative fuel distribution networks will generate jobs; many of these will be jobs for plumbers and pipefitters and other skilled trades. Certifications may be needed to upgrade skills for the installation of infrastructure for hydrogen, renewable diesel, and other low-carbon fuels.

1. Workforce Outcomes

a. Job Growth

The construction and installation of fueling infrastructure (across all fuel types), and the push for more in-state production of renewable fuels and biofuels, are likely to lead to job growth. Statewide, the sector is expected to grow from an estimate of 69,200 positions in 2014 to more than 75,000 positions in 2024, due to the growing push to electrify light-duty vehicles and the consequent need to build the state's electric vehicle charging infrastructure.¹³⁴

Electric vehicle charging stations involve distributing power from the grid to the charging station and installing the actual charging device that converts AC power from the wall to DC power that charges the battery in the vehicle. Electric vehicle service providers (EVSP) not only install the charging station, but also provide the connectivity across a network of charging stations. Connecting to a central server, EVSPs manage the software, database, and communication interfaces that enable operation of the station.

In California, electric vehicle charging stations are installed both by utilities (and their subcontractors) and unregulated private firms. For EVSE managed by the investor-owned utilities (IOUs), utility employees install the connection to the grid, and electricians who work for electrical contractors install the charger. It should be noted that there may be different skill levels needed for different market segments, such as residential recharging of a single electric car versus commercial and industrial electric charging infrastructure that is larger scale and can recharge vehicles more rapidly.

Growth in the use of low-carbon fuels other than electricity will depend on a network of pipelines for refining and distribution. These pipelines will also likely be constructed or



modified by some combination of utility workers and specialty skilled trades, namely plumbers and pipefitters involved in new gas fueling infrastructure. Apprenticeship programs in the plumbing and pipefitting trade already incorporate a set of skill certifications, which potentially can be used or modified to address alternative fuel infrastructure installation. The United Association of Plumbers, Fitters, Welders, and Service Technicians has a well-developed infrastructure for creating certifications aligned with their trade as the need arises, including such diverse certifications as medical gas technician, HVACR service technician, and nuclear mechanic, most of which are certified by national or international industry and/or quality entities.¹³⁵

b. Job Quality

Job quality in the electric vehicle supply equipment sector is ensured for charging stations that are installed through IOU programs. The California Public Utilities Commission (CPUC) requires of the IOUs that the EVSE installation work be performed by state-certified C-10 electrical contractors and by electricians who have received the skill certification given to graduates of EVITP.¹³⁶ This workforce skill standard screens out unqualified workers and contractors, creates a return on investments in training, and ensures higher wages for workers. Furthermore, the EVITP is an upgrade to an existing credential (the state's electricians' certification), adding skills and new work opportunities to a pre-existing defined career pathway.

Job quality can be mixed for installations that are not managed by the IOUs, because those programs typically do not require the use of skilled labor for charging station installation. Neither the CEC's Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP) nor Electrify America, which provides funding for EVSE installation as part of the Volkswagen consent decree, include the EVITP skill certification requirements.¹³⁷

c. Job Access

To the extent that it increases demand for skilled workers in the construction trades (i.e., EVITP-certified electricians), the move toward transportation electrification adds new opportunities for participants in programs that create pathways to good jobs for historically marginalized populations (see Chapter 3). Since the EVITP is a journey-upgrade training program for the electrical trade, it expands opportunities for journey-level electricians and subsequently for apprentices in the state-certified electrical apprenticeship programs. As more work is available, new apprenticeship slots can open up to provide entry for graduates of apprenticeship preparation programs. While the amount of new work from EVSE installation alone may not create large numbers of openings for new apprentices, growth in this line of work does ensure that as work increases for EVITP-certified electricians, the pipeline into middle-class construction jobs also expands.



As long as pre-apprenticeship programs are in place to help disadvantaged workers access and succeed in apprenticeship, inclusion will be supported. These pre-apprenticeship opportunities prioritize populations that face barriers to employment, as discussed in Chapter 3 of this report. Community colleges can also offer EVITP certification, and instructors from a number of community colleges have been trained by EVITP to teach classes.¹³⁸

2. Workforce Recommendations

- ❖ **Adopt the requirement that electric vehicle charging stations be installed by EVITP-certified electricians across all incentive programs overseen by the state, including but not limited to ARFVTP and Electrify America programs.**

EVITP is the skill standard currently used by the IOUs' EVSE installation programs and ensures proper installation and family-supporting jobs. Because the EVITP builds upon the state-certified apprenticeship program, as work increases for EVITP-certified installers, new openings for entry-level apprentices will be supported as well, expanding the pipeline for disadvantaged workers into middle-class construction jobs.

- ❖ **Apply similar labor and skills standards for programs that fund the upgrade, retrofit, or construction of other low-carbon fuel distribution infrastructure.**

For non-electrical sectors (e.g., hydrogen, biofuels, natural gas), assess current certifications that could be used or modified for fueling infrastructure-related work.

E. New Transit Infrastructure and Infill Development

CARB's 2018 Progress Report on California's Sustainable Communities and Climate Protection Act makes clear that California must include land use policies to reduce vehicle miles traveled (VMT) alongside its investments in zero-emission vehicles, in order for the state to achieve the 2030 climate targets. Reducing VMT requires investments in transit infrastructure and operations, active transportation infrastructure, and construction of multifamily and mixed-use infill development projects. Collectively, these investments provide Californians with alternatives to driving and driving alone, by concentrating housing near jobs and transit options, thus reducing the total miles people must travel by car.



The state's tools to reduce VMT focus on providing incentives to public transit and to sustainable, affordable housing construction. Funding sources include gas and diesel taxes (for transportation infrastructure) and the GGRF, which is a major source of funding for both High Speed Rail and for projects that combine affordable housing, transit options, urban greening, and other sustainability elements. GGRF funding, along with other state and federal funding sources, supports the High Speed Rail project, the construction of new light rail infrastructure, the Affordable Housing and Sustainable Communities program, and the Transformative Climate Communities program.

For example, Caltrans administers the Active Transportation Program (ATP) to increase the share of trips made using non-motorized (or active) transportation, like walking and bicycling. After years of limited funding from various state and federal sources, the ATP now has a sizable amount of dedicated annual funding, at least \$100 million per fiscal year, due to the passage of the Road Repair & Accountability Act (SB 1, Beall, Chapter 5, Statutes of 2017).¹³⁹ In ATP's first two-year cycle, it awarded slightly more than \$350 million for 267 projects throughout the state.¹⁴⁰ Eligible projects include: 1) infrastructure improvements that increase safety for people who walk and bike; 2) non-infrastructure improvements that focus on education and training; and 3) planning for more community-wide bicycle and pedestrian improvements.¹⁴¹

These policies intend to drive shifts in land use and travel patterns that will necessitate significant infrastructure development and upgrading, including construction and rehabilitation for road improvements, streetscaping, underground utilities, and storm water and drainage systems. A 2016 report by the Southern California Association of Governments (SCAG) forecasts that for every \$1 billion spent in active transportation infrastructure region-wide, an additional 5,000 jobs are created in construction and related trades.¹⁴²

Infill housing is also key to lowering VMT. The cost of generating enough residential housing to accommodate growth from 2015-2030 would be lower using infill development rather than a business-as-usual development scenario, according to a recent Next10 study.¹⁴³ State investments that focus on multifamily infill development, such as those funded by the Affordable Housing and Sustainable Communities (AHSC) program, support job creation in the construction industry. The AHSC program, specifically the over \$400 million in appropriations between Fiscal Years 2013-14 and 2015-16, is estimated to have supported approximately 1,979 direct, full-time equivalent (FTE) job years.¹⁴⁴ Most of these jobs are in the construction industry, with about 1,318 jobs in multifamily residential construction and 598 jobs in transportation infrastructure construction. Together, they make up nearly 97 percent of all direct jobs supported by the AHSC program between 2013 and 2016. Smart growth experts also point out that the transportation and land-use solutions that result in lower vehicle miles traveled, which are associated with denser infill development, also produce better job quality and rates of construction job growth compared to sprawl development.¹⁴⁵



1. Workforce Outcomes

a. Job Growth

The expansion of investments in transit capital projects, infill development, and other physical infrastructure largely generates jobs in the construction industry. Investment in new transit infrastructure and multifamily housing units provides an opening to expand opportunities for construction jobs. If the state focused efforts to meet local housing needs by targeting investments on infill multifamily housing, an estimated total of 490,000 jobs could be created, according to a study conducted by the UC Berkeley Turner Center for Housing Innovation; the UC Berkeley Center for Law, Energy and the Environment; and Next 10.¹⁴⁶ The High Speed Rail project was estimated to create 415,000 direct construction job years by 2029 in its Phase 1, from San Francisco to Anaheim.¹⁴⁷

b. Job Quality and Job Access

Job quality in this sector is mixed, with construction wages varying significantly between union and nonunion workers.¹⁴⁸ Many of the policies related to supporting infill development and transit expansion are considered public works, requiring contractors to pay prevailing wages.¹⁴⁹ The “skilled and trained” workforce requirement described in Chapter 2 has also been incorporated in recent affordable housing laws, including Senate Bill 35 (Wiener, Chapter 366, Statutes of 2017)¹⁵⁰ and Assembly Bill 73 (Chiu, Chapter 371, Statutes of 2017),¹⁵¹ both of which create streamlined approval processes for certain types of housing developments.¹⁵² In the residential construction sector, investments focused almost exclusively on multifamily housing can produce “larger collective wage income because the shift to multifamily construction demands more skilled labor than single-family construction,”¹⁵³ so job quality can be higher.

For transit infrastructure, Project Labor Agreements (PLAs) and Community Workforce Agreements (CWAs) are commonly used in California cities, where local elected officials see them as a mechanism to maximize the economic benefits of development projects and create jobs for local residents (see Chapter 2).¹⁵⁴ Some agencies that require PLAs for major subsidized housing developments and transit system expansion projects include targets for local hiring, set goals for apprenticeship utilization, and codify goals for participation of disadvantaged workers to expand access to women and other workers underrepresented in the construction trades (turning the PLA into a CWA, as defined in this report). For transit system expansion, the state’s larger transit agencies (e.g., Los Angeles County Metro,¹⁵⁵ BART,¹⁵⁶ SFMTA,¹⁵⁷ and AC Transit¹⁵⁸) regularly establish PLAs for large construction projects. Both PLAs and CWAs set standards for wages and expand training opportunities for workers, because they include use of the state-certified apprenticeship system and contributions to apprenticeship training trust funds for every hour worked.¹⁵⁹



There is an untapped opportunity to promote high-road approaches and enhance job outcomes in competitive programs that support infill residential construction. The AHSC program funded by the GGRF supports infill affordable housing projects tied to sustainable transportation infrastructure investments. The program awards points for projects that establish workforce inclusion and diversity strategies, and AHSC applicants can receive up to two points (out of a possible 100) if the project advances local workforce development and hiring practices.¹⁶⁰ Program guidelines also support prevailing wage standards, but only when a project is otherwise covered by prevailing wage requirements. Adding extra weight to the workforce development element, to ensure job quality not just job access, in the AHSC and other competitive California Climate Investment programs (like the Transformative Climate Communities program) could lead to enhanced workforce outcomes for the state's GGRF-funded housing programs.

PROMISING PRACTICE #7.4

Establishing Labor Protections, Increasing Access to Jobs, and Promoting Infill Development Near Transit: Measure JJJ

Passed by 64.8 percent of voters in Los Angeles in 2016, Measure JJJ enacts minimum affordable housing requirements, training standards, and labor and wage regulations on development projects that seek zoning changes, general plan amendments, or height district changes in the City of Los Angeles. Measure JJJ also establishes the Transit-Oriented Communities (TOC) program, which provides incentives for projects that meet affordability thresholds and are within a half-mile radius of a major transit stop.¹⁶¹

Measure JJJ was supported by a coalition of labor and affordable housing advocates. The measure has strong labor standards and job access goals that largely focus on local hire and employing historically marginalized groups. Measure JJJ provides added development incentives, such as zoning exemptions and density bonuses, for projects that meet the entire suite of labor standards outlined in the policy. For projects eligible for JJJ incentives, construction workers must be paid prevailing wages, 30 percent of

workers must be Los Angeles residents, and 10 percent must be “transitional” (i.e., veterans, single parents, and/or unemployed individuals living within a five-mile radius of the project).

Using language that is very similar to the “skilled and trained” workforce standard discussed in Chapters 2 and 8, projects eligible for Measure JJJ incentives must meet a requirement that 60 percent of the workers on the project must either: 1) have graduated from a joint labor-management, state-certified apprenticeship training program or have at least as many hours of on-the-job experience in the applicable craft as would be required to graduate from such an apprenticeship program; or 2) be registered apprentices in an apprenticeship training program approved by the State of California or an out-of-state, federally-approved apprenticeship program.¹⁶² This requirement ensures both job quality and a job training pathway through the utilization of registered apprentices whose wages rise as they advance in their training program.



PROMISING PRACTICE #7.5

Job Access and Inclusion Model—Los Angeles County Metropolitan Transportation Authority (LA Metro) Construction Careers Policy (CCP)

LA Metro’s Construction Careers Policy (CCP) and associated Project Labor Agreement (PLA) programs provide a good example of a far-reaching workforce access and pathways policy. Approved by the LA Metro Board in 2012, the PLA/CCP has the following requirements for federally-funded local transportation construction projects with a value greater than \$2.5 million:¹⁶³

- **40-percent participation of construction workers residing in economically disadvantaged areas;**
- **20-percent apprentice participation; and**
- **10-percent participation of disadvantaged workers that meet specific criteria for individuals.**

As of March 2018, LA Metro’s construction projects that are subject to the PLA/CCP have seen participation rates that meet and exceed the targeted workforce thresholds outlined above. Sixty percent of construction workers on these projects live in economically disadvantaged areas, 21 percent are apprentices, and 10 percent are economically disadvantaged.¹⁶⁴ The agency has spent more than \$7.5 billion on contracts utilizing the PLA, with more than 5.8 million apprentice hours used across projects.¹⁶⁵

This program also aims to increase access to construction jobs for women. To date, LA Metro’s

female participation average is 3.4 percent.¹⁶⁶ In an effort to boost those numbers, the PLA/CCP also led to the establishment of the Women Build Metro LA (WBMLA), a working group comprised of women and men in construction, community advocates, public officials, and other stakeholders. This committee helps LA Metro achieve its goal of increasing female participation in construction through recruitment, education, and career development for women entering the transportation industry.¹⁶⁷ Their programming includes apprenticeship readiness fairs, workshops, and tours for prospective female construction workers.¹⁶⁸ The committee partners with the organization Women in Non-Traditional Employment Roles (WINTER), and includes the direct involvement of the apprenticeship programs’ training coordinators in assisting applicants with pre-apprenticeship and apprenticeship applications.¹⁶⁹

LA Metro mandates that contractors entering into a PLA must fill out a quarterly “report card” that tracks women and minority participation in their construction projects, and is used to measure progress towards the hiring goals. Contractors are also required to demonstrate their efforts to “create and promote a diverse and inclusive work environment” by reporting their policies around child care, restrooms, and sexual harassment, as these are factors in the retention of women in construction.¹⁷⁰



2. Workforce Recommendations

- ❖ Where public sources contribute funding to infill development projects, awarding agencies can set minimum workforce standards or include scoring criteria that reward applicants who create good jobs and expand access to workers who are under-represented in the construction trades.
- ❖ Where the state award grants to local transit agencies, require PLAs or CWAs for transit infrastructure expansion projects.

IV. Key Recommendations for Sustainable Transportation

Exhibit 7.5. Key Recommendations for Sustainable Transportation

| Demand Side | |
|------------------------------------|--|
| Clean Vehicle Manufacturing | <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement of buses and other fleet vehicles purchased by state and local government and public agencies. ❖ Use job impact metrics to measure the impact of clean vehicle incentive and investment programs on quantity of jobs, job quality, and job access. ❖ Incorporate workforce analysis into emerging technology support programs. |
| Cleaner Trucking | <ul style="list-style-type: none"> ❖ Institute a responsible employer policy for rebates, loans, pilot program grants, and other assistance and for all public agencies that contract-out trucking services that requires: <ul style="list-style-type: none"> ● Strict enforcement of all applicable labor and employment laws; ● Firms receiving public funds for the purchase of clean trucks to operate those trucks with their own employee drivers; and ● Firms receiving public funds for the purchase of clean trucks to be free of outstanding judgments against them for unpaid wages or other violations of labor laws. |



| Demand Side | |
|--|--|
| Public Transit and Passenger Travel | <ul style="list-style-type: none"> ❖ Support funding for public transit operations including for innovative programs that incorporate micro-transit services for first- and last-mile trips as part of public transit systems. ❖ Incorporate inclusive procurement policies in programs where public transit agencies contract with transportation network companies (TNCs) for first- and last-mile mobility. ❖ Incorporate responsible employer policies for projects that use public funding to incentivize cleaner vehicles for TNCs. ❖ Incorporate worker protections and labor standards in comprehensive regulations of TNCs that also address congestion and vehicle miles traveled, through licensing or rules and fees on access to curb space and public streets or other policy levers that may be considered. |
| Cleaner Fuels Infrastructure | <ul style="list-style-type: none"> ❖ Adopt the requirement that electric vehicle charging stations be installed by EVITP-certified electricians across all incentive programs overseen by the state. ❖ Apply labor and skills standards for programs that fund the upgrade, retrofit, or construction of other alternative fuel distribution infrastructure. |
| Infill Development and Transit Infrastructure | <ul style="list-style-type: none"> ❖ Where competitive grants fund infill development projects, include scoring criteria that reward applicants that create good jobs and expand access to disadvantaged groups and communities not well represented in the construction trades. ❖ Require PLAs or CWAs for transit infrastructure expansion projects. |
| All Sustainable Transportation Subsectors | <ul style="list-style-type: none"> ❖ Use job impact metrics to measure the impact of climate policies on job numbers, job quality, and job access. |



| Supply Side | |
|--|--|
| All Sustainable Transportation Subsectors | <ul style="list-style-type: none"> ❖ Support high-road industry training partnerships for low-carbon vehicle manufacturing, lower-carbon vehicle repair, transit operations, and alternative fuel infrastructure installation. ❖ Support professional development and capacity building in transit agencies and regional transportation planning authorities. ❖ Track training program outcomes for graduation, attainment of industry-recognized credentials, job placement, retention, wages, and wage progression. |
| Infill Development and Transit Infrastructure | <ul style="list-style-type: none"> ❖ Fund and participate in High Road Construction Careers, a statewide initiative that includes pre-apprenticeship training linked to expanding the use of CWAs in construction. |



Endnotes

- 1 California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2016: Trends of Emissions and Other Indicators,” 2018, https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.
- 2 California Department of Transportation, “California Public Road Data 2016,” March 2018, http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/prd/prd_pdf_format/prd2016.pdf; California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- 3 Jacob Orenberg, “2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program,” Commission Report (California Energy Commission, Fuels and Transportation Division, May 2018), <https://efiling.energy.ca.gov/getdocument.aspx?tn=223420>.
- 4 California Air Resources Board, “2018 Progress Report: California’s Sustainable Communities and Climate Protection Act,” November 2018, https://ww2.arb.ca.gov/sites/default/files/2018-11/Final2018Report_SB150_112618_02_Report.pdf.
- 5 California Department of Motor Vehicles, “Statistics for Publication,” December 2017, <https://www.dmv.ca.gov/portal/wcm/connect/5aa16cd3-39a5-402f-9453-0d353706cc9a/official.pdf?MOD=AJPERES>.
- 6 California Department of Transportation et al., “California Sustainable Freight Action Plan,” July 29, 2016, http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/Documents/CSFAP_Main%20Document_FINAL_07272016.pdf.
- 7 Orenberg, “2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program.”
- 8 Several of the policies listed below affect multiple categories (e.g., the Low Carbon Transportation Investments and AQIP program includes elements that affect the adoption of cleaner vehicles and reduction in VMT). For this report, we have grouped them based on the policy’s primary sphere of influence.
- 9 California Air Resources Board, “Facts About The Advanced Clean Cars Program,” November 9, 2011, https://www.arb.ca.gov/msprog/zevprog/factsheets/advanced_clean_cars_eng.pdf.
- 10 Alberto Ayala, “California’s Advanced Clean Cars Program: A Coordinated Set of GHG, Criteria, and ZEV Regulations” (California-Mexico Mission, Mexico City, July 9, 2014), <https://www.theicct.org/sites/default/files/%5B9%20July%5D%20Panel%20%20-%20Alberto%20Ayala%2C%20ARB.pdf>.



- 11 California Air Resources Board, “Low Carbon Transportation Investments and Air Quality Improvement Program,” accessed November 21, 2018, <https://www.arb.ca.gov/msprog/aqip/aqip.htm>.
- 12 California Air Resources Board, “Proposed Fiscal Year 2018-19 Funding Plan for Clean Transportation Incentives for Low Carbon Transportation Investments and the Air Quality Improvement Program,” September 21, 2018, https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1819_funding_plan.pdf.
- 13 Ricardo Lara, “SB-1204 California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program,” Chapter 524, Statutes of 2014 § (2014), https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1204.
- 14 California Air Resources Board, “Proposed California Phase 2 Greenhouse Gas Standards (CA Phase 2 GHG) and Potential Amendments to the Tractor-Trailer GHG Regulation” (Sacramento, California, August 31, 2017), https://www.arb.ca.gov/msprog/onroad/caphase2ghg/20170831_workshop_presentation.pdf.
- 15 California Department of Transportation et al., “About the California Sustainable Freight Action Plan,” California Sustainable Freight Action Plan, accessed January 4, 2019, <http://www.dot.ca.gov/csfap/>.
- 16 Norman Brinkman et al., “Well-to-Wheels Analysis of Advanced Fuel/Vehicle Systems — A North American Study of Energy Use, Greenhouse Gas Emissions, and Criteria Pollutant Emissions,” May 2005, https://www.energy.gov/sites/prod/files/2014/04/f14/well_to_wheels_analysis_0.pdf.
- 17 California Air Resources Board, “Low Carbon Fuel Standard,” accessed November 21, 2018, <https://www.arb.ca.gov/fuels/lcfs/background/basics-notes.pdf>.
- 18 California Air Resources Board, “Alternative Fuel Volumes and Credit Generation,” Figure 2, December 31, 2019, <https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm>.
- 19 Julie Witcover, “Status Review of California’s Low Carbon Fuel Standard, 2011–2018 Q1,” Research Report (UC Davis Institute of Transportation Studies, September 24, 2018), <https://escholarship.org/uc/item/445815cd#main>.
- 20 California Air Resources Board, “Alternative Fuel Volumes and Credit Generation.”
- 21 California Air Resources Board, “Low-Income Barriers Study, Part B: Overcoming Barriers to Clean Transportation Access for Low-Income Residents” (California Air Resources Board, February 21, 2018), https://www.arb.ca.gov/msprog/transoptions/sb350_final_guidance_document_022118.pdf.



- 22 Kevin de León, “SB-350 Clean Energy and Pollution Reduction Act of 2015,” Chapter 547, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.
- 23 Eduardo Garcia, “AB-398 California Global Warming Solutions Act of 2006: Market-Based Compliance Mechanisms: Fire Prevention Fees: Sales and Use Tax Manufacturing Exemption,” Chapter 135, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398.
- 24 Darrell Steinberg, “SB-375 Transportation Planning: Travel Demand Models: Sustainable Communities Strategy: Environmental Review,” Chapter 728, Statutes of 2008 § (2008), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080SB375.
- 25 California Air Resources Board, “Sustainable Communities,” 2017, <https://ww2.arb.ca.gov/our-work/topics/sustainable-communities>.
- 26 California Governor’s Office of Planning and Research, “Senate Bill 375 CEQA Provision Flow Charts,” February 2, 2011, <http://www.opr.ca.gov/docs/SB375-Intro-Charts.pdf>.
- 27 Darrell Steinberg, “SB-743 Environmental Quality: Transit Oriented Infill Projects, Judicial Review Streamlining for Environmental Leadership Development Projects, and Entertainment and Sports Center in the City of Sacramento,” Chapter 386, Statutes of 2013 § (2013), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB743.
- 28 California Governor’s Office of Business and Economic Development, “Transportation Impacts (SB 743),” accessed November 21, 2018, <http://opr.ca.gov/ceqa/updates/sb-743/>.
- 29 California Governor’s Office of Planning and Research, “Technical Advisory on Evaluating Transportation Impacts in CEQA,” April 2018, http://www.opr.ca.gov/docs/20180416-743_Technical_Advisory_4.16.18.pdf.
- 30 Committee on Budget and Fiscal Review, “SB-99 Active Transportation Program,” Chapter 359, Statutes of 2013 § (2013), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB99.
- 31 James Beall, “SB-1 Transportation Funding,” Chapter 5, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billStatusClient.xhtml?bill_id=201720180SB1.
- 32 California Department of Finance, “Governor’s Budget Summary 2018-19 (Proposed),” January 10, 2018, <http://www.ebudget.ca.gov/2018-19/pdf/BudgetSummary/FullBudgetSummary.pdf>.



- 33 Melanie Curry, “California Active Transportation Program Funding Unchanged for Next Two Years,” *StreetsBlogLA* (blog), January 26, 2015, <https://la.streetsblog.org/2015/01/26/active-transportation-program-funding-unchanged-for-next-two-year-cycle/>.
- 34 California Department of Transportation, “ATP Purpose and Goals,” March 2015, <http://www.dot.ca.gov/hq/LocalPrograms/atp/documents/2015/Visio-ATP-Purpose-and-Goals-flowchart-3-3-15.pdf>.
- 35 John Melville et al., “CA’s Advanced Transportation Industry Clusters of Opportunity: Driving Market Expansion, Technology Innovation and Job Growth” (Collaborative Economics, Inc., September 2013), http://www.coecon.com/assets/ca_advancedtransportclusters_2013.pdf.
- 36 J.R. DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments” (UCLA Luskin Center for Innovation, August 14, 2018), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Employment_Benefits_from_CA_Climate_Investments_and_Co-investments.pdf.
- 37 Melville et al., “CA’s Advanced Transportation Industry Clusters of Opportunity: Driving Market Expansion, Technology Innovation and Job Growth.”
- 38 U.S. Department of Labor, Bureau of Labor Statistics, “OES Research Estimates by State and Industry,” Occupational Employment Statistics, March 30, 2018, https://www.bls.gov/oes/current/oes_research_estimates.htm. The following major-level SOC occupations were considered blue-collar and/or manual labor occupations: Construction and Extraction Occupations; Production Occupations; Transportation and Material Moving Occupations; Installation, Maintenance, and Repair Occupations; Building and Grounds Cleaning and Maintenance Occupations; Personal Care and Service Occupations; Farming, Fishing, and Forestry Occupations; and Food Preparation and Serving Related Occupations.
- 39 Zoe Lipman and Luke Tonachel, “Supplying Ingenuity II: U.S. Suppliers of Key Clean, Fuel-Efficient Vehicle Technologies” (The Natural Resources Defense Council, BlueGreen Alliance, May 2017), <https://www.nrdc.org/sites/default/files/supplying-ingenuity-clean-vehicle-technologies-report.pdf>.
- 40 U.S. Department of Labor, Bureau of Labor Statistics, “QCEW Data Views,” 2017, https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables.
- 41 CALSTART, “California’s Clean Transportation Technology Industry: Time to Shift into High Gear,” August 2016, <https://calstart.org/report-highlights-growth-opportunity-for-ca-clean-trans-tech-industry/>.
- 42 Original equipment manufacturers (OEMs) that have recently built plants in the state include BYD, Complete Coach Works, Proterra, Motiv Power Systems, TransPower,



Wrightspeed, and Karma—all makers of zero-emission vehicles (ZEVs, i.e., plug-in electric and fuel cell vehicles). These investments follow a decade when very few new automotive plants were built in North America.

43 CALSTART, “California’s Clean Transportation Technology Industry: Time to Shift into High Gear.”

44 Connor Cislo and Nao Sano, “Electric Cars Could Be a Job Killer for Japan’s No. 1 Industry,” *Bloomberg Businessweek*, August 13, 2018, <https://www.bloomberg.com/news/articles/2018-08-13/electric-cars-could-be-a-job-killer-for-japan-s-no-1-industry>; Peter Holley, “‘People Are Freaking out.’ Will Electric Vehicles Doom Your Neighborhood Auto Mechanic?,” *The Washington Post*, December 11, 2017, https://www.washingtonpost.com/news/innovations/wp/2017/12/11/people-are-freaking-out-why-electric-vehicles-might-doom-your-neighborhood-auto-mechanic/?noredirect=on&utm_term=.c6ba47156ab6.

45 Transport & Environment, “How Will Electric Vehicle Transition Impact EU Jobs?,” September 2017, <https://www.transportenvironment.org/sites/te/files/publications/Briefing%20-%20How%20will%20electric%20vehicle%20transition%20impact%20EU%20jobs.pdf>.

46 Transport & Environment.

47 Lawrence Mishel, “Yes, Manufacturing Still Provides a Pay Advantage, but Staffing Firm Outsourcing Is Eroding It” (Economic Policy Institute, March 12, 2018), <https://www.epi.org/files/pdf/141193.pdf>; Ken Jacobs et al., “Producing Poverty: The Public Cost of Low-Wage Production Jobs in Manufacturing” (UC Berkeley Center for Labor Research and Education, May 2016), <http://laborcenter.berkeley.edu/pdf/2016/Producing-Poverty.pdf>.

48 This is based on review of the California Department of Industrial Relations (Division of Occupational Safety & Health and the Division of Labor Standards Enforcement) inspections and investigations since 2011 of zero-emission vehicle (ZEV) manufacturers that have received state funding for workforce and capital/production investments.

49 Ann C. Foster, “Differences in Union and Nonunion Earnings in Blue-Collar and Service Occupations” (U.S. Department of Labor, Bureau of Labor Statistics, June 25, 2003), <https://www.bls.gov/opub/mlr/cwc/differences-in-union-and-nonunion-earnings-in-blue-collar-and-service-occupations.pdf>.

50 Steven Greenhouse, “Connecting Public Transit to Great Manufacturing Jobs,” *The American Prospect*, April 9, 2018, <http://prospect.org/article/connecting-public-transit-great-manufacturing-jobs>; Jobs to Move America, “Labor and Community Groups Sign Landmark Agreement with Electric Bus Manufacturer BYD in Los Angeles,”



July 17, 2017) <https://en.byd.com/news-posts/press-release-labor-and-community-groups-sign-landmark-agreement-with-electric-bus-manufacturer-byd-in-los-angeles/>.

51 Jobs to Move America, “Victories,” accessed November 21, 2018, <https://jobstomoveamerica.org/about/california-jobs-move-america/victories/>; Partnership for Working Families, “Policy & Tools: Community Benefits Agreements and Policies In Effect,” accessed May 9, 2016, <http://www.forworkingfamilies.org/page/policy-tools-community-benefits-agreements-and-policies-effect>.

52 California Air Resources Board, “Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project,” October 10, 2017, <https://www.arb.ca.gov/msprog/aqip/hvip.htm>.

53 Christopher Thornberg et al., “2018 California Green Innovation Index” (Next 10, 2018), <http://next10.org/sites/default/files/2018-ca-green-innovation-index.pdf>; Frances Anderton and Avishay Artsy, “Los Angeles Has Become the Detroit of Electric Buses,” *KCRW Design and Architecture*, July 11, 2017, <https://www.kcrw.com/culture/shows/design-and-architecture/los-angeles-has-become-the-detroit-of-electric-buses>.

54 California Air Resources Board, “Update on Innovative Clean Transit (ICT) Discussion Document,” March 27, 2018, <https://arb.ca.gov/msprog/ict/meeting/mt180327/180327ictconcept.pdf>.

55 Jobs to Move America, “U.S. Employment Plan Fact Sheet,” October 2015, <https://metro council.org/getdoc/6a488e92-1879-4811-8cf8-9fc32ed636a5/BusinessItem.aspx>.

56 Jobs to Move America, “Victories.”

57 Wisconsin Regional Training Partnership, “Manufacturing Better Opportunity & A Stronger Economy,” June 4, 2013, https://www.cows.org/_data/documents/1481.pdf; Rhandi Berth, Laura Dresser, and Emanuel Ubert, “Moving Apprenticeship into Manufacturing’s Future: Industrial Manufacturing Technician” (Wisconsin Regional Training Partnership and COWS, February 2017), https://www.cows.org/_data/documents/1826.pdf.

58 Berth, Dresser, and Ubert, “Moving Apprenticeship into Manufacturing’s Future: Industrial Manufacturing Technician.”

59 Orenberg, “2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program.”

60 U.S. Environmental Protection Agency, “Regulations for Greenhouse Gas Emissions from Commercial Trucks & Buses,” accessed November 21, 2018, <https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-commercial-trucks>.



- 61 California Air Resources Board, “Proposed California Phase 2 Greenhouse Gas Standards (CA Phase 2 GHG) and Potential Amendments to the Tractor-Trailer GHG Regulation.”
- 62 Patrick Calpin and Esteban Plaza-Jennings, “A Look Back at EPA’s Cost and Other Impact Projections for MY 2004-2010 Heavy-Duty Truck Emissions Standards” (National Automobile Dealers Association and American Truck Dealers, February 13, 2012), <https://www.nada.org/WorkArea/DownloadAsset.aspx?id=21474839308>.
- 63 Richard Barone and Emily Roach, “Why Goods Movement Matters: Strategies for Moving Goods in Metropolitan Areas” (Regional Plan Association, 2016), <http://library.rpa.org/pdf/Why-Goods-Movement-Matters-ENG.pdf>.
- 64 Michael Belzer, *Sweatshops on Wheels: Winners and Losers in Trucking Deregulation* (Oxford University Press, 2000).
- 65 Diane Bailey, Zach Goldman, and Maria Minjares, “Driving on Fumes: Truck Drivers Face Elevated Health Risks from Diesel Pollution,” NRDC Issue Paper (The Natural Resources Defense Council, December 2007), <https://www.nrdc.org/sites/default/files/driving.pdf>.
- 66 California Department of Industrial Relations, “Labor Commissioner Posts List of Port Trucking Companies with Unsatisfied Judgments for Labor Violations (News Release No. 2019-01),” January 2, 2019, <https://www.dir.ca.gov/DIRNews/2019/2019-01.pdf>; California Department of Industrial Relations, “U.S. District Court Upholds Labor Commissioner Awards of Almost \$1 Million for Misclassification of Port and Rail Truck Drivers (News Release No. 2017-39),” May 23, 2017, <https://www.dir.ca.gov/DIRNews/2017/2017-39.pdf>; see also Rebecca Smith, Paul Alexander Marvy, and Jon Zerolnick, “The Big Rig Overhaul: Restoring Middle-Class Jobs at America’s Ports Through Labor Law Enforcement” (National Employment Law Project, Change to Win Strategic Organizing Center, Los Angeles Alliance for New Economy, February 2014), <http://www.laane.org/wp-content/uploads/2014/02/BigRigOverhaul2014.pdf>; Steve Viscelli, *The Big Rig: Trucking and the Decline of the American Dream* (University of California Press, 2016).
- 67 Smith, Marvy, and Zerolnick, “The Big Rig Overhaul: Restoring Middle-Class Jobs at America’s Ports Through Labor Law Enforcement.”
- 68 Viscelli, *The Big Rig: Trucking and the Decline of the American Dream*.
- 69 Paul Davidson, “Trucker Shortage Is Raising Prices, Delaying Deliveries,” *USA TODAY*, April 29, 2018, <https://www.usatoday.com/story/money/2018/04/26/truck-driver-shortage-raises-prices/535870002/>.
- 70 Smith, Marvy, and Zerolnick, “The Big Rig Overhaul: Restoring Middle-Class Jobs at America’s Ports Through Labor Law Enforcement.”



71 Time and resource constraints precluded addressing all segments of the trucking industry.

72 Rebecca Smith, David Bensman, and Paul Alexander Marvy, “The Big Rig: Poverty, Pollution, and the Misclassification of Truck Drivers at America’s Ports” (National Employment Law Project and Change to Win, December 2010), <https://s27147.pcdn.co/wp-content/uploads/2015/03/PovertyPollutionandMisclassification.pdf>.

73 California Department of Industrial Relations, “Labor Commissioner Posts List of Port Trucking Companies with Unsatisfied Judgments for Labor Violations (News Release No. 2019-01)”; California Department of Industrial Relations, “U.S. District Court Upholds Labor Commissioner Awards of Almost \$1 Million for Misclassification of Port and Rail Truck Drivers (News Release No. 2017-39)”; see also Brett Murphy, “Rigged. Forced into Debt. Worked Past Exhaustion. Left with Nothing.,” *USA TODAY*, June 16, 2017, <https://www.usatoday.com/pages/interactives/news/rigged-forced-into-debt-worked-past-exhaustion-left-with-nothing/>; Viscelli, *The Big Rig: Trucking and the Decline of the American Dream*.

74 Steve Gorman, “Southern California Ports Clean Up Polluting Trucks,” *Reuters*, October 1, 2008, <https://www.reuters.com/article/us-ports/southern-california-ports-clean-up-polluting-trucks-idUSTRE4906D320081001>.

75 Aurora Percannella, “Under a New Law, Retailers Share Liability for Misclassified Truck Drivers at California Ports,” *Los Angeles Times*, September 25, 2018, <https://www.latimes.com/business/la-fi-truck-drivers-20180925-story.html>.

76 JOC, “Federal Court Bars LA Employee-Driver Mandate,” JOC.com, August 26, 2013, https://www.joc.com/port-news/us-ports/port-los-angeles/federal-court-bars-la-employee-driver-mandate_20130826.html.

77 Murphy, “Rigged. Forced into Debt. Worked Past Exhaustion. Left with Nothing.”

78 Murphy.

79 Ricardo Lara, “SB-1402 Labor Contracting: Customer Liability,” Chapter 702, Statutes of 2018 § (2018), https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1402.

80 Samantha Masunaga, “L.A. and Long Beach Port Truckers and Warehouse Workers Begin Strike,” *Los Angeles Times*, October 1, 2018, sec. Business, <https://www.latimes.com/business/la-fi-port-truckers-strike-20181001-story.html>.

81 Lara, SB-1402 Labor contracting: customer liability.

82 Percannella, “Under a New Law, Retailers Share Liability for Misclassified Truck Drivers at California Ports.”



- 83 Andrew Khouri, “Three Port Truck Companies Exploited Drivers, L.A. City Attorney Says in Lawsuits,” *Los Angeles Times*, January 8, 2018, <https://www.latimes.com/business/la-fi-port-trucker-lawsuits-20180108-story.html>.
- 84 South Coast Air Quality Management District, “Board Meeting Minutes, Agenda No. 29 (Report of the Technology Committee Meeting Held September 21, 2018),” October 5, 2018, <http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2018/2018-oct5-029.pdf?sfvrsn=2>.
- 85 Brett Murphy, “Asleep at the Wheel: Companies Risk Lives by Putting Sleep-Deprived Port Truckers on the Road,” *USA TODAY*, December 28, 2017, <https://www.usatoday.com/pages/interactives/news/rigged-asleep-at-the-wheel/>.
- 86 Viscelli, *The Big Rig: Trucking and the Decline of the American Dream*.
- 87 Viscelli.
- 88 Viscelli.
- 89 Mitchell Hoffman and Stephen V. Burks, “Training Contracts, Worker Overconfidence, and the Provision of Firm-Sponsored General Training,” SSRN Scholarly Paper (Rochester, NY: Social Science Research Network, May 31, 2013), <https://papers.ssrn.com/abstract=2220043>; Viscelli, *The Big Rig: Trucking and the Decline of the American Dream*.
- 90 Steve Viscelli, “The Trouble with Trucking,” in *Shifting to the High Road: Improving Job Quality in Low-Wage Industries* (Paul Osterman Ed.) (Cambridge, MA: MIT Press, forthcoming).
- 91 Stephen V. Burks and Kristen Monaco, “Is the U.S. Labor Market for Truck Drivers Broken? An Empirical Analysis Using Nationally Representative Data,” IZA Discussion Papers (Institute for the Study of Labor (IZA), 2018), <https://ideas.repec.org/p/iza/izadps/dp11813.html>; “IZA Discussion Papers” (Institute for the Study of Labor (IZA), n.d.), <https://ideas.repec.org/s/iza/izadps.html>.
- 92 Steve Viscelli, “Stalled: Make Big Trucks More Fuel Efficient” (Kleinman Center for Energy Policy, March 15, 2017), <https://kleinmanenergy.upenn.edu/policy-digests/stalled-make-big-trucks-more-fuel-efficient>.
- 93 Viscelli; Josie Garthwaite, “Smarter Driver Behavior Improves Fuel Economy for Trucks,” *National Geographic News*, September 24, 2011, <https://news.national-geographic.com/news/energy/2011/09/110923-fuel-economy-for-trucks/>.
- 94 Stephen V. Burks et al., “Using Behavioral Economic Field Experiments at a Large Motor Carrier: The Context and Design of the Truckers and Turnover Project,” IZA Discussion Papers (Institute for the Study of Labor (IZA), May 2007), <https://doi.org/10.3386/w12976>.



- 95 Viscelli, *The Big Rig: Trucking and the Decline of the American Dream*.
- 96 Viscelli.
- 97 Viscelli.
- 98 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Employment and Wages, May 2017: 49-3031 Bus and Truck Mechanics and Diesel Engine Specialists,” May 2017, <https://www.bls.gov/oes/2017/may/oes493031.htm>. Note that these overall numbers include bus mechanics and diesel mechanics working for a range of different firms that might service goods movement trucks (including actual motor carriers in transportation) and also truck leasing firms and service stations.
- 99 CalVans, “History,” CalVans, accessed November 21, 2018, <https://calvans.org/history>.
- 100 Daniel Sperling, professor and American founding director of the UC Davis Institute for Transportation Studies, personal communication with author, December 19, 2017.
- 101 Matt Nichols, Policy Director, Infrastructure and Transportation, Office of Mayor Libby Schaaf, personal communication with author, December 1, 2018.
- 102 Lawrence Mishel, “Uber and the Labor Market: Uber Drivers’ Compensation, Wages, and the Scale of Uber and the Gig Economy” (Economic Policy Institute, May 15, 2018), <https://epi.org/145552>. Lianne Sturgeon, “The Impact of Transportation Network Companies on Public Transit: A Case Study at the San Francisco International Airport,” Scripps Senior Theses, January 1, 2019, https://scholarship.claremont.edu/scripps_theses/1318.
- 103 Anne Elizabeth Brown, “Ridehail Revolution: Ridehail Travel and Equity in Los Angeles” (UCLA, 2018), <https://escholarship.org/uc/item/4r22m57k>.
- 104 Bruce Schaller, “Unsustainable? The Growth of App-Based Ride Services and Traffic, Travel and the Future of New York City” (Schaller Consulting, February 27, 2017), <http://schallerconsult.com/rideservices/unsustainable.pdf>.
- 105 San Francisco County Transportation Authority, “TNCs Today: A Profile of San Francisco Transportation Network Company Activity,” June 2017, <https://www.sfcta.org/emerging-mobility/tncs-today>.
- 106 Michael Manville, Brian D. Taylor, and Evelyn Blumenberg, “Falling Transit Ridership: California and Southern California” (prepared for the Southern California Association of Governments, January 2018), https://www.scag.ca.gov/Documents/ITS_SCAG_Transit_Ridership.pdf.



- 107 Lew Fulton, Jacob Mason, and Dominique Meroux, “Three Revolutions in Urban Transportation” (UC Davis Institute of Transportation Studies and Institute for Transportation & Development Policy, May 2017), https://steps.ucdavis.edu/wp-content/uploads/2017/05/STEPS_ITDP-3R-Report-5-10-2017-2.pdf.
- 108 Fulton, Mason, and Meroux.
- 109 Samuel I. Schwartz and Karen Kelly, *No One at the Wheel: Driverless Cars and the Road of the Future* (New York, NY: PublicAffairs, 2018).
- 110 Joseph Schwieterman, Mallort Livingston, and Stijn Van Der Slot, “Partners in Transit: A Review of Partnerships between Transportation Network Companies and Public Agencies in the United States.,” Policy Series (Chaddick Institute for Metropolitan Development at Depaul University, August 1, 2018), https://las.depaul.edu/centers-and-institutes/chaddick-institute-for-metropolitan-development/research-and-publications/Documents/Partners%20in%20Transit_Live1.pdf.
- 111 Corky Siemaszko, “In the Shadow of Uber’s Rise, Taxi Driver Suicides Leave Cabbies Shaken,” *NBC News*, June 7, 2018, <https://www.nbcnews.com/news/us-news/shadow-uber-s-rise-taxi-driver-suicides-leave-cabbies-shaken-n879281>; Skanda Kadrigamar, “New NYC Regulations on Uber and Lyft a Victory for Union Organizing,” *Waging Nonviolence*, August 11, 2018, <https://wagingnonviolence.org/2018/08/nyc-regulations-uber-lyft-victory-union-organizing/>.
- 112 See, for instance, this recent work which summarizes current research comparing earnings and other labor conditions between TNC drivers and taxi cab drivers, but does not recognize any impact on paratransit or transit drivers. National Academies of Sciences, Engineering, and Medicine, *Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services* (Washington, DC: The National Academies Press, 2016), <https://doi.org/10.17226/21875>.
- 113 Pew Research Center, “America’s Shrinking Middle Class: A Close Look at Changes Within Metropolitan Areas,” May 11, 2016, <http://www.pewsocialtrends.org/2016/05/11/americas-shrinking-middle-class-a-close-look-at-changes-within-metropolitan-areas/>.
- 114 Beverly G. Ward and Eric T. Hill, “Women in Transit: Findings from African-Americans, Other Minorities, and Women in the Transit Industry,” *Women’s Travel Issues: Proceedings from the Second National Conference* FHWA-PL-97-02 (October 1996), <https://www.fhwa.dot.gov/ohim/womens/chap32.pdf>.
- 115 California Transit Works!, “Measurable Results,” accessed November 21, 2018, <http://www.catransitworks.org/metrics.html>.
- 116 California Department of Industrial Relations, “News Release: DIR Recognizes New Apprenticeship Program at the Santa Clara Valley Transportation Authority



during National Apprenticeship Week,” November 14, 2016, <https://www.dir.ca.gov/DIRNews/2016/2016-105.pdf>.

117 Stacey Hendler Ross, “We’re Growing Our Own” (Santa Clara Valley Transportation Authority, November 15, 2016), <http://transportation744.rssing.com/browser.php?indx=15157814&item=31376>.

118 California Transit Works!, “Measurable Results.”

119 Luther Jackson, “Award of Contract to the Santa Clara Valley Transportation Authority to Implement a California Energy Commission Initiative Supporting Transit Apprenticeship Development,” Report to Council, Legislative Public Meetings (City of Sunnyvale, California, November 7, 2017), <https://sunnyvaleca.legistar.com/LegislationDetail.aspx?ID=3096522&GUID=3F12A967-2B43-45CD-8BC5-5ABAD-B209951&Options=&Search=&FullText=1>.

120 Stacey Hendler Ross, “VTA’s Training Expertise Shared Nationwide” (Santa Clara Valley Transportation Authority, December 14, 2017), available via Internet archive at <https://web.archive.org/web/20180221082610/http://www.vta.org/News-and-Media/Connect-with-VTA/VTAs-Training-Expertise-Shared-Nationwide>.

121 Lawrence F. Katz and Alan B. Krueger, “The Rise and Nature of Alternative Work Arrangements in the United States, 1995-2015,” NBER Working Paper (National Bureau of Economic Research, September 2016), <https://doi.org/10.3386/w22667>.

122 Annette Bernhardt and Sarah Thomason, “What Do We Know About Gig Work in California? An Analysis of Independent Contracting” (UC Berkeley Center for Labor Research and Education, June 2017), <http://laborcenter.berkeley.edu/what-do-we-know-about-gig-work-in-california/>; Ian Hathaway and Mark Muro, “Tracking the Gig Economy: New Numbers,” October 13, 2016, <https://www.brookings.edu/research/tracking-the-gig-economy-new-numbers/>.

123 Bernhardt and Thomason, “What Do We Know About Gig Work in California? An Analysis of Independent Contracting.”

124 Nancy Skinner, “SB-1014 California Clean Miles Standard and Incentive Program: Zero-Emission Vehicles.,” Chapter 369, Statutes of 2018 § (2018), https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1014.

125 Los Angeles County Metropolitan Transportation Authority, “LA Metro MicroTransit Pilot Project (MTP) Draft Scope Questions for Consideration,” August 29, 2017, <https://media.metro.net/uploads/Portal/MicroTransit.pdf>.

126 Orenberg, “2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program.”



127 Orenberg.

128 Veloz, “Monthly U.S. Sales,” April 5, 2018, http://www.veloz.org/wp-content/uploads/2018/04/3_mar_2018_Dashboard_PEV_Sales_veloz-2.pdf.

129 California Air Resources Board, “2017 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” August 2017, https://ww2.arb.ca.gov/sites/default/files/2018-12/ab8_report_2017.pdf.

130 For this report, we define “biofuels” as non-petroleum diesel substitutes, gasoline substitutes, and bio-methane. “Diesel substitutes” refers to liquid fuel that can significantly displace diesel fuel, including biodiesel, renewable diesel, and renewably derived dimethyl ether. “Gasoline substitutes” refers to any liquid fuel that can directly displace gasoline in internal combustion engines, including ethanol and renewable drop-in gasoline substitutes. Orenberg, “2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program.”

131 Orenberg.

132 The need for this training is documented in the specific safety requirements identified in the National Electrical Code (NEC). Relevant code sections include NEC articles 220.14(A) – Load Calculations (requiring site assessment); 625.40 – Dedicated Circuits, and article 625.42 – Continuous Loads. National Fire Protection Association, “List of NFPA Codes and Standards,” accessed January 7, 2019, <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards>.

133 EVITP is open to any certified electrician, so it does not exclude either non-unions workers or workers who obtained their certifications without going through an apprenticeship program.

134 California Employment Development Department, “Training Program Summary,” accessed January 7, 2019, <http://www.labormarketinfo.edd.ca.gov/cgi/databrowsing/traProgramSummary.asp?menuChoice=ocexplorer&CipCode=470614++++&-geogArea=0601000000>.

135 United Association: Union of Plumbers, Fitters, Welders, and Service Techs, “Continuing Education,” accessed December 10, 2018, <http://www.ua.org/education>.

136 California Public Utilities Commission, “Decision on the Transportation Electrification Priority Review Projects,” January 11, 2018, <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K655/204655240.PDF>.

137 California Air Resources Board, “California Air Resources Board’s Guidance to Volkswagen on First 30 Month Electric Vehicle Infrastructure Investment Plan of the 2.0



Liter Diesel Engine Partial Consent Decree Settlement,” February 2017, https://www.arb.ca.gov/msprog/vw_info/vsi/vw-zevinvest/documents/carb_guidance_021017.pdf.

138 We were unable to find information about enrollment, graduation, or the job placement rates from community college programs.

139 California Transportation Commission, “Senate Bill (SB) 1 Road Repair and Accountability Act of 2017: Active Transportation Program (ATP),” accessed April 17, 2019, <http://www.catc.ca.gov/programs/atp/>.

140 Curry, “CA Active Transportation Program Funding Unchanged for Next Two Years.”

141 California Department of Transportation, “ATP Purpose and Goals.”

142 Urban Design 4 Health and AECOM, “Active Transportation Health and Economic Impact Study” (Southern California Association of Governments, November 7, 2016), http://www.ochealthiertogether.org/content/sites/ochca/Local_Reports/SCAG_Active_Transportation_Health_and_Economic_Impact_Study_2016.pdf.

143 Nathaniel Decker et al., “Right Type, Right Place: Assessing the Environmental and Economic Impact of Infill Residential Development Through 2030” (Next 10, n.d.), <http://next10.org/sites/default/files/right-type-right-place.pdf>.

144 DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments.”

145 Philip Mattera, “The Jobs Are Back in Town: Urban Smart Growth and Construction Employment” (Good Jobs First, 2003), <http://www.goodjobsfirst.org/sites/default/files/docs/pdf/backintown.pdf>.

146 Decker et al., “Right Type, Right Place: Assessing the Environmental and Economic Impact of Infill Residential Development Through 2030.”

147 Parsons Brinckerhoff, “California High-Speed Rail Project: Economic Impact Analysis Report” (California High-Speed Rail Authority, April 2012), http://www.hsr.ca.gov/docs/about/business_plans/BPlan_2012EIR.pdf.

148 George I. Long, “Differences between Union and Nonunion Compensation, 2001–2011,” *Monthly Labor Review*, U.S. Department of Labor, Bureau of Labor Statistics 136, no. 4 (April 2013): 16–23.

149 California Department of Industrial Relations, “Prevailing Wage Requirements,” October 2016, <https://www.dir.ca.gov/public-works/prevailing-wage.html>.

150 Scott Wiener, “SB-35: Planning and Zoning: Affordable Housing: Streamlined Approval Process,” Chapter 366, Statutes of 2017 § 65400, 65582.1 and 65913.4 (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB35.



- 151 David Chiu, “AB-73: Planning and Zoning: Housing Sustainability Districts,” Chapter 371, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB73.
- 152 Scott Wiener, “SB-35: Planning and Zoning: Affordable Housing: Streamlined Approval Process,” Chapter 366, Statutes of 2017, (chaptered September 29, 2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB35; David Chiu, “AB-73: Planning and Zoning: Housing Sustainability Districts,” Chapter 371, Statutes of 2017 (chaptered September 29, 2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB73.
- 153 Decker et al., “Right Type, Right Place: Assessing the Environmental and Economic Impact of Infill Residential Development Through 2030.”
- 154 Partnership for Working Families, “Policy & Tools: Community Benefits Agreements and Policies In Effect”; Carol Zabin et al., “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan)” (UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014), <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>.
- 155 Los Angeles County Metropolitan Transportation Authority, “Project Labor Agreement & Construction Careers Policy,” LA Metro, accessed November 21, 2018, <https://www.metro.net/about/placcp/>.
- 156 Bay Area Rapid Transit, “BART Major Projects Project Stabilization Agreement (PSA) Summary of Workforce Goals and Steps Towards Establishing Good Faith Efforts for Contractors,” n.d., <https://www.bart.gov/sites/default/files/docs/Summary%20of%20Workforce%20Goals%20and%20GFE%20Steps%20for%20Contractors.pdf>.
- 157 SFMTA, “SFMTA MOUs, CBAs and Labor Organizations / Unions,” accessed November 21, 2018, <https://www.sfmta.com/about-us/labor-relations/sfmta-mous-cbas>.
- 158 “Project Labor Agreement, AC Transit, Bus Rapid Transit Project” (Alameda Contra Costa Transit District, n.d.), <http://www.actransit.org/wp-content/uploads/purchasing/Attachment%20B%20-%20Project%20Labor%20Agreement.pdf>.
- 159 Nikki Luke et al., “Diversity in California’s Clean Energy Workforce: Access to Jobs for Disadvantaged Workers in Renewable Energy Construction” (UC Berkeley Center for Labor Research and Education, Green Economy Program, August 2017), <http://laborcenter.berkeley.edu/pdf/2017/Diversity-in-Californias-Clean-Energy-Workforce.pdf>.
- 160 California Strategic Growth Council, “Affordable Housing and Sustainable Communities Program: FY 2016-2017 Program Guidelines,” July 17, 2017, http://sgc.ca.gov/programs/ahsc/docs/20171024-AHSC_16-17_Guidelines.pdf.



- 161 Howard Fine, “Labor-Backed Housing Initiative Measure JJJ Passes,” *Los Angeles Business Journal*, November 9, 2016, <http://labusinessjournal.com/news/2016/nov/09/los-angeles-voters-approve-measure-jjj/>; Los Angeles City Planning, “City Planning Releases Measure JJJ and Transit Oriented Communities Housing Progress Report,” August 9, 2018, <https://www.lacity.org/blog/city-planning-releases-measure-jjj-and-transit-oriented-communities-housing-progress-report>.
- 162 “The Build Better LA Initiative” (City of Los Angeles, 2016), http://clkrep.lacity.org/onlinedocs/2016/16-0684_misc_06-15-2016.pdf.
- 163 Los Angeles County Metropolitan Transportation Authority, “Metro’s Project Labor Agreement and Construction Careers Policy,” March 2018, https://media.metro.net/about_us/pla/images/policy_constructioncareers_2018-03.pdf.
- 164 Los Angeles County Metropolitan Transportation Authority.
- 165 Los Angeles County Metropolitan Transportation Authority.
- 166 Los Angeles County Metropolitan Transportation Authority.
- 167 Los Angeles County Metropolitan Transportation Authority, “Women Build Metro Los Angeles (WBMLA): Overview,” LA Metro, accessed January 7, 2019, <https://www.metro.net/about/wbmla/overview/>.
- 168 “Will Metro Contractors Make The Grade On Female Hires?,” *Los Angeles County Supervisor Sheila Kuehl* (blog), December 1, 2017, <https://supervisorkuehl.com/will-metro-contractors-make-grade-female-hires/>.
- 169 “Women Build Metro LA: Apprenticeship Readiness Fair in Van Nuys,” *Los Angeles County Supervisor Sheila Kuehl* (blog), April 18, 2018, <https://supervisorkuehl.com/women-build-metro/>.
- 170 “Will Metro Contractors Make The Grade On Female Hires?”; Anne Morello, Raja Issa, and Bryan Franz, “Exploratory Study of Recruitment and Retention of Women in the Construction Industry,” *Journal of Professional Issues in Engineering Education and Practice* 144 (April 1, 2018), [https://doi.org/10.1061/\(ASCE\)EI.1943-5541.0000359](https://doi.org/10.1061/(ASCE)EI.1943-5541.0000359).



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 8: Industrial Sector

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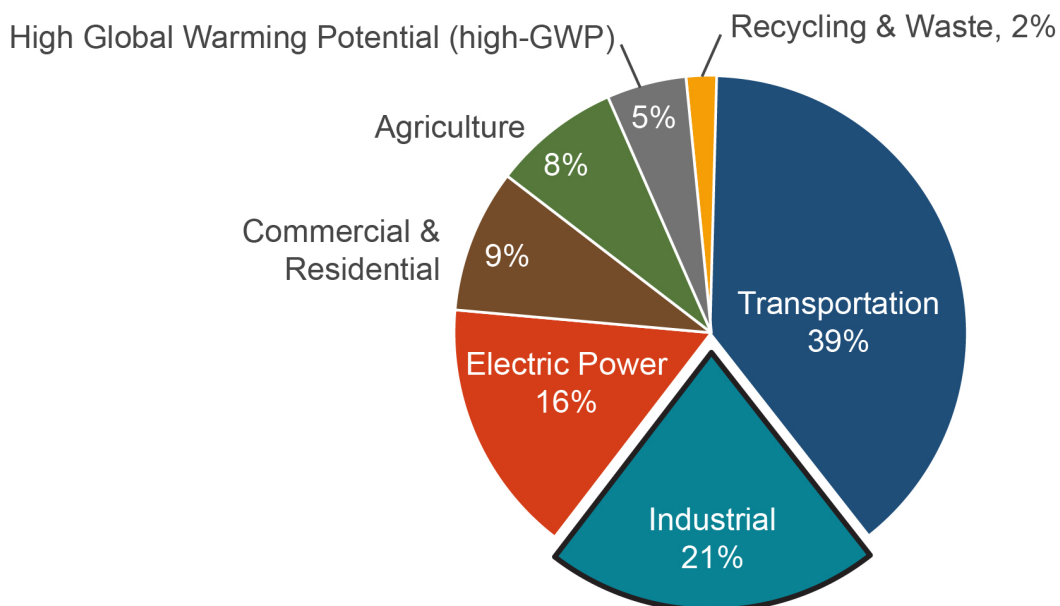
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I. Overview of Sector and Key Climate Policies

The industrial sector is a major source of greenhouse gas emissions, comprising 23 percent of statewide emissions in 2017. The Scoping Plan industrial sector includes manufacturing industries as well as oil and gas extraction, distribution, and refining. **Exhibit 8.1** shows the importance of industrial emissions as a share of total emissions.

Exhibit 8.1. Industrial Sector Emissions (MMTCO₂E) as of 2017



Source: California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019, https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf.

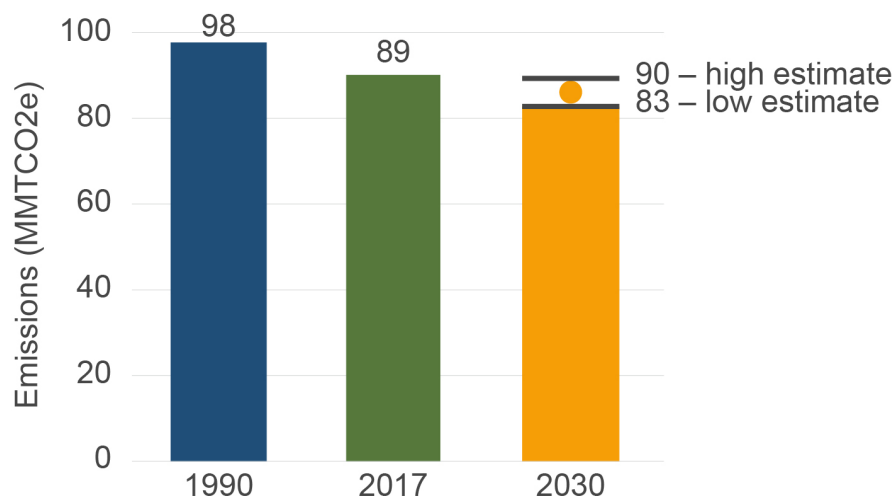
The Scoping Plan identifies emission reductions for the industrial sector of approximately 8-15 percent below 1990 levels by 2030 from direct regulations and mandates implemented to achieve the SB 32 target.¹ In addition, the Cap-and-Trade Program is expected to reduce greenhouse gas emissions by up to 236 MMTCO₂e from all covered sectors from 2021-2030, as much as approximately 38 percent of the emissions reductions needed to meet the state’s 2030 target. A portion of this reduction is expected to come from emissions reductions in the industrial sector.²

Exhibit 8.2 shows emissions from the industrial sector in 1990 and 2017 and finally, the estimated range of emissions for the sector in 2030 from implementing the measures



identified in the Scoping Plan. Missing from this figure are the expected emission reductions from the Cap-and-Trade Program. Since this market-based program covers all large sources of greenhouse gas emissions across sectors and does not predetermine where emission reductions will occur, its projected impact in each sector cannot be specified.

Exhibit 8.2. Industrial Sector Emissions, 1990 and 2017, and Expected Range of Emissions in 2030 after Implementation of Scoping Plan Measures (excluding reductions from the Cap-and-Trade Program)



Sources: 1990 levels and 2030 GHG emissions targets: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” page 31, table 3, November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf 2017 levels from: California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.

Industrial emissions are mainly caused by fossil fuel combustion, hence the industries that use a large quantity of energy also have the highest greenhouse gas emissions. For these industries, the principal opportunities to reduce emissions are lowering overall energy use, decarbonizing fuels, and switching equipment from using petroleum-based fuels (e.g., natural gas) to electricity from renewable sources (addressed in Chapter 6).

In the California Air Resources Board (CARB) economic sector categorization of emissions, petroleum refining and hydrogen production were responsible for 29 percent of the industrial sector’s greenhouse gas emissions in 2017, followed by manufacturing



(24 percent, with cement as a very large emitter), oil and gas extraction (17 percent), and cogeneration³ (combined heat and power, 8 percent).⁴ Other emissions that are classified in the economic sector emission inventory as industrial include landfills (8 percent) and solid waste and waste water treatment (2 percent); these are addressed in the waste and water chapters.

Averting climate catastrophe necessitates profound transformations in the industrial sector. Oil and gas extraction and refining are large emissions sources, and the use (i.e., fuel combustion) of finished petroleum products is an even greater source of the state's GHG emissions. In addition to the policies described in this chapter, which directly impact the petroleum industry, many climate policies identified in the other chapters are intended to reduce demand for petroleum, which is likely to eventually lead to a decline in sales and production.⁵ This contraction in demand for petroleum presents a risk of job loss in the petroleum industry.

Workforce policy can help protect workers during this transition of the petroleum industry. A phase-down in petroleum demand can both limit greenhouse gas emissions and sustain or grow employment through continued investments in emissions reductions in petroleum extraction and refining. In addition, with advanced planning the state can develop worker transition strategies if jobs are lost or require new skill sets as the industry evolves in the low-carbon economy. Workforce assistance can help place workers in jobs at comparable wages in other industries or maintain workers' living standards through other forms of assistance, including for example, bridges to retirement or wage insurance (see Chapter 4 for a full discussion of just transition). Investment in low-carbon manufacturing can also create jobs, but not all of these jobs will be in or stay in California.

The complexities of the industrial sector make it difficult to predict job impacts of implementing climate policies. The following analysis provides a general assessment of the ways in which each major policy is likely to affect jobs and identifies where workforce interventions may be necessary or possible.

Policies to reduce emissions in the industrial sector fall into three categories:

1. Market-based policies;
2. Emissions standards and mandates; and
3. Incentives, procurement, and other public investments to support emissions-reduction programs and measures and/or promote low-carbon technologies.



❖ Market-Based Mechanisms

➤ **Cap-and-Trade (Assembly Bill 398, E. Garcia, Chapter, Statutes of 2017)⁶**

Codified the state's Cap-and-Trade Program through 2030. The Cap-and-Trade Program is a market-based mechanism that places a declining cap on greenhouse gas emissions for all entities that emit more than 25,000 metric tons of carbon dioxide equivalent (CO₂e) per year. It requires all these entities to either purchase emission allowances, or a limited number of offsets, for every ton of carbon emitted, or reduce emissions, and allows the buying and selling of these allowances to achieve emission reductions at overall least cost.

❖ Emissions Standards and Mandates

➤ **Mandatory Reductions of Short-Lived Climate Pollutants**

California recently prohibited the use of hydrofluorocarbons (HFCs) in new refrigeration equipment or foams and implemented a comprehensive strategy to reduce HFC emissions. Senate Bill 1383 (Lara, Chapter 395, Statutes of 2015)⁷ requires reduction in short-lived climate pollutants (SLCPs) to achieve a 40-percent reduction in methane emissions, a 40-percent reduction in HFC gases, and a 50-percent reduction in anthropogenic black carbon below 2013 levels by 2030.

➤ **Mandates on Fugitive Methane Emissions from Oil and Gas Facilities**

These are regulations to capture fugitive emissions from natural gas pipelines and from oil and gas extraction and refining. Senate Bill 1371 (Leno, Chapter 525, Statutes of 2014)⁸ required the development of regulations to abate leakage in natural gas infrastructure. In 2017, CARB adopted a rule to reduce fugitive and vented emissions of methane from both new and existing oil and gas facilities.⁹

❖ Incentives, Procurement, and Other Public Supports

➤ **Combined Heat and Power (CHP) Procurement**

Governor Brown's Clean Energy Jobs Plan (2010) set a goal of 6,500 MW of new CHP capacity by 2030.¹⁰ To achieve this goal, the "Qualifying Facilities and CHP Program Settlement Agreement" requires the state's three largest Investor Owned Utilities (IOUs) to procure a minimum of 3,000 MW of CHP.¹¹ Another



smaller program, the Waste Heat and Carbon Emissions Reduction Act, Assembly Bill 1613 (Blakeslee, Chapter 713, Statutes of 2007),¹² created a feed-in-tariff to incentivize small CHP generation facilities of less than 20 MW.

➤ **Utility Incentives for Industry**

IOUs provide incentives for their industrial customers—including customized incentives for energy efficiency retrofit and new construction projects involving the installation of high-efficiency equipment or systems in the industry sector—and rebates for energy efficiency measures that have been identified through standard energy efficiency audits.

➤ **Grant Programs for Efficiency in Specific Industries**

Examples include the Food Production Investment Program, funded with \$66 million from the Budget Act of 2017 (Assembly Bill 109, Ting, Chapter 249, Statutes of 2017¹³) and administered by the California Energy Commission (CEC). The program provides grants, loans and other incentives to promote implementation of projects in the food processing industry that reduce greenhouse gas emissions.

➤ **Research and Development for Emerging Technologies**

The state is providing a variety of R&D support for emerging industrial technologies that reduce emissions, including industrial carbon capture and sequestration systems to reduce greenhouse gas emissions in the atmosphere by capturing them and sequestering them in land. These technologies are still under development and not market ready.

➤ **Support for Low-Carbon Manufacturing Through Procurement—The Buy Clean California Act (Assembly Bill 262, Bonta, Chapter 816, Statutes of 2017)¹⁴**

This law requires contractors that bid on state infrastructure and construction projects to disclose the greenhouse gas emissions for certain materials, including concrete and steel, and requires the Department of General Services to develop a method for agencies to include this emission data in their review process for bid selection. Reporting emission data can incentivize low-carbon procurement to reduce the greenhouse gas emissions of supply chains and could increase domestic and local manufacturing.



II. Industries and Occupations

The main industries within this sector that will be directly impacted by climate policy are: 1) manufacturing industries; 2) petroleum production and refining industries.

California leads the nation in employment in manufacturing, with about 1.3 million workers in 2017.¹⁵ Heavy-GHG emitting industries include manufacturers of cement and lime, paper and wood products, glass, petroleum refining and petroleum products, iron and steel, chemicals, certain food processing, and oil and gas extraction.¹⁶ The state is an important producer of petroleum products, ranking fourth among U.S. states in crude oil production, third in refining capacity, and 15th in natural gas production.¹⁷ California is also home to a growing segment of low-carbon substitutes for traditionally high-emitting manufacturing products. Hundreds of billions of dollars in private-sector investment are developing California industries such as electric vehicles, advanced batteries, and other lower carbon components and final products.¹⁸

III. Workforce Issues in Key Subsectors and Policies

The following sections analyze the subsectors addressed in the industrial sector of the Scoping Plan. The first section presents analysis of manufacturing industries. The next section presents a supplementary discussion of the petroleum industry due to its impact on emissions through fuel combustion in end uses, in addition to its emissions from the production process.

For each subsector, the analysis describes the main climate policies identified in the Scoping Plan, assesses the possible workforce implications, and provides recommendations on how to ensure the best possible outcomes for workers while delivering on climate goals.

A. Manufacturing Sector

1. Cap-and-Trade Program

The primary policy that incentivizes emission reductions in the industrial sector is the state's Cap-and-Trade Program, which establishes a cap on greenhouse gas emissions that declines over time, puts a price on carbon, and creates a market for allowances and



limited offsets that are used to cover greenhouse gas emissions. The program requires major emitters of greenhouse gases to obtain one allowance for each metric ton of CO₂e that they emit. The buying and selling of emissions allowances is expected to result in the lowest cost solutions to emissions reductions. As opposed to direct regulations which specify where and how emissions reductions will take place, the Cap-and-Trade Program does not predetermine the specific industries or locations where reductions will occur. This makes it difficult to predict employment impacts, but the following discussion sheds light on the factors determining possible employment outcomes.

Since the passage of the California Global Warming Solutions Act (Assembly Bill 32, Núñez, Chapter 488, Statutes of 2006),¹⁹ the Cap-and-Trade Program has been a key component of California's suite of climate policies.²⁰ For the upcoming period of 2021-2030, Senate Bill 32 (Pavley, Chapter 32, Statutes of 2016)²¹ set the state's target to reduce greenhouse gas emissions to 40 percent below 1990 levels by 2030, and AB 398 codified the Cap-and-Trade program as a key strategy to achieving the 2030 GHG target.

In its first iteration, which will end in 2020, the Cap-and-Trade Program was anticipated to contribute only about 20 percent of the total emissions reductions needed, with the rest being driven by mandates, public investments, and other policies. From 2021 to 2030, the program is anticipated to be responsible for a greater share of emission reductions, up to about 38 percent of total emission reductions, according to the 2017 Scoping Plan.²²

California's Cap-and-Trade Program is comprehensive, covering roughly 420 entities in electricity generation, natural gas, transportation fuels, and large industrial sources in California.²³ With the inclusion of suppliers of transportation fuels in the public auction in 2015, these covered sources are collectively responsible for approximately 80 percent of greenhouse gas emissions in the state, but as noted above many of them are also subject to direct air quality and other climate regulations as well.²⁴ Firms in industries above the 10,000 metric tons of CO₂e threshold are required to submit annual emission reports, and any entity that emits more than 25,000 metric tons of CO₂e is required to comply with the Cap-and-Trade Program.²⁵ Quantifying the share of reductions that will be generated in the industrial sector from the Cap-and-Trade Program is not possible, because the Program does not predetermine how entities will reduce emissions and instead lets individual firms choose between lowering emissions, obtaining the required number of emissions allowances and limited offsets, or a combination of the two.

About one-half of the emission allowances are sold in quarterly auctions administered by CARB. These funds are deposited in the Greenhouse Gas Reduction Fund (GGRF), discussed in Chapter 5, and allocated by the legislature to projects in all six Scoping Plan sectors, as described in the other sector chapters of this report.²⁶



CARB allocates the other approximately one-half of the allowance value, free of cost, to specified entities covered by the Cap-and-Trade Program. Allowances are freely allocated to industrial covered entities to reduce cost impacts to consumers, prevent emissions leakage, and to help businesses adapt to a carbon price. CARB also distributes free allowances to electricity distribution utilities and natural gas suppliers to benefit their ratepayers.

Prevention of Leakage

Allowances are allocated freely to the industrial sector partly to prevent emissions leakage. Leakage is a reduction in greenhouse emissions within a jurisdiction with a mandate on emissions reductions that is offset by an increase in emissions in jurisdictions without such a mandate in place. AB 32 and SB 32 required CARB to design measures to minimize leakage to the extent feasible. Providing free allowances for leakage-prone industries can be considered a workforce policy, because they are an intervention designed to prevent businesses from leaving the state due to the Cap-and-Trade Program which may mitigate the risk of job loss.

In 2017, 50 percent of the free allowances were distributed to the petroleum refineries and hydrogen processing industry, 23 percent to oil and gas extraction, 16 percent to cement manufacturing, and the rest distributed among a number of other industries.²⁷

a. Workforce Outcomes in the Industrial Sector from the Cap-and-Trade Program

i. Employment in Manufacturing Industries

Exhibit 8.3 presents estimates of the number of employees at covered entities that receive free allowances in 2017, by industry, using Dun and Bradstreet data.²⁸ The approximately 40,000 jobs in the covered entities represents 0.2 percent of the 17 million jobs that currently exist in California,²⁹ and since only a small percentage of the jobs in covered entities are at risk, the maximum number of workers potentially at risk of job loss is an even smaller share of the California workforce.



Exhibit 8.3. Employment, Blue-Collar Share, and Wages at Leakage-Prone Firms Covered by California’s Cap-and-Trade Program, 2017

| Industrial Sector | Estimated # of Employees at Covered Facilities | Percent in Blue-Collar Occupations | Mean Hourly Wage of Blue-Collar Workers |
|--|--|------------------------------------|---|
| Petroleum Refining and Hydrogen Production | 4,354 | 55% | \$35.58 |
| Crude Petroleum and Natural Gas | 2,955 | 41% | \$22.82 |
| Cement, Lime, and Gypsum Product Manufacturing | 1,557 | 80% | \$15.08 |
| Fruit and Vegetable Canning | 3,005 | 80% | \$11.63 |
| Other Food Manufacturing | 6,957 | 70% | \$12.13 |
| Dairies | 1,458 | 76% | \$13.67 |
| Glass Manufacturing | 3,055 | 72% | \$12.42 |
| Paper Manufacturing | 2,153 | 73% | \$17.80 |
| Metal Processing and Manufacturing | 1,573 | 74% | \$13.00 |
| Chemical, Biological, and Pharmaceutical Manufacturing | 9,684 | 35% | \$12.85 |
| Miscellaneous Industrial Facilities | 2,528 | 51% | \$14.81 |
| Total | 39,279 | 58% | \$13.90 |

Sources: Jesse Strecker et al., “Protecting California Workers in Cap and Trade,” unpublished (UC Berkeley Goldman School of Public and UC Berkeley Labor Center, 2018). Employment in covered facilities based on queries of the Dun & Bradstreet database, done in December of 2017. All industry sectors except for Paper Manufacturing were missing data on some facilities. “Estimated # of Employees at Covered Facilities,” then, represents a minimum employment level. However, this is a more accurate count than estimating employment from the BLS NAICS code because only those facilities that emit more than 25,000 metric tons of CO₂e in a specific time period are covered by cap-and-trade. For a full list of firms receiving free industrial assistance allowances, see California Air Resources Board, “Public Data on Allocation,” December 5, 2017, <https://ww3.arb.ca.gov/cc/capandtrade/allowanceallocation/v2018allocation.pdf>; wage and occupation data is calculated for the entire industry in California, not just the covered businesses, and extracted from U.S. Department of Labor, Bureau of Labor Statistics, “OES Research Estimates by State and Industry,” (for May 2017) Occupational Employment Statistics, March 30, 2018, https://www.bls.gov/oes/current/oes_research_estimates.htm.



This discussion of the Cap-and-Trade Program illustrates the difficulty of predicting the job impacts of the Program on industrial jobs through 2030. Given California's free allowance allocation to maintain industrial competitiveness and to prevent leakage, it may be that no workers will be displaced. However, there is a credible risk that a small number of workers could lose their jobs relative to a Business-as-Usual projection of California employment in the absence of Cap-and-Trade Program.³⁰

For the small number of individual workers in manufacturing whose may face job loss as climate policies are implemented, the consequences of job loss can be devastating. Chapter 4 reviews just transition strategies that can be implemented to avoid placing disproportionate economic burdens on a small number of displaced workers. Although job loss has not yet occurred and may not occur, the recommendations in Chapter 4 and at the end of this chapter suggest steps to begin just transition planning now, in anticipation of future risk, particularly as climate policies require deeper and deeper emissions reductions and involve more significant changes to Business-as-Usual.

Finally, it is also important to note that there is wide variation in job quality for California production workers in the industrial sector as noted in **Exhibit 8.3**. While manufacturing was once assumed to produce middle-class jobs for blue-collar workers, recent research shows that manufacturing employment is increasingly generating low-wage jobs. More than one-third of manufacturing workers in the United States are now on some form of public assistance because their wages are so low that they qualify for safety net programs.³¹ Unions now represent less than 10 percent of the manufacturing workforce, and the use of workers employed by temporary agencies in manufacturing has risen sharply.³² In the industrial sectors in California, food processing production workers receive low wages on average, with a mean hourly wage in 2017 of \$11.63 (the state minimum wage in 2017 was \$10.00). Blue-collar oil refinery workers in contrast, had a mean wage of \$36.58 in the same year, representing solidly middle-class jobs.

2. Mandates and Incentives to Reduce Emissions, Including High Global Warming Potential Gases

In addition to the Cap-and-Trade Program, the Scoping Plan also includes mandates that require industrial facilities to lower emissions of non-CO₂ greenhouse gases, particularly high global warming potential (high-GWP) gases (i.e., hydrofluorocarbons, methane, and black carbon). The state also has a wide variety of programs to reduce costs to businesses as they adapt stricter emissions controls and mandates. These supports include incentives and rebates for energy efficiency measures and pollution abatement, research and development grants for emerging low-carbon technologies, and procurement policies that provide market guarantees for lower carbon products and services.



❖ Direct Climate Mandates

➤ Mandatory Reductions of Hydrofluorocarbons

California is leading the global effort to reduce hydrofluorocarbons (HFCs) through direct regulations of their use. HFCs account for 97 percent of all high-GWP gas emissions in the state.³³ In 2016, the state enacted SB 1383, which requires the reduction of emissions of short-lived climate pollutants (SLCPs), including methane, HFCs, and anthropogenic black carbon.³⁴ SB 1383 directs CARB to develop and then implement a plan to achieve a 40-percent reduction in HFCs by 2030.

To that end, in 2016 CARB mandated a ban on HFCs for certain equipment, especially refrigeration and air conditioning equipment, which commonly use HFCs. Fugitive refrigerants used in commercial and industrial refrigeration and air conditioning systems account for 48 percent of HFC emissions.³⁵ CARB banned HFCs in new refrigeration equipment and foams, including those used in supermarkets and remote condensing units used by convenience stores, refrigerated food processing dispensing equipment, stand-alone or small self-contained refrigeration units, refrigerated vending machines, and foams used in buildings and elsewhere.³⁶

These mandates require businesses to purchase new equipment, creating jobs in manufacturing and installation. Installation of refrigeration and HVAC equipment is generally carried out by workers in the skilled construction trades occupations, particularly plumbers and pipefitters, insulators and sheet metal workers, where training through apprenticeship is available.³⁷ Manufacturing of equipment may or may not be in California; see Section III.A in this chapter for an overview of strategies to encourage in-state manufacturing. Purchases of new equipment generally raise costs for businesses, which may affect the competitiveness of industries such as food processing, but are unlikely to impact output or jobs in retail businesses such as supermarkets.

➤ Mandatory Reductions of Fugitive Methane Emissions from Oil and Gas Facilities

Fugitive methane emissions from oil and gas facilities are a critical target for climate policy because of methane's high global warming potential. The majority of the state's oil wells are located in Southern California, and crude oil is transported within the state through an extensive network of oil and gas pipelines from import terminals and on-shore and offshore oil fields to the refineries that distribute finished fuels to more than 70 product terminals throughout California.³⁸ Natural gas is California's largest source of fuel for electricity generation and



supplies most of the energy used for industrial operations. It is also the largest source of fuel for heating and cooling in residential and commercial buildings. The majority of gas fields are in Northern California, but most natural gas consumed in California (about 90 percent) comes from out of state.

The state aims to reduce methane emissions from oil and gas infrastructure by 40 to 50 percent by 2025. The two main policies for reducing methane emissions are CARB's 2017 regulation, Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities, and SB 1371, which aims to minimize natural gas leaks from CPUC-regulated intrastate transmission and distribution gas pipelines and facilities.³⁹ The CARB regulation promotes statewide uniformity in methane emission controls, specifies the measures that companies are required to adopt to capture methane emissions, establishes quarterly leak detection and repair requirements, and requires enhanced leak-monitoring and alarm systems for underground natural gas storage facilities.⁴⁰ SB 1371 is focused on minimizing methane leaks from in-state gas pipelines and distribution facilities. The bill includes heightened leak-reporting requirements and directs the CPUC to adopt rules and procedures for avoidance, reduction, and repair of leaks and leaking components. The bill also mandates leaks to be repaired as soon as possible after discovery, and it establishes and requires best practices for leakage monitoring, prevention, and reduction. These mandates will induce investment in leakage abatement.

These mandates create work hours for the skilled construction trades that specialize in leakage abatement in pipelines and extraction and storage facilities. This work is carried out mainly by pipefitters, utility workers and related trades workers. Leakage abatement also creates work for engineering and technical workers who design and manage leakage prevention and monitoring systems.

➤ **Mandatory Technology Upgrades: Best Available Retrofit Control Technology in Refineries**

Assembly Bill 617 (C. Garcia, Chapter 136, Statutes of 2017),⁴¹ the companion bill to AB 398, requires refineries to install industry-standard pollution control mechanisms, known as “best available retrofit control technology” (BARCT), no later than the end of 2023.⁴² The law also mandates tighter monitoring and reporting of refineries' criteria air pollutants and toxic air contaminants by local air districts. AB 617 also requires CARB to develop a statewide strategy to reduce emissions of toxic air contaminants and criteria air pollutants in communities affected by a high cumulative exposure burden.⁴³

Installation of BARCT requires upgrades of equipment and processes in refineries and is carried out by boiler-makers, plumbers and pipefitters, ironworkers, and related skilled construction trades.



❖ Public and Ratepayer Incentives and Supports

While incentives cannot be used for compliance with existing mandates and regulations, assistance is available to lower the costs of transition for businesses subject to upcoming and stricter mandates. For example, along with the mandates to ban HFCs just discussed, a number of programs provide incentives for low-GWP refrigeration systems in retail food stores. One of these, a Sacramento Municipal Utility District (SMUD) pilot program, incentivizes low-GWP natural refrigerant technologies by offering up to \$150,000 in rebates for avoided greenhouse gas emissions.⁴⁴ Participants receive \$25 per metric ton CO₂e reduction from refrigerants and a 25-percent incentive bonus for projects located in Disadvantaged Communities (DACs, as defined by CalEnviroScreen) and implemented by small businesses.⁴⁵

The following section describes some of the assistance that the state is providing to help businesses in the industrial sector reduce greenhouse gas emissions.

➤ IOUs' Statewide Industrial Energy Efficiency Program

The investor-owned utilities' statewide Industrial Energy Efficiency Program provides audits, energy planning, rebates, and incentives to adopt energy efficiency measures.⁴⁶ The IOUs' statewide program offers an energy advisor program for benchmarking, pump efficiency services, nonresidential audits, and retro-commissioning assessments.⁴⁷ The program also includes "calculated incentives," which are customized incentives for nonresidential energy efficiency retrofit and new construction projects based on the energy savings captured by the user, as well as "deemed incentives," which are fixed rebates for standard efficiency measures. CPUC-affiliated "third-party programs" are undertaken by contractors and offer targeted efficiency planning for different industry subsectors.⁴⁸ The combined budget for these industrial energy efficiency programs overseen by the CPUC was over \$120 million in 2013.⁴⁹ Industrial efficiency is among the lowest cost options for electricity savings, with lower variability in outcomes⁵⁰ and longer average lifetime savings than other types of efficiency programs.⁵¹ Industrial efficiency improvements for deep retrofits can have a projected payback period of three to six years, although case study evidence indicates the payback may be shorter.⁵²

Industrial energy efficiency retrofits are carried out by skilled construction trades workers, predominantly those involved in energy systems installation, maintenance and operations. This includes electricians, plumbers and pipefitters, and sheet metal workers, who are primarily responsible for electrical equipment including lighting, and heating, cooling, and ventilation systems (HVAC).⁵³



➤ **Incentives to Support Combined Heat and Power Generation**

Supports for Combined Heat and Power (CHP) are an important strategy in the industrial sector because CHP lowers the demand for externally supplied energy and fuel use in production processes. CHP is an integrated system that generates electricity as well as thermal energy that can be used on site for heating, cooling, and steam production. Various industrial equipment can use CHP, including reciprocating engines, combustion or gas engines, steam turbines, micro-turbines, and fuel cells. CHP is a mature and successful technology already in widespread use.

California is supporting CHP generation through a combination of incentives and procurement policies that guarantee markets for CHP. Governor Brown's 2010 Clean Energy Jobs Plan set a goal of 6,500 MW of new CHP capacity by 2030. The state has exceeded this goal: by 2016, approximately 7,800 MW of CHP were installed, with an additional 6,300 MW under development.⁵⁴ Support for CHP is driven by the procurement policy in the "Qualifying Facilities and CHP Program Settlement Agreement", which mandates that the three largest IOUs procure a minimum of 3,000 MW of CHP.⁵⁵ Another program, the Waste Heat and Carbon Emissions Reduction Act, AB 1613, created a feed-in-tariff to incentivize small CHP generation less than 20 MW. As a result of these policies, in 2017, the amount of installed CHP increased to 8,590 MW, with 4,097 MW in the industrial sector.⁵⁶

Among all industrial subsectors, oil and gas extraction have by far the largest potential to expand the use of CHP with a combined additional capacity of almost 3,700 MW, followed by food processing (1,418 MW), primary metals (576 MW), and wastewater treatment (392 MW).⁵⁷

CHP installation and maintenance is carried out by skilled construction trades-workers, including boiler makers, electricians, pipefitters, stationary engineers and related trades.⁵⁸

➤ **Food Production Investment Program**

The state and the IOUs also have programs that are customized to specific industries. One target for assistance is the food processing industry, a large energy user in the state.⁵⁹ In 2015, the food processing industry consumed approximately 7 million MWh and 500 million therms; it also emits more than 3.3 million metric tons of CO₂e every year, about 4 percent of all industrial emissions.⁶⁰ Food processors with GHG emissions over 25,000 CO₂e annually are also subject to the Cap-and-Trade Program.



In 2017, the state passed AB 109 to provide the CEC with \$66 million from the GGRF to establish the Food Production Investment Program (FPIP), which promotes implementation of projects that reduce greenhouse gas emission by providing grants, loans, or financial incentives to food processors.⁶¹ Administered by the CEC, the FPIP aims to: 1) help replace high energy-consuming equipment and systems; and 2) accelerate the adoption of advanced energy technologies that can substantially reduce energy use and greenhouse gas emissions, and subsequently compliance obligations under the Cap-and-Trade Program.⁶² Installing new equipment or establishing new manufacturing processes under these grants may lead to increased employment in the skilled construction trades.

a. Workforce Outcomes

i. Changes in Direct Employment

The mandates on high-GWP gases and the funding for incentives and supports to increase industrial energy efficiency and CHP are expected to result in new investments which could lead to job growth in skilled construction trades. CHP generation is an area that could also provide significant job growth. Previous analysis found that for every \$1 million invested in CHP construction, installation, and manufacturing, 4.4 direct jobs are created or maintained.⁶³ For industrial energy efficiency, estimates show that approximately 4.7 direct jobs are created for every \$1 million dollars of investment.⁶⁴

As noted above, the majority of the jobs generated by these mandates are for skilled blue collar construction trades workers who carry out the retrofits and install new equipment and components.⁶⁵ In addition, these investments generate jobs for engineers and technical workers who design, manage, and administer these projects, as well as a mix of workers who do not need specialized knowledge in industrial energy systems, such as administrative and other personnel (see Chapter 6).

ii. Job Quality and Job Access

Specialized skills in the construction trades are needed to carry out industrial energy efficiency, CHP, HFC retrofits or related work resulting from mandates and incentives in the industrial sector. **Exhibit 8.4** shows 2017 wages for workers employed in several key occupations in the manufacturing sector in California, at the 25th, 50th, and 75th percentile of workers.



Exhibit 8.4. Wages for Key Occupations Involved in Emissions Reducing Retrofits in Manufacturing in California, 2017

| Occupational Title | 25th Percentile Hourly Wage | 50th Percentile (Median) Hourly Wage | 75th Percentile Hourly Wage |
|---|-----------------------------|--------------------------------------|-----------------------------|
| Electricians | \$24.32 | \$29.80 | \$37.22 |
| Plumbers, Pipefitters, and Steamfitters | \$19.98 | \$26.71 | \$31.07 |
| Sheet Metal Workers | \$15.36 | \$21.41 | \$30.28 |
| Boilermakers | \$18.74 | \$23.51 | \$29.44 |

Source: May 2017 OES Research Estimates by State and Industry, [https://www.bls.gov/oes/current/oes_research_estimates.htm]; occupational wages for the manufacturing sector only.

State-certified apprenticeship training is available for all the skilled trades involved in these activities, but no information is available to quantify the share of these workers who are current apprentices or have a journey card (See Chapter 3 for details about the apprenticeship system). However, these state-wide average wages are significantly lower than prevailing wages for workers with journey cards in these occupations,⁶⁶ suggesting that a substantial share of workers are not trained through apprenticeship nor represented by a trade union. Very few skill standards are currently required in IOU or other incentives programs (see Chapter 6, Section III.A for a discussion of skill standards in energy efficiency programs). For the refinery sector, only, Senate Bill 54 (Hancock, Chapter 795, Statutes of 2013)⁶⁷ requires refiners to pay a modified prevailing wage and employ a “skilled and trained workforce” for all major maintenance, upgrade and modernization projects, known as turnaround or change-out work. See Chapter 2 for an explanation of the skilled and trained workforce standard and Section III.B of this chapter for more information on the training that has been developed.

No specific information is available about the demographic profile of workers involved in the industrial energy efficiency, CHP, or related work that has been generated by the mandates and incentives affecting emissions-intensive industries.



b. Workforce Recommendations

❖ Use skill standards in incentive programs for industrial energy efficiency, CHP, and other industry emission reductions measures to ensure safe and proper performance in the installation, operation, and/or maintenance of low-carbon measures and good jobs.

SB 54 offers a model for how to incorporate skill and training requirements in climate and air quality programs. As legislated by SB 54, oil refineries have specific worker protections and training requirements for workers responsible for retrofits and major maintenance and upgrades—commonly known as change-outs.⁶⁸ SB 54 requires refineries to file a risk management plan (RMP) under federal and/or state environmental protection and air quality acts and to comply with a modified prevailing wage, apprenticeship and journeyperson qualifications, and training requirements on private refinery construction. The rationale for workforce specifications is to prevent the use of unskilled and untrained workers at facilities that generate, store, treat, transport, and otherwise deal with hazardous materials that pose a risk to public health and safety.⁶⁹ SB 54 standards could be incorporated into all the climate programs for the emissions-intensive industries discussed in this section. See Chapter 2 for more explanation of the “skilled and trained” labor standard.

In addition to the skilled and trained workforce requirements, specialized certifications may be needed for emerging or advanced technologies that require enhanced skills. Certifications are most effective when they build upon an existing occupation training pathway rather than stand-alone trainings with no prerequisites, when they are validated by subject matter experts and are industry-recognized. See Chapter 6, Section III.C for a discussion of skill certifications in the context of utility-administered energy efficiency incentives, and Chapter 2 for a discussion of certification requirements under SB 54.

❖ Support high-road industry training partnerships via apprenticeship and journey-upgrade training.

As noted above, much of the work generated by the measures discussed in this section is carried out by the skilled construction trades who install and maintain industrial equipment. Retrofit, replacement, and process improvement work can be done with current or new workers trained through existing certified apprenticeship programs in the skilled construction trades. As emerging low-carbon technologies, equipment, and processes develop, curriculum updates can be incorporated in apprenticeship and journey upgrade training.



❖ Support a statewide initiative for pre-apprenticeship for construction careers.

Support for pre-apprenticeship is critical to improving inclusion in the skilled construction trades. Although there is no specific information about inclusion in the jobs that are supported by the incentives and mandates discussed in this section, pre-apprenticeship is critical throughout the skilled trades. Any investments related to pre-apprenticeship should connect to, align with, or feed into the emerging statewide infrastructure that is being modeled by the CWDB High Road Construction Careers (HRCC) initiative, described in Chapter 3. This initiative is developing a statewide pre-apprenticeship strategy that links to all state and local agencies that award public works contracts.⁷⁰ Pre-apprenticeship programs should not be developed to prepare workers for projects in particular climate programs, but rather increase access to high-quality career pathways in all construction.

B. Oil and Gas Industries

The oil and gas industries comprise extraction, refining, and pipeline distribution. While extraction and refining are included in the analysis on industries above, the petroleum sector merits supplemental discussion because California's overarching strategy to avert climate catastrophe is to wean the economy off petroleum-based fuels. All the major climate policies—from the Renewables Portfolio Standard, to the Low Carbon Fuel Standard, to the Cap-and-Trade Program to regulations on high-GWP gases—are designed to provide low-carbon alternatives to our energy, transportation and other fuel needs. Whereas manufacturing industries, that consume but do not produce petroleum-based fuels, can switch to cleaner sources over time, the fossil fuel producers face a more fundamental challenge of reduced demand for the main product they produce.

Californians use 39 million gallons of gasoline daily, about 11 percent of the national total, and the state's consumption has not yet declined.⁷¹ But if California is to meet the statewide targets for a 40-percent reduction in greenhouse gas emissions below 1990 levels by 2030 and an 80-percent reduction by 2050, this will be accomplished largely by lowering combustion of and demand for fossil fuels.⁷² CARB's Scoping Plan shows demand for fossil fuels will decrease by more than 45 percent by 2030.⁷³ This drop in demand and production, while necessary to combat climate change, increases the likelihood of reductions in employment in this sector. It therefore presents a credible risk for workers employed in petroleum extraction and refining and affirms the need for advanced planning for a just transition.



In 2017 there were approximately 57,000 workers in the petroleum sector in California, including approximately 11,000 employed in refineries (these figures do not include the skilled trades workers employed by contractors on refinery modernization and upgrade projects), 9,000 in oil and gas extraction, and 2,000 in oil and gas pipeline work, and about 32,000 in natural gas distribution.⁷⁴

However, direct employment in the petroleum sector has declined over the last twenty five years. Employment in petroleum refining, for instance, is only half what it was in 1992, even though total refining capacity is nearly unchanged from 1992 to now.⁷⁵ The rate of employment decline was mostly gradual through the years, with no acceleration after the implementation of any of California's climate policies.⁷⁶ This finding suggests that modernization and industrial efficiency have been the prime drivers of job loss, not climate policy. For any industry, there are many factors beyond climate policy that impact trajectories of growth or decline in employment, and these other factors often have much greater impact than the state's efforts to combat climate change catastrophe.

a. Workforce Outcomes of Climate Policies in Refineries

i. Changes in Direct Employment

For the period through 2030, it is difficult to predict the impact of climate policy on employment in refineries due to the complexities of the policies as well as global market trends that affect this industry. In the longer run the risk of job loss is likely to grow, if and when California and the rest of the world are successful in thoroughly replacing petroleum with low-carbon substitutes.⁷⁷

For the period through 2030, contraction in the petroleum industry is by no means the only inevitable outcome for the petroleum industry in California. Even if production declines, actual job loss depends on many factors, including whether employment is reduced at the same pace as production, whether attrition and retirement can be used to avoid lay-offs, and whether employers provide jobs for their incumbent workers in non-petroleum components of their businesses.

While there is uncertainty in the impact of reduced demand for fossil fuels on the petroleum sector, **averting climate catastrophe does increase the risk of job loss in the sector. Addressing this credible risk directly and early is critical for the planning of a smooth and equitable transition away from fossil fuel consumption.** Planning is particularly challenging because policymakers also face the difficulty of predicting the cumulative impact of climate policies on petroleum industries over time. Understanding the timing and intensity of the decline and designing and implementing processes to manage it are key workforce challenges for this sector.



ii. Job Quality and Workforce Demographics

Average annual wages for workers in California refineries in 2017 were almost \$157,000, with blue-collar workers earning a mean hourly wage of about \$36.00 per hour.⁷⁸ The sector is characterized by high levels of unionization, with the United Steelworkers union representing operations workers at 11 of the state’s 18 refineries. Various building trades unions represent about 60 percent of the external contract workers, who are brought in to refineries for modernization and upgrades.⁷⁹

Refineries employ predominately white and male workers. In 2017, 76 percent of workers were white, and 81 percent were male.⁸⁰ The share of Latinx workers (of all races) has increased markedly over the past decade, accounting for 24 percent of workers in 2017.⁸¹

The refineries’ workforce is aging. In 1992, 66 percent of workers were under 35, and only 10 percent were over 55, while in 2017, 21 percent were under 35, and 29 percent were over 55.⁸² This shift means a significant portion of the refineries’ workforce is near retirement age, a characteristic that needs to be considered in the design of a worker transition package. Older workers face greater challenges in finding comparable work, suggesting that transition assistance should consider a bridge to retirement, as discussed in Chapter 4.

iii. New Training Investments

New training programs in the refinery sector were initiated in 2017 in response to SB 54 and a new refinery Process Safety Management (PSM) regulation, both of which were created in the aftermath to the explosion at Chevron’s refinery in Richmond in 2012. Both are industry-led labor management partnerships.

Under SB 54, refiners are required to pay prevailing wage and employ a skilled and trained workforce for all major maintenance, upgrade and modernization projects, known as turnaround work.⁸³ This has created new demand for high-quality apprenticeship training in refinery-related trades. Local 342 of the United Association of Plumbers, Pipefitters and Sprinkler Fitters (UA) in Concord, for example, is expanding their apprentice programs to meet the demand for this new work, building a large new training facility to accommodate an influx of apprenticeships in pipefitting and welding.⁸⁴ All of the apprenticeships related to refinery turnaround work now include a minimum of 20 hours of advanced training in refinery safety, as required under SB 54.⁸⁵

The new PSM regulation requires refiners to develop and implement comprehensive engineering and management programs to prevent major chemical releases, fires and explosions.⁸⁶ In most cases, these programs require highly specialized knowledge and experience, and now—for the first time in California—the regulation requires refiners to involve employees and their representatives “throughout all phases” of



PSM decision-making, with representatives selected by the employees.⁸⁷ To ensure effective implementation, the regulation requires refiners to train employees in the PSM elements in which they will be involved.⁸⁸ For example, employees at Chevron who serve on a Damage Mechanism Review committee must be trained in assessing and correcting damage mechanisms, such as corrosion, that could affect—and possibly weaken—the refinery’s piping systems, as occurred at the Chevron, Richmond refinery in 2012, resulting in a catastrophic vapor cloud explosion and fire.⁸⁹ The training must be continually updated to keep pace with changing conditions in the refineries.

b. Workforce Recommendations

California climate policy has embarked on a transition path that supports emissions reductions and pollution abatement of the petroleum industry immediately, and phase-out of petroleum as low- and zero-carbon substitute technologies and products become available, with an eventual full shift away from petroleum. Worker protections can be incorporated throughout this transition. This will ensure that all avenues for retaining jobs are maximized while lowering emissions. Lowering emissions through implementation of Best Available Retrofit Technology, the mandates for fugitive methane emission capture, and IOU and other industrial energy efficiency incentive programs all create jobs. The recommendations for labor standards below ensure the work is done by skilled workers, jobs are family-supporting and pathways into good jobs are created. Planning for possible job loss is also critical, and can be carried out early and throughout the transition process.

❖ Use skill standards in incentive programs to ensure safe and proper performance in the installation, operation, and/or maintenance of low-carbon measures, and in decommissioning of facilities if they close.

Apply workforce standards to investments in pollution abatement, which creates jobs. In the refining sector, skilled and trained workforce requirements are already required for upgrades and modernization. These workforce standards can be applied to all major emission reduction investments throughout the petroleum and natural gas industries, to ensure skill delivery and family-supporting jobs. Within SB 1371, section 977 suggests that the CPUC consider, “providing an adequate workforce to achieve the objectives of reducing hazards and emissions from leaks, including leak avoidance, reduction, and repair.”⁹⁰ This language could be made stronger, creating a requirement similar to SB 54 and explicitly requiring prevailing wage, apprenticeship utilization, journey person qualification, and training requirements on work affecting natural gas infrastructure and decommissioning work. See discussion in Section III.A above on mandates and incentives and Chapter 2 for more details on the skilled and trained labor standards in SB 54.



❖ **Support high road training partnerships in refineries.**

Support industry-led, labor-management training partnerships in the refinery-related trades to upgrade incumbent worker skills involved in turnaround work, including upgrades for pollution abatement, and explore the opportunity to expand the industry-led labor-management training partnership at Chevron for process safety decision-making and related training to other refineries across the state. See Chapter 3 for an explanation of high road training partnerships.

❖ **Plan for fossil fuel industry changes via an interagency task force charged with developing a blueprint for transition.**

This task force should engage stakeholders from labor and affected communities in all stages of transition planning and lead a process to:

- Use research and stakeholder engagement to identify the most vulnerable communities, industries, and localities. Research should include cost estimates for employment transition incorporating factors such as alternative worker transition assistance packages, options for retraining and job placement, policy options that affect speed of industry decline, and firm and worker characteristics, including age of workforce, availability of pension plans, attrition and rehiring patterns, layoff and severance policies, and other factors. Decommissioning of industrial facilities and site clean-up should be included in the analysis and planning, with efforts to redeploy the incumbent workers in the decommissioning process.
- Develop a proposal for a transition package, using existing resources and identifying new sources of revenues, like the GGRF, based on the research and stakeholder engagement just described.
- Facilitate longer-term regional planning focused on the economic and societal transformations that are necessary to diversify and support sustainable regional economies. This plan should consider economic development and job-creation strategies to help move displaced workers into comparable jobs. Such employment may be found in clean energy and other low-carbon work, but also in a variety of occupations that use similar skills and require similar experience.



C. Low-Carbon Goods Manufacturing Opportunities

The growth of manufacturing of low-carbon substitutes for traditionally high-emitting manufactured goods has been significant. Billions of dollars in private-sector investment are developing California industries such as electric vehicles, advanced batteries, HVAC technologies for buildings, solar photovoltaic and solar thermal design, advanced metering, distributed power management, and countless others.⁹¹ California has generated more than \$22 billion in clean technology venture capital investment from 2007 to 2017, and 5.4 percent of global clean technology patents.⁹²

Markets for low-carbon manufactured goods are created by the full gamut of climate policies. However, it is difficult to assess the impact or significance of individual policies and programs, and likewise to disentangle climate measures from market factors and technological innovations that may have occurred even with no climate policy.

Although California leads the nation in terms of the number of patents and venture capital funds for clean technologies, there is no guarantee that manufacturing will expand and stay in the state as products move from design to mass production. There is a vast body of research on the strategies that local and regional governments have used to promote and retain manufacturing jobs, with a mixed record of success.⁹³ These strategies include targeted investments in infrastructure and workforce training, assistance with access to markets, streamlining of zoning and permitting and tax credits, and incentives and subsidies.⁹⁴ Often, success depends on customized approaches that are designed to exploit particular locational advantages and overcome obstacles that might be preventing investment.

The development of off-shore wind for electricity generation in California presents a pertinent example of how customized supports might be able to encourage local manufacturing. As noted in Chapter 6 on energy, the state often supports emerging low-carbon energy technologies, funding research and development and providing a guaranteed market for investors through pilot procurement policies. A recent report argues that California could design a more comprehensive strategy for off-shore wind technology that could capture not only the final production of electricity from assembled wind generators, but also the in-state manufacturing and final assembly of component parts for wind turbines. In this case, the report identifies a number of customized strategies to root a greater share of the off-shore wind supply chain in California. These include investments in port infrastructure needed to site manufacturing and assembly facilities close to the enormous wind turbines, as well as more common approaches such as procurement, transmission upgrades, and other regulatory actions.

Procurement is a particularly powerful tool that governments have to support job creation in manufacturing, and California policy-makers are taking steps to expand its use, as described below.



1. Programs to Support Clean Technology Development and Low-Carbon Goods Manufacturing

❖ Low-Carbon Procurement through Buy Clean California Act

The state government is a large and therefore important buyer of many goods and products, some of which are emission-intensive to produce. California is taking steps to lead by example, by purchasing goods and products with a lower carbon footprint.

A key new law is the Buy Clean California Act (AB 262, Chapter 816, Statutes of 2017), which requires contractors that bid on state infrastructure and construction projects to disclose the greenhouse gas emissions for certain materials, including concrete and steel, and requires the state's Department of General Services (DGS) to develop a method for agencies to include this emission data in their review process for bid selection.⁹⁵ DGS is also required to establish and publish threshold levels for the maximum-acceptable global warming potential for each category of eligible materials in the State Contracting Manual by January 1, 2019. Over time, the levels may be adjusted downward to reflect industry improvements. The Act leverages the state's buying power to shape procurement to encourage purchasing of low-carbon goods. In doing so, this mandate signals to manufacturers that there is significant demand for low-carbon goods.

A. Workforce Outcomes

By accounting for supply-chain greenhouse gas emissions, the law will incentivize purchasing manufactured goods whose production process, including production of components, is less carbon intensive. These goods and their components can be sourced in California or elsewhere, so this will not necessarily create jobs in the state. However, even if there is not an explicit incentive for in-state manufacturing, the policy positions California manufacturers on a more level playing field against out-of-state manufacturers who are often subject to less strict emissions controls.⁹⁶ Therefore, the Buy Clean California Act is expected in many (but not all) cases to favor California production and employment within the state because businesses in California have led the nation in clean technology development.

This policy might or might not favor high-road employers, however. This report has documented a number of examples of firms and industry segments that produce innovative low-carbon products or use low-carbon processes, but also have low-road employment practices. Moreover, while manufacturing jobs paid significantly higher than average wages in past decades, recent research shows that is no longer the case. In 2013, the typical manufacturing production worker made 7.7 percent below the median wage for all occupations nationwide.⁹⁷



B. Workforce Recommendations

❖ Incorporate workforce and job criteria into the Buy Clean procurement policy for public procurement of manufactured goods and equipment.

Buy Clean is a strong start to encouraging local clean manufacturing, and procurement practices can also be used in a targeted manner to specifically encourage family-sustaining jobs and access into them for disadvantaged workers. Chapter 7 on transportation documents the U.S. Employment Plan for instance, which addresses job creation, job quality, and job access in the procurement of transit vehicles. Procurement policies to advance job quality and inclusion are most feasible for purchases of large capital equipment (e.g., zero-emission buses) and where the government is the main buyer and has the market power to ensure public investment creates public benefits. These policies face similar challenges to Buy Clean—the higher the number of small inputs, the harder it is to document and influence their production and labor practices.

The state has the opportunity to incorporate disclosure of workforce impacts, as described in the inclusive procurement policies of Chapter 2 and Chapter 7, along with disclosure of greenhouse gas emissions in the Buy Clean procurement policy.⁹⁸



IV. Summary Recommendations

Exhibit 8.5. Key Recommendations for the Industrial Sector

| | |
|---|--|
| <p>Manufacturing and Fossil Fuel Industries</p> | <ul style="list-style-type: none"> ❖ Use skill standards in incentive programs for industrial energy efficiency, CHP, and other emission reductions measures to ensure safe and proper performance in the installation, operation, and/or maintenance of low-carbon measures. ❖ Plan for industry transition away from fossil fuels and the risk of job loss in the petroleum sector and manufacturing, and develop just transition programs. ❖ Support High-Road Industry Partnerships. <ul style="list-style-type: none"> ● Support the development of skill-upgrade programs for incumbent workers through journey-upgrade programs for the skilled trades who carry out pollution abatement and emission upgrades in refineries and other emission-intensive industries. ● Support the development of industry-led labor-management training partnerships in operations in refineries. ❖ Support the state-wide pre-apprenticeship strategy to broaden opportunities for workers from disadvantaged communities to access family-supporting careers in the skills trades. |
| <p>Clean-Tech Development and Low-Carbon Goods Manufacturing Opportunities</p> | <ul style="list-style-type: none"> ❖ Incorporate workforce and jobs criteria in Buy Clean responsible procurement policies for state purchases of goods and services. |
| <p>All Industrial Subsectors</p> | <ul style="list-style-type: none"> ❖ Use job impact metrics to measure the impact of climate incentive and investment programs on quantity of jobs, job quality and job access. ❖ Incorporate workforce analysis into emerging technology support programs. ❖ Track training program outcomes for graduation rates, attainment of industry-recognized credentials, job placement, retention, wages and wage progression. |



Endnotes

- 1 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, 31, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- 2 California Air Resources Board, 31.
- 3 Cogeneration is the use of heat from a fuel to produce thermal and electrical energy. In separate production of electricity some energy must be rejected as waste heat, but in cogeneration this thermal energy is used for power as well.
- 4 California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.
- 5 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” ES 8; James Ayre, “Report: 1/4 Of World’s Oil Refineries Face Closure By 2035 If Greenhouse Gas Emissions Targets Are Met” (CleanTechnica, November 4, 2017), <https://cleantechnica.com/2017/11/04/report-14-worlds-oil-refineries-face-closure-2035-greenhouse-gas-emissions-targets-met/>.
- 6 Eduardo Garcia, “AB-398 California Global Warming Solutions Act of 2006: Market-Based Compliance Mechanisms: Fire Prevention Fees: Sales and Use Tax Manufacturing Exemption,” Chapter 135, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398.
- 7 Ricardo Lara, “SB-1383 Short-Lived Climate Pollutants: Methane Emissions: Dairy and Livestock: Organic Waste: Landfills,” Chapter 395, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383.
- 8 Mark Leno, “SB-1371 Natural Gas: Leakage Abatement,” Chapter 525, Statutes of 2014 § (2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1371.
- 9 California Air Resources Board, “Oil and Gas Regulation,” July 18, 2017, <https://www.arb.ca.gov/regact/2016/oilandgas2016/oilandgas2016.htm>.
- 10 Office of Governor Edmund G. Brown Jr., “Clean Energy Jobs Plan,” 2010, https://www.gov.ca.gov/wp-content/uploads/2017/09/Clean_Energy_Plan.pdf.
- 11 California Public Utilities Commission, “Qualifying Facilities and CHP Program Settlement,” accessed October 24, 2018, <http://www.cpuc.ca.gov/General.aspx?id=5168>.
- 12 Sam Blakeslee, “AB-1613 Energy: Waste Heat and Carbon Emissions Reduction Act,” Chapter 713, Statutes of 2007 § (2007), http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200720080AB1613.



- 13 Philip Ting, “AB-109 Budget Act of 2017,” Chapter 249, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB109.
- 14 Rob Bonta, “AB-262 Public Contracts: Bid Specifications: Buy Clean California Act,” Chapter 816, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB262.
- 15 U.S. Department of Labor, Bureau of Labor Statistics, “Private, 1013 Manufacturing, All States and U.S. 2017 Annual Averages, All Establishment Sizes,” Quarterly Census of Employment and Wages, accessed August 28, 2018, https://data.bls.gov/cew/apps/table_maker/v4/table_maker.htm?type=0&year=2017&qtr=A&own=5&ind=1013&supp=0.
- 16 California Air Resources Board, “Proposed Regulation to Implement the California Cap-and-Trade Program: Appendix K - Leakage Analysis,” October 28, 2010, <https://www.arb.ca.gov/regact/2010/capandtrade10/capv4appk.pdf>.
- 17 U.S. Energy Information Administration, “California State Profile and Energy Estimates: Profile Analysis,” October 20, 2016, <https://www.eia.gov/state/analysis.php?sid=CA>.
- 18 Christopher Thornberg, Hoyu Chong, and Adam Fowler, “California Green Innovation Index” (Next 10, 2017), <http://next10.org/sites/default/files/2017-CA-Green-Innovation-Index-2.pdf>.
- 19 Fabian Núñez, “AB-32 Air Pollution: Greenhouse Gases: California Global Warming Solutions Act of 2006,” Chapter 488, Statutes of 2006 § (2006), 32, https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32.
- 20 California Air Resources Board, “Assembly Bill 32 Overview: California Global Warming Solutions Act,” August 5, 2014, <https://www.arb.ca.gov/cc/ab32/ab32.htm>.
- 21 Fran Pavley, “SB-32 California Global Warming Solutions Act of 2006: Emissions Limit.,” Chapter 249, Statutes of 2016 § (2016), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32.
- 22 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 28.
- 23 California Air Resources Board, “Mandatory GHG Reporting - Reported Emissions,” accessed January 1, 2019, <https://ww2.arb.ca.gov/mrr-data>.
- 24 California Air Resources Board, “Cap-and-Trade Regulation and Mandatory GHG Reporting Regulation 2018 Amendments,” (2018), <https://www.arb.ca.gov/board/books/2018/121318/18-10-6pres.pdf>.



- 25 California Air Resources Board, “Overview of ARB Emissions Trading Program,” February 9, 2015, https://www.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf.
- 26 California Air Resources Board, “Allowance Allocation,” accessed December 6, 2018, <https://www.arb.ca.gov/cc/capandtrade/allowanceallocation/allowanceallocation.htm>.
- 27 California Air Resources Board, “Cap-and-Trade Program: Vintage 2017 Allowance Allocation,” August 9, 2017, <https://www.arb.ca.gov/cc/capandtrade/allowanceallocation/v2017allocation.pdf>.
- 28 Jesse Strecker et al., “Protecting California Workers in Cap and Trade,” unpublished (UC Berkeley Goldman School of Public and UC Berkeley Labor Center, 2018).
- 29 U.S. Department of Labor, Bureau of Labor Statistics, “May 2017 OES State Occupational Employment and Wage Estimates- California (Farming, Fishing, and Forestry Occupations),” Occupational Employment Statistics, March 30, 2018, https://www.bls.gov/oes/2017/may/oes_ca.htm#45-0000.
- 30 California Air Resources Board, “Attachment C: Staff Report: Initial Statement of Reasons; Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation,” September 4, 2018, <https://www.arb.ca.gov/regact/2018/capandtrade18/ct18sria.pdf>; Wayne Gray, Joshua Linn, and Richard Morgenstern, “Employment and Output Leakage under California’s Cap-and-Trade Program,” Discussion Paper (Resources for the Future, May 2016), <https://www.rff.org/documents/1716/RFF-DP-16-17.pdf>; Dallas Burtraw, Karen Palme, and Danny Kahn, “Allocation of CO2 Emissions Allowances in the Regional Greenhouse Gas Cap-and-Trade Program” (Resources for the Future, May 2005), <https://ageconsearch.umn.edu/bitstream/10650/1/dp050025.pdf>; David Farnsworth, Christina Palmero, and Christopher Sherry, “Potential Emissions Leakage and the Regional Greenhouse Gas Initiative (RGGI): Evaluating Market Dynamics, Monitoring Options, and Possible Mitigation Mechanisms” (Regional Greenhouse Gas Initiative, March 14, 2007), https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Staff-Working-Group/il_report_final_3_14_07.pdf.
- 31 Ken Jacobs et al., “Producing Poverty: The Public Cost of Low-Wage Production Jobs in Manufacturing” (UC Berkeley Center for Labor Research and Education, 2016), <http://laborcenter.berkeley.edu/pdf/2016/Producing-Poverty.pdf>.
- 32 Catherine Ruckelshaus and Sarah Leberstein, “Manufacturing Low Pay: Declining Wages in the Jobs That Built America’s Middle Class” (National Employment Law Project, 2014), <http://stage.nelp.org/content/uploads/2015/03/Manufacturing-Low-Pay-Declining-Wages-Jobs-Built-Middle-Class.pdf>; Laura Putre, “Manufacturing’s



Temporary Worker Boom,” IndustryWeek, May 11, 2015, <https://www.industryweek.com/workforce/manufacturings-temporary-worker-boom>.

33 California Air Resources Board, “High Global Warming Potential Gases,” June 22, 2018, <https://www.arb.ca.gov/cc/inventory/background/hgwp.htm>.

34 Lara, SB-1383 Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills.

35 California Air Resources Board, “Proposed Short-Lived Climate Pollutant Reduction Strategy,” April 11, 2016, <https://www.arb.ca.gov/cc/shortlived/meetings/04112016/proposedstrategy.pdf>.

36 Michael Garry, “California Adopts U.S. SNAP Regs on HFCs,” Hydrocarbons 21, March 27, 2018, http://hydrocarbons21.com/articles/8194/california_adopts_u_s_snap_regs_on_hfcs.

37 California Department of Industrial Relations, Division of Apprenticeship Standards, “Division of Apprenticeship Standards (DAS) - Minimum Industry Training Criteria (MITC),” accessed December 31, 2018, <https://www.dir.ca.gov/das/mitc.htm>.

38 California Air Resources Board, “Proposed Short-Lived Climate Pollutant Reduction Strategy.”

39 “Oil and Gas Final Regulation Order: Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4” (California Code of Regulations, n.d.), https://www.arb.ca.gov/cc/oil-gas/oil-gas_final_regulation.pdf; Mark Leno, “SB-1371 Natural Gas: Leakage Abatement,” Chapter 525, Statutes of 2014 § (chaptered September 21, 2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1371.

40 California Air Resources Board, “Oil and Gas Methane Regulation,” accessed January 2, 2019, <https://ww2.arb.ca.gov/resources/fact-sheets/oil-and-gas-methane-regulation>.

41 Cristina Garcia, “AB-617 Nonvehicular Air Pollution: Criteria Air Pollutants and Toxic Air Contaminants,” Chapter 136, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB617.

42 EJAG, “SCAQMD AB 617 Implementation,” January 26, 2018, <http://www.aqmd.gov/docs/default-source/ab-617-ab-134/ab-617-overview-to-ejag.pdf?sfvrsn=9>.

43 Stacey Davis, “California’s AB 617: A New Frontier in Air Quality Management... If Funded,” Center for Clean Air Policy, August 2, 2017, <http://ccap.org/californias-ab-617-a-new-frontier-in-air-quality-management-if-funded/>.



- 44 SMUD, “SMUD Pilot Natural Refrigerant Incentive Program,” May 2017, <https://www.smud.org/-/media/Documents/Business-Solutions-and-Rebates/Refrigerant-Pilot-Program-Summary.ashx>.
- 45 North American Sustainable Refrigeration Council, “SMUD Launches Natural Refrigerant Incentive Program,” June 12, 2017, <http://nasrc.org/articles1/2017/6/12/smud-launches-natural-refrigerant-incentive-program>.
- 46 California Public Utilities Commission, “Fact Sheet Industrial Programs 2013-2014,” March 2013, <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5418>.
- 47 California Public Utilities Commission.
- 48 California Public Utilities Commission.
- 49 California Public Utilities Commission.
- 50 Megan A. Billingsley et al., “The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs,” LBNL-6595E (Lawrence Berkeley National Laboratory, March 2014), <https://emp.lbl.gov/sites/all/files/lbnl-6595e.pdf>; Ian M. Hoffman et al., “The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level” (Lawrence Berkeley National Laboratory, April 2015), <https://emp.lbl.gov/sites/all/files/total-cost-of-saved-energy.pdf>.
- 51 William Morrow et al., “Assessment of Energy Efficiency Improvement in the United States Petroleum Refining Industry” (Lawrence Berkeley National Laboratory, June 2013).
- 52 Amelie Goldberg, Robert P. Taylor, and Bruce Hedman, “Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector” (State and Local Energy Efficiency Action Network, March 18, 2014), ES-2, https://www4.eere.energy.gov/seeaction/system/files/documents/industrial_energy_efficiency.pdf.
- 53 Carol Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response” (UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011), <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.
- 54 Office of Governor Edmund G. Brown Jr., “Clean Energy Jobs Plan.”
- 55 California Public Utilities Commission, “CHP Program Settlement Agreement Term Sheet,” October 8, 2010, <http://docs.cpuc.ca.gov/PUBLISHED/GRAPHICS/124875.PDF>.



- 56 Pacific CHP Technical Assistance Partnership, “The State of CHP: California” (U.S. Department of Energy, November 2017), <https://www.energy.gov/sites/prod/files/2017/11/f39/StateOfCHP-California.pdf>.
- 57 U.S. Department of Energy, “Combined Heat and Power Installation Database | Facilities in CA,” accessed November 12, 2018, <https://doe.icfwebervices.com/chpdb/state/CA>.
- 58 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Outlook Handbook, Construction and Extraction, Ironworkers,” 2015, <https://www.bls.gov/ooh/construction-and-extraction/structural-iron-and-steel-workers.htm>.
- 59 California Energy Commission, “Food Production Investment Program (18-MISC-01),” accessed October 29, 2018, available via Internet archive at <https://web.archive.org/web/20180831230516/https://www.energy.ca.gov/research/fpip/index.html>.
- 60 Calculated by the total greenhouse gas emissions in the state is approximately 400 million metric tons CO₂ equivalent and industry sector emissions are 21 percent of all emissions using information from Guido Franco, “Greenhouse Gas Emission Reductions - Tracking Progress” (California Energy Commission, December 2017), https://ww2.energy.ca.gov/renewables/tracking_progress/documents/%20%20_%20%20duplicate:old%20files%20here/Greenhouse_Gas_Emissions_Reductions.pdf.
- 61 Philip Ting, “AB-109 Budget Act of 2017,” Chapter 249, Statutes of 2017 (chaptered September 16, 2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB109.
- 62 California Energy Commission, “New California Program Provides \$57 Million to Help Food Processors Cut Energy, Greenhouse Gas Emissions,” July 13, 2018, https://www.energy.ca.gov/releases/2018_releases/2018-07-13_fpip_grants.html.
- 63 Betony Jones and Abigail Martin, “Statewide Program to Improve Industrial Energy Efficiency in Clean Power Plan Implementation: A Proposal for States,” unpublished (UC Berkeley Center for Labor Research and Education, 2016).
- 64 Charles A. Goldman et al., “Energy Efficiency Services Sector: Workforce Education and Training Needs” (Lawrence Berkeley National Laboratory, March 2010), <https://emp.lbl.gov/publications/energy-efficiency-services-sector-0>.
- 65 Goldman et al.; Zabin et al., “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.”
- 66 Statewide prevailing wages are not available for comparison because they vary by region. See California Department of Industrial Relations, Office of Policy, Research and Legislation, “Index 2018-2 General Prevailing Wage Journeyman Determinations,”



accessed January 2, 2019, <https://www.dir.ca.gov/OPRL/2018-2/PWD/index.htm#Journeyman>.

67 Loni Hancock, “SB-54 Hazardous Materials Management: Stationary Sources: Skilled and Trained Workforce,” Chapter 795, Statutes of 2013 § (2013), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB54.

68 Loni Hancock, “SB-54 Hazardous Materials Management: Stationary Sources: Skilled and Trained Workforce,” Chapter 795, Statutes of 2013 § (chaptered October 13, 2013), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB54.

69 Hancock.

70 California Workforce Development Board, “High Road Partnerships for Construction Careers,” accessed October 12, 2018, <https://cwdb.ca.gov/initiatives/hrcc/>.

71 California Energy Commission, “California Retail Fuel Outlet Annual Reporting (CEC-A15) Results,” accessed October 16, 2018, https://www.energy.ca.gov/almanac/transportation_data/gasoline/piira_retail_survey.html.

72 James H. Williams et al., “The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity,” *Science* 335, no. 6064 (January 6, 2012): 53–59, <https://doi.org/10.1126/science.1208365>.

73 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” ES 8.

74 California Employment Development Department, “Quarterly Census of Employment and Wages (QCEW) - Industry Detail,” 2016, https://www.labormarketinfo.edd.ca.gov/qcew/CEW-Detail_NAICS.asp?MajorIndustryCode=1021&Geo-Code=06000000&Year=2016&OwnCode=50&Qtr=00; natural gas distribution jobs were not available in the QCEW, and are reported for the less reliable Current Employment Statistics Survey: California Employment Development Department, “Labor Market Information for the State of California (Statewide Summary),” accessed December 4, 2018, <https://www.labormarketinfo.edd.ca.gov/geography/california-statewide.html>.

75 U.S. Census Bureau, “QWI Explorer,” accessed November 2, 2018, <https://qwexplorer.ces.census.gov/static/explore.html#x=0&g=0>.

76 U.S. Census Bureau.

77 David Manley, “Oil Companies Face Stranded Assets, But Producer Countries Have It Worse,” *Natural Resource Governance Institute* (blog), January 27, 2017, <https://resourcegovernance.org/blog/oil-companies-face-stranded-assets-producer-countries-have-it-worse>.



- 78 U.S. Department of Labor, Bureau of Labor Statistics, “OES Research Estimates by State and Industry.”
- 79 Mark Edward Nero, “SB 54 Creates a New, Safe Day at Refineries” (International Brotherhood of Boilermakers, March 1, 2016), <https://boilermakers.org/news/headlines/SB-54-creates-a-new-safe-day-at-refineries>.
- 80 See NAICS code 324 at U.S. Census Bureau, “QWI Explorer.”
- 81 See NAICS code 324 at U.S. Census Bureau.
- 82 See NAICS code 324 at U.S. Census Bureau.
- 83 Hancock, SB-54 Hazardous materials management: stationary sources: skilled and trained workforce, see Section 25536.7.
- 84 Michael P. Wilson, National Director for Occupational and Environmental Health, BlueGreen Alliance, personal communication with author, December 6, 2018.
- 85 Hancock, SB-54 Hazardous materials management: stationary sources: skilled and trained workforce, see Section 25536.7.
- 86 California Department of Industrial Relations, “Process Safety Management for Petroleum Refineries,” California Code of Regulations, Title 8, General Industry Safety Orders § 5189.1 (2017), https://www.dir.ca.gov/title8/5189_1.html; Also see Occupational Safety and Health Standard Board, “Process Safety Management for Petroleum Refineries: Initial Statement of Reasons” (California Department of Industrial Relations, September 15, 2016), <https://www.dir.ca.gov/OSHSB/documents/Process-Safety-Management-for-Petroleum-Refineriess-ISOR.pdf>; California Department of Industrial Relations, “Landmark Workplace Safety and Health Regulation Approved to Reduce Risk of Major Incidents at Oil Refineries in California,” May 18, 2017, <https://www.dir.ca.gov/DIRNews/2017/2017-37.pdf>.
- 87 California Department of Industrial Relations, Process Safety Management for Petroleum Refineries at subsection (q)(1)(A), Employee Participation.
- 88 California Department of Industrial Relations at subsection (g), Training.
- 89 California Department of Industrial Relations at subsection (k), Damage Mechanism Review; U.S. Chemical Safety and Hazard Investigation Board, “Regulatory Report: Chevron Richmond Refinery Pipe Rupture Fire,” May 2014, https://www.csb.gov/assets/1/20/chevron_regulatory_report_06272014.pdf?15267.
- 90 Leno, SB-1371 Natural gas: leakage abatement.
- 91 Thornberg, Chong, and Fowler, “2017 California Green Innovation Index.”



- 92 Christopher Thornberg et al., “2018 California Green Innovation Index” (Next 10, 2018), <http://next10.org/sites/default/files/2018-ca-green-innovation-index.pdf>.
- 93 Nancey Green Leigh and Edward J. Blakely, *Planning Local Economic Development: Theory and Practice*, Sixth Edition (SAGE Publications, 2016), <https://us.sagepub.com/en-us/nam/planning-local-economic-development/book244769>.
- 94 Leigh and Blakely.
- 95 Rob Bonta, “AB-262 Public Contracts: Bid Specifications: Buy Clean California Act,” Chapter 816, Statutes of 2017 (chaptered October 15, 2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB262.
- 96 JB Tengco, West Coast Director for the BlueGreen Alliance, interview with author, June 8, 2018, notes available from author (mcha@oxy.edu).
- 97 Jacobs et al., “Producing Poverty: The Public Cost of Low-Wage Production Jobs in Manufacturing.”
- 98 Jobs to Move America, “U.S. Employment Plan,” 2016, <https://jobstomoveamerica.org/wp-content/uploads/2015/10/JMA-Fact-Sheet-Branded-U.S.-Employment-2016.pdf>.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 9: Waste Sector

by Roxane Auer and Holly Myers

Contents

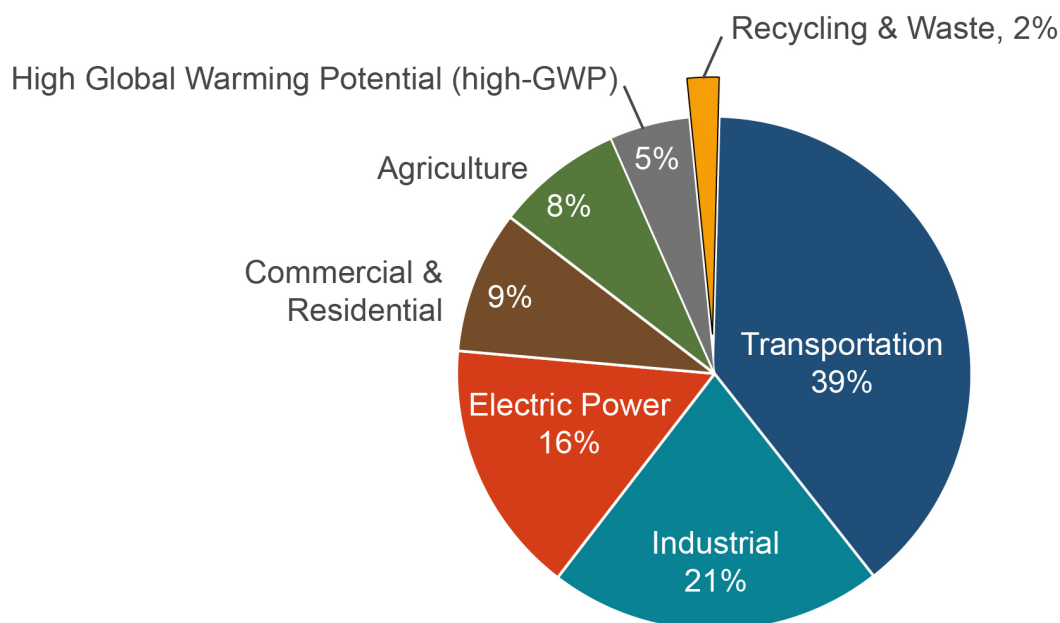
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I. Overview of Sector and Key Climate Policies

The waste sector, which includes waste management and recycling comprised 2 percent of statewide emissions in 2017. **Exhibit 9.1** shows the importance of emissions from waste as a share of total emissions.

Exhibit 9.1. Waste Sector Emissions (MMTCO₂E) as of 2017

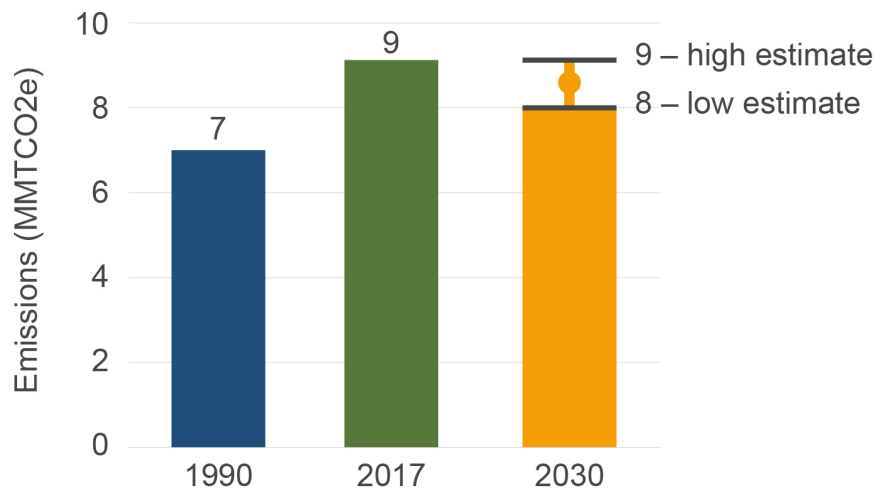


Source: California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019, https://ww3.arb.ca.gov/cc/inventory/pubsw/reports/2000_2017/ghg_inventory_trends_00-17.pdf.

The Scoping Plan expects emissions to keep rising in this sector but identifies measures to limit the growth of emissions significantly. **Exhibit 9.2** shows emissions from the waste sector in 1990 and 2017 and finally, the estimated range of emissions in 2030 from implementing the measures identified in the Scoping Plan. Missing from this figure are the expected emission reductions from the Cap-and-Trade Program. Since this market-based program covers all large sources of greenhouse gas emissions across sectors and does not predetermine where emission reductions will occur, its projected impact in each sector cannot be illustrated.



Exhibit 9.2. Waste Sector Emissions, 1990 and 2017, and Expected Range of Emissions in 2030 after Implementation of Scoping Plan Measures (excluding reductions from the Cap-and-Trade Program)



Sources: 1990 levels and 2030 GHG emissions targets: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” page 31, table 3, November 2017, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf 2017 levels from: California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.

Since 1989, when California enacted the Integrated Waste Management Act (IWMA; Assembly Bill 939, Sher, Chapter 1095 Statutes of 1989),¹ the state has led the nation in mandating a decrease in the quantity of solid waste it sends to landfills. Established in 2011 by Assembly Bill 341 (Chesbro, Chapter 476, Statutes of 2011),² 75 percent of all waste generated must be source-reduced, recycled, or composted by 2020. The IWMA also established a statewide permitting, inspection, and enforcement structure that later became the California Department of Resources Recycling and Recovery (CalRecycle), the agency currently responsible for implementing the state’s climate policies in the waste industry. In 2016, California established a statewide target for organic waste (Senate Bill 1383, Lara, Chapter 395, Statutes of 2015³), mandating a 75 percent reduction in organic waste disposal from 2014 levels by 2025 as part of the state’s Short-Lived Climate Pollutant (SLCP) reduction strategy to phase in organic waste recycling requirements by 2022.⁴



The waste sector's most significant impact on climate change is from the large quantity of methane emissions produced by landfills. Within CARB's greenhouse gas inventory, emissions from the waste sector consist of methane and nitrous oxide, with methane being the primary contributor, from landfills (94 percent) and from commercial-scale composting (a small fraction).⁵ The sector emitted 8.85 million metric tons of carbon dioxide equivalent (CO₂e) in 2014, approximately 2 percent of the state's total annual greenhouse gas emissions.

Almost all methane emissions from the sector are derived from the landfill disposal of organic waste, which comprises two-thirds of all landfilled material. Organic waste includes compostable materials such as food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper; additionally, materials like cardboard and paper are organic in nature but are typically recycled as commercial commodities rather than through composting.⁶ Diverting plastic, glass, and aluminum materials from landfills to recycling facilities also serves to reduce greenhouse gas emissions from the waste sector, although indirectly because reuse and remanufacturing generate fewer emissions than manufacturing from virgin materials. While increasing recycling remains an important part of the state's greenhouse gas emissions reduction strategy, diverting organic waste from landfills is the priority because it reduces methane (a Short-Lived Climate Pollutant, SLCP) emissions directly.

As an essential component of SB 1383, CalRecycle is implementing a strategy to ensure that by 2025, local jurisdictions prevent at least 75 percent of all organic waste from ending up in a landfill and reduce by 20 percent the edible food destined for landfills.⁷ When fully implemented, the organics diversion and food waste prevention and rescue programs will reduce methane emissions by an estimated 4 million metric tons of CO₂ equivalent by 2030.⁸

CalRecycle has not seen a meaningful decrease in the per-capita amount of material that ends up in the landfill since 2009, despite the state continuing to push toward new and more aggressive diversion targets. Indeed, 2016 marked the fourth consecutive year in which per-capita disposal increased. In addition, the state's rate of diversion (i.e., the percent of waste that is diverted from landfills to recycling, composting, and other uses) has gone down in recent years, from 50 percent in 2014 to 44 percent in 2016.⁹

There is urgency at the state level to correct this trend and move meaningfully toward the 75 percent diversion target by 2020 established by AB 341. In order for California to reach the 2020 mandate, more than half of the solid waste that is currently disposed of in landfills would need to be reduced, recycled, or composted.¹⁰ Reaching this target would require rapid growth in diversion programs and in the development of facilities for processing waste at the local level. Increasing diversion and building new facilities for diverted materials could contribute to significant job creation—from entry-level jobs to advanced, professional careers—because of the steady flow of committed and skilled



workers that would be needed to process and remanufacture the additional waste. In addition, waste diversion is more complex and creates more jobs than landfilling.¹¹

Waste management has historically been provided or managed by local governments and is generally viewed as a core local governmental responsibility.¹² Throughout the history of the industry, waste workers employed by a public entity, those who are members of a union, and especially, waste workers who are both have had the ability to make gains in working conditions and pay. The sanitation workers' strike in Memphis, Tennessee, that Dr. Martin Luther King, Jr. famously attended in his final days was sparked by the death of two sanitation workers on the job and workers' subsequent demand that the city recognize the union, improve safety, and raise wages.¹³ After Dr. King's assassination, the city recognized the union and agreed to higher wages, and organizing efforts by sanitation workers elsewhere led to better job quality in this industry.

In more recent years, new labor and workforce challenges have arisen as subcontracting has become more prevalent in the waste industry. Wages and working conditions for public sector sanitation workers continue to generally be decent. Subcontracting, however has reduced California's share of public workers in the waste management and remediation industry to only 1.6 percent.¹⁴ In the private waste hauling industry throughout the United States, including in California, there are long-standing low-road employment practices, such as insufficient training, dangerous working conditions, long and inconsistent shifts, and wage theft.¹⁵ In this environment, employees cannot perform at their best, and this impact is evident in efficiency and diversion rates. For this reason, high-road employment practices and successful diversion go hand in hand. Employees who are well trained and well treated will stay on the job longer, gain more expertise, and perform higher quality work and/or be more productive.

Directly employing waste workers as municipal employees, as was more common in the past, might be the most effective way to ensure high-road labor and workforce development practices. Another method to improve employment (and environmental) outcomes in this sector would be to use the government contracting process to structure the market in ways that lead to high quality careers and increase access for disadvantaged workers. For instance, California could mandate or incentivize high-road training and employment practices for waste sector contracts involving state funds. Local governments are mainly responsible for waste services, however, which means municipalities and counties would need to integrate high-road labor practices via mandates or incentives in the bidding processes they oversee. Local jurisdictions could seek waste management contractors based on required high-road practices and a responsible contracting model.



The following key policies affecting the waste sector are the following:

❖ **General Statewide Diversion Mandates and Goals**

➤ **Integrated Waste Management Act (Assembly Bill 939, Sher, Chapter 1095, Statutes of 1989)**

Required 50 percent waste diversion by 2000, with a monitoring and enforcement system at the state level to ensure compliance.¹⁶ It was the first legislation in the country to prioritize source reduction and diversion, and it changed the way California approached waste management. The 2000 target was reached by most local jurisdictions.

➤ **Solid Waste Per Capita Disposal Measurement Act (Senate Bill 1016, Wiggins, Chapter 343, Statutes of 2006)¹⁷**

Required each jurisdiction to establish a 2002-2006 base rate of total waste generated in pounds/per person/per day, and required jurisdictions to landfill no more than 50 percent of that amount.¹⁸ The state began checking compliance in 2007 through a yearly report that each local jurisdiction was required to submit to CalRecycle.¹⁹ The timing of this change meant that local jurisdictions measured the base rate during the economic boom years and measured disposal rates just as the recession began in 2008. For this reason, the vast majority of local jurisdictions in California achieved their target immediately. Since then, however, the state has emerged from the recession and Assembly Bill 1594 (Williams, Chapter 719, Statutes of 2014)²⁰ mandated a change in how alternative daily cover (ADC, non-earthen materials used to cover landfills) is counted as disposal, so for both reasons some local jurisdictions are expected to have trouble maintaining compliance without implementing new diversion programs.²¹

➤ **75 Percent Statewide Recycling Goal and Mandatory Commercial Recycling (Assembly Bill 341, Chesbro, Chapter 476, Statutes of 2011)**

Required 75 percent of solid waste generated to be reduced, recycled, or composted by 2020 and established more stringent requirements for what can be considered diversion. To achieve the 2020 mandate, the law required mandatory commercial recycling beginning in 2012, with the goal of recycling an additional 2 million to 3 million tons of materials annually by the year 2020.²² It required all businesses generating more than four cubic yards of commercial solid waste per week and all multifamily buildings of five units or more to institute a recycling program as of July 1, 2012. AB 341 authorized local jurisdictions to collect a fee to cover the cost of running the program²³ and authorized districts to implement an enforcement program.²⁴ CalRecycle reviews the actions of local jurisdictions and can impose penalties for noncompliance.



- **Direct Reporting Requirements (Assembly Bill 901, Gordon, Chapter 746, Statutes of 2015)²⁵**

Provided CalRecycle with enforcement authority for existing disposal reporting requirements, thus enabling CalRecycle to accurately measure progress toward the 75 percent target.

❖ Organic Waste Recycling

- **Mandatory Commercial Organics Recycling (Assembly Bill 1826, Chesbro, Chapter 727, Statutes of 2014)²⁶**

Progressively tightened requirements for businesses generating a certain amount of organic waste.²⁷ Initially, the requirements applied to businesses generating at least eight cubic yards of organic waste per week; as of January 1, 2017, the threshold was reduced to four cubic yards per week. If, in 2020, CalRecycle determines that organic waste disposal has not been reduced by 50 percent from 2014 levels, it will require compliance from businesses that generate at least two cubic yards of total solid waste per week. This change would leave very few businesses exempt. The law required local jurisdictions to have an organic waste recycling program in place by January 1, 2016, and to inform businesses of the requirement. The law also supports transportation biofuel development from organic waste. As of August 2017, local jurisdictions were required to begin including information on program implementation in their annual reports. CalRecycle has already begun to monitor compliance.

- **Compostable Organics (Assembly Bill 876, McCarty, Chapter 593, Statutes of 2015)²⁸**

Addressed longer-term planning for organics infrastructure, requiring counties and regional agencies to report their organic waste output and processing infrastructure needs in the state's Electronic Annual Report (EAR) beginning on August 1, 2017.

- **Organic Waste Composting Promotion (Assembly Bill 1045, Irwin, Chapter 596, Statutes of 2015)²⁹**

Required CalEPA, in coordination with CalRecycle, the State Water Resources Control Board (SWRCB), ARB, and California Department of Food and Agriculture (CDFA) to develop and implement policies that divert organic waste from landfills through composting and appropriate uses of that compost.



- **Bioenergy Market Adjusting Tariff (Senate Bill 1122, Rubio, Chapter 612, Statutes of 2012)**³⁰

Created a bioenergy incubation program requiring the state's three large investor-owned utilities (PG&E, Southern California Edison, San Diego Gas and Electric) to procure a share of the required 250 megawatts of renewable capacity from small-scale bioenergy projects that commenced operation on or after June 1, 2013.

- **Biomethane Pipeline Injection (Assembly Bill 1900, Gatto, Chapter 602, Statutes of 2012)**³¹

Established standards for biogas pipeline injection, requires gas producers to be responsible for the costs of biogas pipeline injection, and established a ratepayer-funded program of up to \$40 million to assist the nascent biogas market with interconnection costs.

❖ Short-Lived Climate Pollutant Reduction Strategy

- **Senate Bill 605 (Lara, Chapter 523, Statutes of 2014)**³²

Required CARB to develop a strategy to reduce short-lived climate pollutants (SLCPs), including methane.

- **Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016)**³³

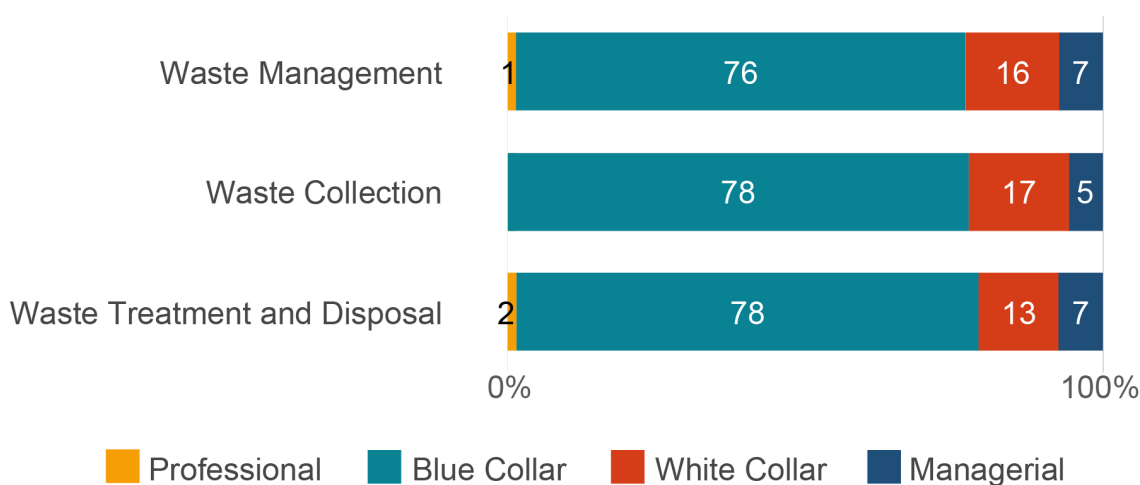
Mandated CARB's Short-Lived Climate Pollutant Reduction Strategy be implemented by January 1, 2018. It also specifically addressed the reduction of methane emissions from landfills through the diversion of organic waste. The strategy adopted by CARB requires CalRecycle to meet specific benchmarks for keeping organic waste out of landfills: 50 percent below the 2014 level by 2020, growing to 75 percent by 2025. It also specifies that not less than 20 percent of the edible food destined for the organic waste stream is to be recovered to feed people in need by 2025. CalRecycle is in the process of drafting regulations, which will be finalized and take effect by January 1, 2022. CalRecycle, in consultation with CARB, must analyze the progress that the waste management sector and state and local governments have made in achieving the 2020 and 2025 targets by July 1, 2020. As part of SB 1383, the California Energy Commission was required to develop recommendations regarding the production and use of renewable natural gas (RNG) as part of the 2017 Integrated Energy Policy Report (IEPR) and based on these recommendations, to adopt policies and incentives to increase sustainable production and use of RNG.³⁴



II. Industries and Occupations Affected

The main industry impacted by the proposed greenhouse gas emission reduction measures is the waste management and remediation service industry (NAICS 562). As of 2016, there were just under 48,000 workers in this industry in California.³⁵ The vast majority of these workers are private-sector employees. **Exhibit 9.3** shows the detailed 4-digit NAICS segments of this industry: waste management and remediation, waste collection and waste treatment and disposal. The occupational distribution in all three of these industry segments is very similar: the vast majority are blue-collar occupations.

Exhibit 9.3. NAICS Industries within Waste Management and Remediation Services



Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]

Exhibit 9.4 shows that the largest occupation within the waste management and remediation service industry in California is that of “refuse and recyclable material collectors,” the sanitation worker who collects trash, recyclables, or organic waste from residences and businesses. These workers drive or help on waste collection vehicles, and they account for 23 percent of all waste management and remediation service industry workers.

Waste processing workers, who sort the waste by hand and otherwise move or handle the material once it arrives at a waste processing facility, make up 10 percent of the industry.” Material moving workers, those who use heavy machinery to move waste around, make up less than 1 percent. Waste processing jobs exist largely as



a result of diversion efforts, as these are the workers who process the waste that does not go to the landfill. A widely cited 2011 report by National Resources Defense Council estimated that of the jobs created by increasing California's diversion rate to 75 percent, 31 percent will be created in materials collection and 24 percent in materials processing, while most of the rest are in manufacturing that uses recycled feedstock.³⁶

Exhibit 9.4. Top 10 Occupations in Waste Management and Remediation Services

| SOC Code | Occupation Title | % Share of Occupations in Sector (NAICS 562) | Landfilling, Diversion, or Both | 25 th Percentile Hourly Wage | 50 th Percentile Hourly Wage | 75 th Percentile Hourly Wage |
|----------|--|--|---------------------------------|---|---|---|
| 53-7081 | Refuse and Recyclable Material Collectors | 23% | Both | \$18.50 | \$22.50 | \$26.40 |
| 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 10% | Largely diversion | \$10.40 | \$12.70 | \$15.80 |
| 47-4041 | Hazardous Materials Removal Workers | 9% | N/A | \$16.10 | \$19.10 | \$23.80 |
| 53-3032 | Truck Drivers, Heavy and Tractor-Trailer | 7% | Largely diversion | \$17.10 | \$21.30 | \$25.00 |
| 49-3031 | Bus and Truck Mechanics and Diesel Engine Specialists | 3% | Both | \$20.00 | \$24.10 | \$30.00 |
| 43-5111 | Weighers, Measurers, Checkers, Samplers, and Recordkeeping | 3% | Largely diversion | \$15.00 | \$17.30 | \$20.10 |
| 47-4071 | Septic Tank Servicers and Sewer Pipe Cleaners | 2% | N/A | \$15.00 | \$18.10 | \$23.10 |
| 47-2061 | Construction Laborers | 2% | Both | \$24.80 | \$29.50 | \$39.50 |
| 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 2% | Both | \$10.00 | \$11.70 | \$16.20 |
| 43-4051 | Customer Service Representatives | 2% | Both | \$14.20 | \$17.50 | \$21.50 |

Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



The waste sector comprises residential hauling, commercial hauling, which are sometimes separate businesses, and waste processing which generally includes both commercial and residential waste. The commercial hauling segment includes all businesses, industries, and large apartment buildings (i.e., 5 units or more); residential includes single-family homes and small apartment buildings with less than five units. Material processing facilities include material recovery, composting, digestion, transformation (incineration), and landfilling. CARB does not include medical and hazardous waste in its consideration of this sector.³⁷

There are two national, publicly traded companies with a large market share in California: Waste Management, Inc. and Republic Services, Inc. Regional companies comprise the rest of the industry, with some of these smaller firms operating in multiple states. Many companies operate in both residential and commercial waste, and often, the collection and processing of waste is vertically integrated within a single company.

Municipal waste services, where a local government entity hires waste workers directly, has all but disappeared. According to the U.S. Bureau of Labor Statistics, 98.4 percent of California's waste management and remediation service workers are in the private sector, while only 1.6 percent are in the public sector.³⁸ Most local jurisdictions have established a contracting process for securing both residential and commercial waste management services from private firms. This process involves the submission and evaluation of bids in response to a request for proposals (RFP), which allows local governments the opportunity to mandate or incentivize high-road practices should they choose to do so. Local jurisdictions often take a hands-off approach with waste haulers in the commercial sector; although licenses are required, they often have minimal stipulations. In these cases, the waste services contract is between the commercial client and the waste management company directly. Where it exists, this "open-market" or "nonexclusive" practice impedes attempts to improve diversion rates as well as employment practices, as explained below.

A handful of industries outside of waste will also be affected by the policies under discussion here. As the state moves forward with its organic waste recycling mandates, for instance, new facilities are likely to be needed to process the additional quantities of compostable organic waste, stimulating employment in the industrial building construction industry (NAICS 23621). There may also be a need for additional remanufacturing facilities that use recycled materials as feedstock, stimulating both the building construction and the manufacturing industries (NAICS 31-33).³⁹ Organic waste, the primary focus of the state's diversion policy drivers is cost-prohibitive to transport. As a result, with the exception of paper and cardboard, organic waste generated in California is typically managed entirely in California (currently through compost, anaerobic digestion, or landfill disposal). Recycling an additional 20 million tons of organic waste that are currently landfilled by 2025, as called for in SB 1383, is estimated to create 11,700 permanent jobs and more than 80 new or expanded compost or anaerobic digestion facilities according to CalRecycle.⁴⁰ More detailed projections of employment growth would be highly speculative at this time.



In addition, CalRecycle's new focus on food rescue has resulted in more funding for organizations involved in the operation of food banks. For that reason, the religious, grant-making, civic, professional, and similar organizations industry (NAICS 813) will also be impacted in a range of occupations. The funds already distributed for this program have been largely used for the purchase of equipment to safely store the food, and direct job growth is likely limited due to emphasis on investment in capital (i.e., food storage equipment) more than in labor.

III. Key Policies for the Waste Sector

The following section addresses the workforce issues embedded in the major climate policy areas in the waste sector. The section first examines the available evidence on current workforce outcomes. It then discusses the climate policy mechanism and identifies the additional workforce policy levers that the agencies responsible for implementing the climate policies can employ in order to create good jobs and the demand for skilled labor. It also highlights opportunities to develop, utilize, and leverage the state's workforce development, training, and education infrastructure to prepare workers for the labor market changes that will occur due to climate policies in this sector.

A. Statewide Diversion Mandates

The main driver of industry change in the waste sector flows from state diversion mandates. CalRecycle is approaching the task of ensuring compliance with the statewide diversion mandates placed on local jurisdictions in multiple ways. The official strategies for achieving the state's 75-percent diversion target are contained in CalRecycle's AB 341 *Report to the Legislature* in 2015. These include moving organics out of the landfill; expanding the recycling/remanufacturing infrastructure (i.e., permitting, compliance assistance and financing); exploring new models for state and local funding of sustainable waste management programs; promoting state procurement of post-consumer recycled content products; and promoting extended producer responsibility, in which producers are obligated to take financial and/or physical responsibility for the treatment or disposal of post-consumer products.⁴¹

❖ Diverting Organic Waste from the Landfill

Organic waste (i.e., compostable materials such as food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper) is the largest waste stream in California, accounting for nearly half of all solid waste generated annually in the state.⁴² Essential to both achieving the state's diversion mandate and reducing methane emissions, the diversion of organic waste from landfills has been



at the center of many of the state's waste-related policies. For instance, the state's Short-Lived Climate Pollutant Reduction Strategy, approved in 2016, requires that local jurisdictions divert 75 percent of organic waste by 2025. Mandatory commercial organics recycling, passed in 2014, requires any business producing more than four cubic yards of solid waste per week to establish an organic waste diversion program.⁴³

The two main methods being used to divert organic waste from landfills are composting and digestion.⁴⁴ In composting, organic material is allowed to break down in a controlled, open-air environment; in digestion, the material breaks down in a closed environment, such as a tank. Composting is aerobic (exposed to gaseous oxygen), whereas digestion can be either aerobic or anaerobic (deprived of gaseous oxygen). When the digestion process takes place in a closed environment, 100 percent of the methane produced by the decomposing material can be captured, which makes digestion superior to composting when considering the reduction of short-lived climate pollutants. Open-air composting does emit methane, although far less than landfilling. Incineration, which involves the burning of waste, is another organic waste diversion method, but is viewed as environmentally inferior to other methods and is not a target for growth.⁴⁵

Both composting and digestion can be used to produce environmentally friendly products. Composting produces mulch, fertilizer, and other beneficial soil additives. Digestion produces renewable natural gas (RNG) that can replace fossil natural gas and be used to directly to generate electricity or provide thermal energy, or RNG can be refined into a transportation fuel. Studies indicate that California could produce nearly 300 billion cubic feet of renewable natural gas per year from organic waste, enough to replace 75 percent of all the diesel fuel used by motor vehicles in the state.⁴⁶ Composting facilities are less expensive to build than digestion facilities, and both types of facilities face difficulties in finding locations and securing approval. For this reason, the state has recommended that, where feasible, existing, closed-environment wastewater processing facilities also accept and process non-solid organic waste (e.g., food waste and fats, oil, and grease).⁴⁷

Recycling, in addition to organic waste diversion, is important to meeting the state's GHG emissions reduction targets, as well. Mandatory commercial recycling, implemented in 2012, was designed to achieve a reduction in greenhouse gas emissions of five million metric tons of CO₂e. It is impossible to track how much of the state's current diversion rate is attributable to the recycling destined for remanufacturing versus the diversion of organic waste; local jurisdictions are not required to report recycling quantities and CalRecycle will not have statewide tracking of recycling until 2019. Nonetheless, it is clear that many local jurisdictions have already taken action on recycling whereas organic waste diversion programs are less common.⁴⁸ Recycling is also limited by remanufacturing and infrastructure capabilities.

A CalRecycle analysis of diversion rates in the commercial waste sector illustrates the significance of organic waste diversion.⁴⁹ Currently, the commercial sector in California



landfills 64 percent of its total waste, diverting 7 percent through curbside organic waste programs and 8 percent through curbside recycling. CalRecycle, however, considers 43 percent of this total waste to be recoverable through organics diversion (into compost or mulch) and 25 percent through recycling. The potential gain for organic waste (36 percent) is therefore considerably higher than the potential gain for recycling (17 percent)

❖ Expanding the Recycling/Remanufacturing Infrastructure

There are not enough remanufacturing facilities in the state to handle the recyclable materials being collected. Existing remanufacturing facilities in California are near capacity and still only handle 2.3 million tons of recyclable feedstock; the rest must be exported.⁵⁰ The United States as a whole exports about a third of its recycling, nearly half of it to China.⁵¹ Shipping recyclable materials to other states or nations is not the best choice for decreasing greenhouse gas emissions. It also subjects California to market volatility. In January 2018, for example, China tightened its standards and banned imports of various types of plastic and paper, wreaking havoc in the industry and leaving thousands of tons of recycled material with no place to go but the landfill.⁵²

To address the deficit in remanufacturing capacity, CalRecycle is working with businesses on multiple levels to assist in the development of additional recycling facilities. The 20-year-old Recycling Market Development Zone program, which includes tax breaks, incentives and attractive loans to manufacturers using feedstock from the waste stream, is one such initiative, though CalRecycle admits it is underfunded.⁵³ The Legislature has allocated Greenhouse Gas Reduction Fund (GGRF) monies to support remanufacturing facilities through CalRecycle's Organics and Recycling Manufacturing Loans and the Recycled Fiber, Plastic, and Glass Grants programs.⁵⁴

Similarly, there are not enough organic waste processing facilities in the state to handle the large increase in organic waste diversion that the state will require. In 2015, CalRecycle calculated that capacity for organic waste processing was less than one-half—perhaps only one-third—of what was needed to handle the mandated diversion.⁵⁵ In 2015, California had 30 anaerobic food waste digesting facilities, which is nearly twice the number of such facilities in Wisconsin, the second-leading state, with 17 facilities.⁵⁶ Some progress has been made: As of May 2017, at least 11 new anaerobic digestion facilities were either pending or in the permitting stage in California,⁵⁷ however, more will be needed. A representative from CR&R—operator of the world's largest anaerobic digestion facility, located in Perris, Riverside County—stated that about 50 more facilities are needed throughout the state.⁵⁸ To assist with organic waste processing capacity, CalRecycle works with local governments, shepherding businesses through the approval processes and providing grants through its GGRF allocations.⁵⁹ Development of new organic waste processing facilities remains a challenge, however, because multiple agencies are involved in the approval process and they maintain different, and sometimes even conflicting, requirements from one another, according to a consultant in the industry.⁶⁰



❖ **Promoting State Procurement of Post-Consumer Recycled-Content Products**

The State Agency Buy Recycled Campaign program encourages state purchases of recycled-content products. Existing law requires each state agency to ensure that at least 50 percent of reportable purchases are recycled products, with the mandate extended to 75 percent of reportable purchases starting January 2020.⁶¹ However, only \$200 million out of an annual \$14 billion of total state spending on good and services has been documented as spent on post-consumer recycled-content products.⁶² CalRecycle is exploring ways to improve this program.

❖ **Exploring New Models for State and Local Funding of Sustainable Waste Management Programs and Promoting Extended Producer Responsibility**

Both these CalRecycle strategies face obstacles due to current costs. Diversion at the scale the state has mandated will be expensive, as the waste management industry has externalized environmental costs to date and local jurisdictions have emphasized lowest-cost when evaluating bids for waste management services. Improving wages and working conditions and instituting more professional behavior in the industry can help improve operational efficiency, but in the current environment, there is a danger that the low cost of landfilling will continue to win out unless mandates are strictly enforced.

CalRecycle is exploring new models for state and local funding of sustainable waste management programs. This includes exploring a strategy known as extended producer responsibility, or product stewardship, which is intended to place a shared responsibility for end-of-life product management on the producers and other entities involved in the product chain, instead of the general public.⁶³ The statutory authority to make product stewardship the norm has not yet been established. Alternatively, increased allocations from the GGRF and other public (i.e., state and local) funding mechanisms could support new waste processing facilities. If nothing is done, the cost of the state's diversion mandates are likely to fall on residential and commercial producers of waste and local governments will likely be forced to take the unpopular step of raising rates.

❖ **CalRecycle Enforcement of State Diversion Mandates**

Local governments have been tasked with enforcing state diversion mandates, and CalRecycle has the right to investigate and impose financial penalties on local governments if they do not comply. Local governments have broad authority to establish enforcement programs and institute fees to fund an increase in diversion programs and processing facilities, whether as a direct fee on producers of waste or as a fee paid by haulers that is then passed on to producers. However, increased fees are politically



unpopular. The Los Angeles City Council recently included requirements for increased diversion and high-road employment practices in a new exclusive franchise program on the commercial side of the industry, and city officials faced anger from the business community when the program resulted in an increase in rates.⁶⁴ Oakland experienced a similar problem.⁶⁵

In January 2017, a letter from Scott Smithline, director of CalRecycle, to all statewide elected officials and recycling coordinators communicated the urgency with which the state intends to move forward with its diversion mandates.⁶⁶ The letter makes clear that if at a minimum, a jurisdiction is not making a good faith effort to implement mandated diversion programs, CalRecycle will initiate a formal public review sooner rather than waiting until the end of the regular four-year review cycle.

❖ Greenhouse Gas Reduction Fund (GGRF) Allocations

By the end of Fiscal Year 2017-18, CalRecycle had received a cumulative amount of \$111 million from the GGRF for waste diversion efforts,⁶⁷ which were used to fund the following programs: the Recycled Fiber, Plastic, and Glass Grant Program for supporting the development of remanufacturing facilities; the Organics Grant Program for supporting the development of organic waste processing facilities; and the Food Waste Prevention and Rescue Grant Program to get edible food otherwise destined for the landfill to those who need it.⁶⁸ The Organics Grant Program has received the majority of the above funds. In the 2017-18 funding cycle, the following projects were funded through this program (see **Exhibit 9.5**).

Exhibit 9.5. Projects Funded through CalRecycle’s Organics Grant Program 2017-18⁶⁹

| Grantee and Partners | County | Project Description | Total Award |
|--|----------------|---|-------------|
| Arakelian Enterprises, Inc. (DBA Athens Services) | San Bernardino | Upgrade Victorville windrow composting facility to an aerated static pile composting system to increase capacity, reduce air emissions, and help protect water quality. | \$3,000,000 |
| Best Way Disposal Company, Inc. (DBA Advance Disposal Co.) | San Bernardino | Equipment upgrades at material recovery facility in Hesperia to remove contaminants from organic waste to divert the clean material for composting. | \$2,481,250 |
| Burrtec Waste Industries, Inc. | Riverside | Construction of new covered composting system at Robert A. Nelson material recovery facility and transfer station near Riverside. | \$3,000,000 |



| Grantee and Partners | County | Project Description | Total Award |
|---|---------------|--|---------------------|
| Contra Costa Waste Services, <i>partnering with Food Bank of Contra Costa and Solano</i> | Contra Costa | Purchase of new equipment and infrastructure upgrades at Mount Diablo Resource Recovery park to utilize existing anaerobic digesters for increased organic waste landfill diversion and biogas production. Includes a food rescue partnership with Food Bank of Contra Costa and Solano. | \$4,000,000 |
| CR&R Incorporated | Riverside | Third of a three-phase project at a current anaerobic digestion facility in Perris. Expansion increases organic waste landfill diversion and increases biofuel used to fuel CR&R vehicle fleet. | \$4,000,000 |
| Recology Yuba-Sutter | Yuba | First of a three-phase project to construct a new compost facility at Ostrom Road Landfill. This project received \$2.8 million in a previous grant cycle. | \$216,865 |
| Santa Barbara County | Santa Barbara | Develop an anaerobic digestion facility at the Tajiguas Landfill to process currently landfilled organics into biogas and compost. | \$4,000,000 |
| Upper Valley Disposal Service, <i>partnering with Sacramento Food Bank and Family Services</i> | Napa | Construction of new “organics blending barn” to mix food, green, and wood waste for composting. Includes a food rescue partnership with Sacramento Food Bank and Family Services. | \$1,250,000 |
| Waste Management of Alameda County, Inc., <i>partnering with Alameda County Community Food Bank</i> | Alameda | Purchase of pre-processing equipment for a new organic material recovery facility in San Leandro. Separated materials will be composted at a new facility co-located at the Davis Street complex. Includes food rescue partnerships with Alameda County Community Food Bank. | \$3,000,000 |
| West Coast Waste | Madera | Construction of a new aerated static pile composting facility to divert currently landfilled organic material. This project received \$1.2 million in a previous grant cycle. | \$161,326 |
| Total | | | \$25,109,441 |



One example of an initiative funded in part by CalRecycle's Organics Grant Program is an anaerobic digestion facility in Perris, Riverside County.⁷⁰ The facility, which became fully functional in April 2017, produces enough renewable natural gas to displace four million gallons of diesel fuel, and the liquid and solid material left over from the process is turned into 260,000 tons of natural fertilizer.⁷¹ CR&R, the waste company that partnered with the city to develop the digester, plans to fuel 900 of its waste collection vehicles from the RNG produced at the site.

In conclusion, there are significant challenges in meeting the state's diversion targets. In its 2015 report to the Legislature, CalRecycle noted that its annual funding is not enough to cover the overall effort to reach 75-percent diversion by 2020.⁷² The GGRF only partially fills the funding gap. With landfilling and fossil natural gas priced very low, and the cost of building waste processing facilities high, renewable natural gas is not economically competitive enough to spur private investment, though it promises large returns in methane emission reduction. Funding for the promotion of remanufacturing development, to support the state's recycling mandates, is also lacking as the Recycled Fiber, Plastic, and Glass Grant Program has not received funding since 2016-17. Without complementary funding, state waste mandates will be difficult to enforce upon local authorities who must gain support from residents and businesses for unpopular rate increases.

1. Workforce Outcomes from Statewide Diversion Mandates

a. Job Growth

Evidence suggests that far more jobs will be created through diversion than have been created through landfill disposal.⁷³ There have also been some perhaps overly optimistic estimates of the number of jobs yet to be created. In a 2014 report for the Natural Resources Defense Council, Tellus Institute estimated that achieving California's 75-percent diversion goal, as established in AB 341, could create 110,000 direct jobs.⁷⁴ More than 34,000 of these jobs would be in materials collection, 26,000 in materials processing, and 50,000 in manufacturing using the recovered materials, although not all manufacturing jobs will necessarily be in California. The same report predicts 14,000 direct jobs in organic waste diversion. In an analysis of the mandatory commercial organic waste recycling law (AB 1826), CalRecycle estimated that composting creates an average of four jobs for every 1,000 tons of material diverted, approximately four times more than landfilling.⁷⁵ When discussing job creation for an organic waste digestion facility with a capacity of 400 tons per day, a representative from the operator of the facility, CR&R, cites 50 temporary construction jobs, 25 permanent jobs for sorters and grinders who prepare the waste for the digester, and 10 permanent jobs for engineers and chemists who keep the digester operating properly.⁷⁶



This large anticipated job growth has not yet been realized. The total number of waste management employees, not including remediation and landfill workers, is up 7.6 percent from 2012.⁷⁷ However, the Gross State Product grew by 15 percent during the same period, suggesting that it is the state of the overall economy, not diversion mandates, that is responsible for this job growth.⁷⁸

By 2017, when the CARB Scoping Plan was published, California's diversion rate had actually declined, and similar potential job creation numbers were cited. This decline points to the primary limitation to significant job growth: in order to create jobs in the sector, California must figure out how to improve diversion and must keep processing and re-manufacturing jobs in-state. That said, much of the recent legislation requiring organic waste diversion is only now beginning to be enforced. The new laws and policies seem likely to improve diversion rates and therefore stimulate job growth.

ii. Job Quality

The waste industry has both high- and low-road jobs. Among entry-level jobs, as a general rule, waste collection jobs are better quality, while waste processing jobs are lower quality.⁷⁹ Waste collection jobs have existed longer, and workers have benefited from years of unionization efforts and public sector employment at the municipal level. Waste processing jobs are relatively new, created in response to diversion efforts that began in 1989 and are almost entirely non-union in California.⁸⁰ Entry-level waste processing jobs are also the least-skilled jobs in waste management, and this characteristic has been exploited to drive down wages and working conditions significantly, and there is evidence of wage violations.⁸¹ The waste processing workforce will have to grow in number and skill level to be able to meet California's diversion targets. As described in this chapter's introduction, in recent decades the subcontracting of this public service has led to a decline in wages and working conditions, just as California needs the industry to grow its capacity significantly. Low road labor practices are an impediment to skill development since they generally result in high turnover, and can lead to wasted investments in training when workers exit (See Chapter 3).

Waste collection jobs—including drivers and other workers on waste collection vehicles—are relatively good quality jobs, especially in California.⁸² In 2016, the 25th percentile hourly wage was \$18.50, and the 50th percentile hourly wage was \$22.50.⁸³ These workers are often represented by the International Brotherhood of Teamsters and thus are more likely to receive family health insurance benefits and pensions.⁸⁴

Employment in waste processing—which includes the workers who sort recyclables at material recovery facilities, grind organic waste for digestion facilities, and turn the compost at mulching facilities—is almost entirely non-union and, consequently, lower-wage than in waste collection.⁸⁵ The occupation group “laborers and freight, stock and material movers, hand,” the bulk of waste processing workers, make a 25th



percentile hourly wage of \$10.40 and a 50th percentile hourly wage of \$12.70.⁸⁶ The 50th and 75th percentile hourly wage for waste processing workers in 2016 are both above the California minimum wage, which was \$11 per hour as of January 2018. It is also dirty and dangerous work.⁸⁷ Furthermore, waste processing faces the most immediate pressure from increased automation in the waste sector, so worker bargaining power, already low, will only decrease as automation advances.

It is important to note that wage theft is common in the industry, affecting both waste collection and processing workers, and government wage data does not capture this problem.⁸⁸ For example, some employers in the waste industry pay workers a flat rate for a certain route or for a “day,” regardless of the hours worked.⁸⁹ Even when wages are decent, working conditions can be abusive. In 2015, the Partnership for Working Families conducted 57 in-depth interviews with waste workers throughout the country, 18 of them in California. Many of these workers reported insufficient gear, inadequate training, inconsistent schedules, long hours, abusive management, and being rushed to get dangerous work done faster, all of which increase safety problems in the industry and community.⁹⁰ OSHA records show that the waste industry, including waste collection and processing, is dangerous,⁹¹ with injury and accident rates high compared to other industries.⁹²

These kinds of low-road labor practices often go hand in hand with poor recycling and composting practices, as businesses seek to push the cost of waste management as low as possible. In this environment, landfilling will win out because it costs less than diversion. These race-to-the-bottom practices thrive where local governments do not manage the waste industry sufficiently and either seek lowest price practices in their contracting decisions, or choose non-exclusive contracting or an open-market system.⁹³

There are also examples of high road practices in the waste industry. Many local jurisdictions in California already have exclusive franchise systems; several local jurisdictions throughout the state are already taking steps to require high-road employment and business practices when they contract with waste management providers, such as those described in below in the two promising practices case studies. Clear best practices are emerging, and many more local governments could follow suit. One example of a high road approach has been initiated in Los Angeles, as described below in **Promising Practice 9.1**.

iii. Job Access

The labor demand for waste collection and processing workers is likely to increase if California begins to make measurable progress toward the 75 percent diversion target. Yet there is no defined process by which an individual can seek employment in the waste industry. According to the Partnership for Working Families 2015 survey, access to waste jobs can be determined by who you know; a family connection to someone already in the industry is how some waste workers describe getting access.⁹⁴ Waste collection jobs



are better paid than waste processing jobs, but remain hard to fill due to dangerous work, abusive conditions, and an increasing shortage of truck drivers as waste companies compete with the freight industry for workers.⁹⁵ As has been emphasized throughout this report, improvements in job quality must go hand-in-hand with efforts to increase job access for disadvantaged workers, otherwise, the racial and gender inequities in the labor market will simply be reinforced.

Within waste processing occupations, low wages and dangerous working conditions make it hard to fill positions.⁹⁶ Programs facilitating community access to waste processing jobs would help the industry meet its need for more workers to handle the large increase in waste diversion capacity, as long as improvements in wages and career paths also occur. GGRF grants to waste management companies to help with the development of waste processing facilities, mostly for organic waste, could require evidence of high-road business practices from an applicant before consideration for funding. Many of the companies receiving grants are large regional players that employ a large number of waste processing employees. Grants that can be as high as \$3 million offer an opportunity to engage these businesses in a conversation about improving waste processing working conditions. As wages and working conditions improve, efforts to sustain or encourage employment of workers from disadvantaged communities can be initiated, as described below in **Promising Practice #9.2**.

iv. Risk of Job Loss or Job Degradation

There appears to be little to no risk of overall job loss or degradation in the waste sector at the current time. On the contrary, the urgency at the state level to meet the 75 percent diversion target, combined with the authority of local jurisdictions to charge fees or raise rates to fund increased diversion, point to continued growth in employment in the waste sector, particularly given that many of the timelines for enforcement are only getting started. Job growth will be stymied or limited, however, if the state cannot figure out how to adequately facilitate, incentivize, and enforce diversion.

There is potential for a small decrease or a plateau in the number of landfill workers. Current landfills will still need to be maintained, and any reduction in landfilling jobs due to diversion efforts will be offset by growth in the economy and the population.⁹⁷

It is also worth noting that the pressure to recycle more waste may speed up efforts already underway to automate the sorting process at material recovery facilities. It is much easier to automate the closed environment of a material recovery facility than to automate the waste collection process. If automation were to increase within material recovery facilities, the state's climate measures could be partly responsible for displacing waste processing workers, some of the most vulnerable workers in the industry. It is unlikely that these workers will be able to easily transition to other jobs within the sector. Programs to help with such a transition could be considered if automation becomes more widespread. See Chapter 4 for more discussion of Just Transition programs.



PROMISING PRACTICE #9.1

Improving Waste Sector Working Conditions While Meeting State Diversion Mandates

In December 2016, the Los Angeles City Council finalized the adoption of the Zero Waste LA Franchise System, now known as recycLA.⁹⁸ This new exclusive contracting process for commercial waste has the dual objective of improving waste diversion in Los Angeles and creating better job outcomes for local waste workers. The new contract requirements include streamlined truck routes, guaranteed recycling and waste tracking, standardized rates, and cleaned bins. They also require contractors to comply with a series of worker protection ordinances that the city council passed to ensure positive worker outcomes for contracted out city services. These include the city's Living Wage Ordinance, Service Worker Retention Ordinance, Contractor Responsibility Ordinance, First Source Hiring Ordinance, and Labor Peace Agreement.⁹⁹

The Service Worker Retention Ordinance requires new city contractors to retain workers from a previous contractor. It was passed in response to repeated efforts by new city contractors to undercut the improvements in working conditions under previous contractors by firing large numbers of workers.

Contractors in Los Angeles are also required to provide outreach and training programs for potential new employees, sufficient training for existing employees, sufficient staffing levels, and health and safety program details and monitoring.

A new division of the Los Angeles Sanitation Department was created to enforce the new

contracts, called the Solid Resources Commercial Franchise Division, allowing for a level of oversight that was all but non-existent in the city's former commercial waste industry structure. These requirements are being touted as the nation's toughest and are being studied carefully by New York City, San Diego, and other major cities.¹⁰⁰ It is too early to measure results as Los Angeles's ability to issue fines or cancel contracts to waste companies for lack of compliance only began in February 2018.¹⁰¹ In addition, higher city fees passed on to waste producers prompted a business group and a pair of apartment owners to file lawsuits claiming an illegal tax in 2017 and 2018, respectively, which has slowed but not stalled implementation.¹⁰²

The City of San Jose included many of the same requirements in its exclusive contracting process for both commercial and residential waste management, including compliance with the city's living wage, prevailing wage, worker retention, job fair, and labor peace provisions, as well as service standards and personnel training requirements.¹⁰³ A number of other cities—including Beverly Hills, San Jose, Azusa, and West Hollywood—require franchisees to comply with living or prevailing wage requirements, and several cities require employees to receive health benefits.¹⁰⁴ Maywood, Carson, and Santa Ana have worker retention ordinances applicable to sanitation workers, adopted to ensure “seamless service” in case of a transition between waste companies.¹⁰⁵



2. Workforce Recommendations

a. *Demand-Side Workforce Policy Levers for Job Quality and Job Access*

❖ **Use in-sourcing or exclusive franchise contracting models to support labor and environmental standards for public services.**

The state has the opportunity to incentivize local jurisdictions to switch to either a municipal or an exclusive contracting model for commercial and residential waste services, and to eliminate open-market waste service systems that have produced low-road jobs and failed to meet waste diversion mandates. The most effective tool for improving both diversion rates and working conditions within the waste industry lies with local governments and their authority and capacity to regulate and monitor the industry.¹⁰⁶ Where waste collection is carried out by private businesses, as it is in the vast majority of municipalities, local jurisdictions can establish exclusive franchise systems to institute and enforce both high-road employment practices and high diversion rates. In an exclusive franchise system, local governments limit participation to a predetermined number of businesses and engage in a bidding process, as illustrated in **Promising Practice #9.1**.

Local jurisdictions can set specific living wage and other labor standards. Alternatively, they can use procurement language to identify best value or best in class contractors by incorporating anticipated workforce outcomes in the criteria they use to rank bidders in competitive solicitations. In this way, local jurisdictions can avoid “lowest bidder” contracting. Companies that rely on being the lowest bid to get contracts often skimp on working conditions, safety, and service to make ends meet, as previously explained.¹⁰⁷

❖ **Use responsible procurement policies for public procurement of large capital equipment and in CalRecycle grant programs.**

Agencies or entities administering climate investment funds can use responsible procurement policies to incorporate workforce outcomes in the criteria they use to rank bidders in competitive solicitations. Awarding agencies can insert this language in solicitations for the procurement of large capital equipment.

CalRecycle provides tens of millions of dollars in grant funds to waste management companies for the development of waste processing centers and to remanufacturing companies for the development of facilities. In order for diversion efforts to be successful, and for job quality to be promoted, local municipalities need to exert more control over waste management systems and businesses. One way for CalRecycle to



ensure waste management systems reduce greenhouse gas emissions and support high-road employers is to limit grant funding to publicly-run waste management systems or to private waste haulers that are operating within an exclusive franchise system. Exemptions could be granted when specific mitigating circumstances are present; for example, for processing facilities in remote locations where there are limited options for local agencies. Ensuring that hiring programs exist for the surrounding communities, as part of the grant program guidelines, would improve access to these jobs. In all cases, if the GGRF is used to build new waste processing facilities, job quality requirements for waste processing workers can be attached.

❖ **Provide technical assistance to agencies implementing climate policy on how and when to apply these demand-side workforce interventions.**

The state can encourage increased diversion and improved employment practices by providing model language to local jurisdictions for contracting under an exclusive franchise system that includes policy levers for high-road employment practices. There is expertise in the state and among advocacy organizations and consulting firms on the development and enforcement of exclusive franchise contracts for waste management services.

❖ **Explore options to address rate increases for waste services due to climate mandates.**

Local jurisdictions must grapple with the need to increase rates for waste services as mandatory commercial recycling and composting are fully implemented, given an increased number of bins to be picked up, an increase in processing requirements, and the investment in facilities that is needed. There is a long-standing practice throughout California of keeping waste management rates as low as possible, while externalizing environmental and social costs. This creates challenges for local jurisdictions that lead the way towards better practices and need more resources to accomplish their goals. The recent opposition to rate increases from residents and businesses in Los Angeles and Oakland are cases in point.¹⁰⁸ Responsible contracting policies that remove low-road actors from the waste sector can help improve service quality, which customers also value; state resources may also be necessary to achieve waste diversion targets and improve outcomes for workers.



b. Supply-Side Workforce Development Strategies

❖ Support the development of high-road training partnerships for contractors of municipal waste services.

High-road training partnerships should be encouraged as more waste workers will be needed in order to achieve mandatory commercial recycling and composting and 75-percent organic waste diversion. High-road training partnerships are collaborations among employers and unions, when they are present, and other partners such as community groups, community colleges, and other training institutions. In this case, high-road training partnerships can be used both to train incumbent workers on waste diversion, and to promote inclusion and advancement of workers from disadvantaged communities into high-quality jobs in waste. Such training partnerships are valuable once family-supporting wages and benefits have already been established; public investment in workforce training will be squandered where low wages and high turnover persist.

The Waste Industry Pre-Apprenticeship and Apprenticeship Program, partially funded by the California Workforce Development Board's High Road Training Partnership initiative, is an industry-led partnership between Waste Management of Alameda County, Civicorps, and the Teamsters union. See **Promising Practice #9.2**. This type of effort, if implemented throughout California, would help ensure enough well-trained drivers, recyclers, and other waste diversion workers to meet the state's targets and improve safety and efficiency in the industry.

B. Other Major Transformations of the Waste Sector

The push toward 75 percent recycling is expected to increase the need for workers at material recovery facilities and other waste processing facilities. Automation is already being tested successfully in this segment of the industry. In the next three to eight years, robots may take over many of the sorting and moving operations currently carried out by humans, bringing new jobs that involve the robot operation and repair, with a need for computer-literate employees. It would likely be difficult for a sorter to transition into working as a robot operator without significant prerequisites being completed prior to retraining. It is much easier for sorters to transition into waste collection jobs, although there are some requirements that can be a barrier, such as possessing a driver's license.

It is unclear how fast automation will advance in the industry or how fast job growth will occur among waste processing workers. Therefore, it is important to monitor the situation: worker displacement is a real risk, if workers are hired in large numbers to meet the state's diversion targets and a rapid increase in automation follows. Given the difficulty that waste processing workers will face in moving to other jobs within the industry, local or state programs that help them transition may be needed.



PROMISING PRACTICE #9.2

Waste Hauling Training and Hiring Program

In Oakland, along with diversion requirements and high-road employment requirements, the city also used an exclusive franchise process to require that its waste contractor, Waste Management of Alameda County, establish a training program for haulers in partnership with local unions and the community organization Civicorps. Through the Waste Industry Pre-Apprenticeship and Apprenticeship Program, local young adults—often adults without a high school diploma and from low-income communities—get training and job placement assistance so they can become unionized waste collection drivers after two years of paid training.¹⁰⁹ Truck driver apprentices earn \$20 an hour, and after two years, they are eligible for union jobs earning \$70,000 annually, with benefits. Civicorps Executive Director Alan Lessik described the initiative as “the only city garbage franchise agreement in the country to include a nonprofit job-training program,” even though such programs can be an essential component of building the waste diversion workforce of the future.

As with improving diversion rates, the key to developing more initiatives like the Civicorps program lies with local jurisdictions and their willingness to engage in a “best value” contracting model that asks more of waste haulers than just low-cost services, including requiring haulers to provide training programs and access to jobs for disadvantaged community members. With this kind of effort from local jurisdictions, more people like Khris Bland can be given an opportunity to succeed. At age 20, Khris had already served a stint in jail and become a father. “I needed a job,” he told the San Francisco Chronicle.¹¹⁰ “I needed to provide.” Seven years later, he has graduated from the pre-apprenticeship program run by Civicorps, is working in Oakland as a paid Waste Management/Teamster apprentice, and is soon to be eligible for full employment with the company. “It’s a career I love,” he said. “And I can send my daughter to college if she wants to go.”



IV. Key Recommendations for the Waste Sector

Exhibit 9.6. Key Recommendations for Waste Sector

| Demand Side |
|---|
| <ul style="list-style-type: none"> ❖ Use in-sourcing or exclusive franchise contracting models to support labor and environmental standards for waste services. ❖ Use inclusive procurement policies for public procurement of large capital equipment and in CalRecycle grants programs. ❖ Provide technical assistance to municipal waste agencies on how to apply inclusive procurement policies and provide model contract language with best practice workforce policy levers and diversion enforcement. ❖ Explore options to address rate increases for waste services due to climate mandates. ❖ Use job impact metrics to measure the impact of waste incentive and investment programs on quantity of jobs, job quality and job access. |
| Supply Side |
| <ul style="list-style-type: none"> ❖ Support the development of high-road training partnerships for contractors of municipal waste services. These should target incumbent worker training for new waste diversion practices as well as creating pipeline programs for the inclusion and advancement of disadvantaged workers. ❖ Implement only where family-supporting jobs have been created. ❖ Track training program outcomes for graduation rates, attainment of industry-recognized credentials, job placement, retention, wages and wage progression |



Endnotes

- 1 Byron Sher, “AB-939 Solid Waste Management, Source Reduction, Recycling, Composting, and Market Development,” Chapter 1095, Statutes of 1989 § (1989), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=198919900AB939.
- 2 Wesley Chesbro, “AB-341 Solid Waste: Diversion,” Chapter 476, Statutes of 2011 § (2011), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB341.
- 3 Ricardo Lara, “SB-1383 Short-Lived Climate Pollutants: Methane Emissions: Dairy and Livestock: Organic Waste: Landfills,” Chapter 395, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383.
- 4 California Department of Resources Recycling and Recovery (CalRecycle), “California’s Climate Strategy: Waste Sector Goals,” April 18, 2019, <https://www2.calrecycle.ca.gov/Publications/Details/1650>.
- 5 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 88.
- 6 California Department of Resources Recycling and Recovery (CalRecycle), “Short-Lived Climate Pollutants (SLCP): Organic Waste Reductions; Proposed Regulation Text,” January 18, 2019, <https://www.calrecycle.ca.gov/docs/cr/laws/rulemaking/slcp/proposedregulations.pdf>.
- 7 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 90. In both requirements, green waste diversion is measured against 2014 as a benchmark year.
- 8 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan.”
- 9 California Department of Resources Recycling and Recovery (CalRecycle), “State of Disposal and Recycling in California for Calendar Year 2016,” August 2017, 6, <https://www2.calrecycle.ca.gov/Publications/Download/1398>.
- 10 California Department of Resources Recycling and Recovery (CalRecycle), 12.
- 11 California Air Resources Board, “Landfilling of Waste,” September 17, 2013, <https://ww3.arb.ca.gov/cc/waste/landfillingofwaste.pdf>.
- 12 Lauren Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits A Blueprint for Cities” (LAANE: A New Economy For All, July 2015), <http://laane.org/wp-content/uploads/2017/06/Cleaning-Up-Waste-1.pdf>.



- 13 Carl Zimring, “The Brutal Life of a Sanitation Worker,” *The New York Times*, February 9, 2018, <https://www.nytimes.com/2018/02/09/opinion/sanitation-workers-deaths-unions.html>.
- 14 Data drawn from: U.S. Department of Labor, Bureau of Labor Statistics, “Quarterly Census of Employment and Wages: Private, NAICS 562 Waste Management and Remediation Services, All Counties in California, 2018 First Quarter, All Establishment Sizes,” accessed July 13, 2018, https://data.bls.gov/cew/apps/table_maker/v4/table_maker.htm#type=2&st=06&year=2018&qtr=1&own=5&ind=562&supp=0.
- 15 Cole Rosengren, “Crackdown on Wage Violations Continues in California Recycling Industry,” *Waste Dive*, May 20, 2016, <https://www.wastedive.com/news/crackdown-on-wage-violations-continues-in-california-recycling-industry/419538/>; Kiera Feldman, “Trashed: Inside the Deadly World of Private Garbage Collection,” *ProPublica*, April 1, 2018, <https://www.propublica.org/article/trashed-inside-the-deadly-world-of-private-garbage-collection>; Partnership for Working Families, “Los Angeles Waste Workers Survey,” unpublished 2015.
- 16 California Department of Resources Recycling and Recovery (CalRecycle), “History of California Solid Waste Law, 1985-1989,” July 27, 2018, <https://www.calrecycle.ca.gov/laws/legislation/calhist/1985to1989>.
- 17 Patricia Wiggins, “SB-1016 Diversion: Compliance: Per Capita Disposal Rate,” Chapter 343, Statutes of 2008 § (2008), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080SB1016.
- 18 Wiggins.
- 19 California Department of Resources Recycling and Recovery (CalRecycle), “Per Capita Disposal and Goal Measurement (2007 and Later),” accessed September 19, 2018, <https://www.calrecycle.ca.gov/lgcentral/basics/percapitadsp/>.
- 20 Das Williams, “AB-1594 Waste Management,” Chapter 719, Statutes of 2014 § (2014), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1594.
- 21 AB 1594 (Williams, Chapter 719, Statutes of 2014) mandated a change in measurement of Daily Cover, which is the dirt or other organic material used to cover layers of landfilled material to control contamination of the surrounding environment. Alternative Daily Cover is recycled material that is used by many cities as a significant portion of their diversion goals. AB 1594 stipulated that Alternative Daily Cover will no longer count toward diversion as of 2020.



| City | Alternative Daily Cover used— tons 2016 |
|---------------|--|
| Fresno | 32 |
| Bakersfield | 15,096 |
| Riverside | 23,391 |
| Santa Ana | 34,049 |
| Sacramento | 45,818 |
| San Francisco | 86,350 |
| Long Beach | 131,553 |
| San Jose | 169,637 |
| Anaheim | 171,168 |
| Oakland | 249,325 |

Source: California Department of Resources Recycling and Recovery (CalRecycle), “Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility,” accessed November 1, 2018, <https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Destination/DisposalByFacility>.

22 California Department of Resources Recycling and Recovery (CalRecycle), “Mandatory Commercial Recycling,” October 23, 2018, <https://www.calrecycle.ca.gov/Recycle/Commercial/>.

23 California Department of Resources Recycling and Recovery (CalRecycle).

24 California Department of Resources Recycling and Recovery (CalRecycle), “Businesses Going Green With Commercial Recycling,” September 27, 2013, <https://www2.calrecycle.ca.gov/Publications/Details/1413>.

25 Rich Gordon, “AB-901 Solid Waste: Reporting Requirements: Enforcement,” Chapter 746, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB901.

26 Wesley Chesbro, “AB-1826 Solid Waste: Organic Waste,” Chapter 727, Statutes of 2014 § (2014), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1826.

27 Chesbro.

28 Kevin McCarty, “AB-876 Compostable Organics,” Chapter 593, Statutes of 2015 § (2015), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB876.

29 Jacqui Irwin, “AB-1045 Organic Waste: Composting,” Chapter 596, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB1045.



30 Michael J. Rubio, “SB-1122 Energy: Renewable Bioenergy Projects,” Chapter 612, Statutes of 2012 § (2012), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201120120SB1122.

31 Mike Gatto, “AB-1900 Renewable Energy Resources: Biomethane,” Chapter 602, Statutes of 2012 § (2012), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201120120AB1900.

32 Ricardo Lara, “SB-605 Short-Lived Climate Pollutants,” Chapter 523, Statutes of 2014 § 39730 (2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB605.

33 Lara, SB-1383 Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills.

34 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 68.

35 U.S. Department of Labor, Bureau of Labor Statistics, “OES Research Estimates by State and Industry,” Occupational Employment Statistics, March 30, 2018, https://www.bls.gov/oes/current/oes_research_estimates.htm.

36 Tellus Institute, “From Waste to Jobs: What Achieving 75 Percent Recycling Means for California” (Natural Resources Defense Council, March 2014), 2, <https://www.nrdc.org/sites/default/files/green-jobs-ca-recycling-report.pdf>.

37 California Air Resources Board, “Overview of the Waste Management Sector Plan: Assembly Bill (AB) 341,” June 18, 2013, https://www.arb.ca.gov/cc/waste/ws_overview.pdf.

38 Data drawn from U.S. Department of Labor, Bureau of Labor Statistics, “Private, NAICS 562 Waste Management and Remediation Services, All Counties in California 2018 First Quarter, All Establishment Sizes Source.”

39 Recycled products fall into a variety of categories within manufacturing and a detailed breakdown of remanufacturing-related subsectors or occupations is beyond the scope of this report.

40 California Department of Resources Recycling and Recovery (CalRecycle), “Proposed Regulation for Short-Lived Climate Pollutants: Organic Waste Methane Emissions; Standardized Regulatory Impact Assessment (SRIA),” n.d., 18, 32, <https://www.calrecycle.ca.gov/docs/cr/laws/rulemaking/slcp/impactassessment.pdf>.

41 California Department of Resources Recycling and Recovery (CalRecycle), “AB 341 Report to the Legislature,” August 28, 2015, <https://www2.calrecycle.ca.gov/Publications/Details/1538>.



- 42 California Department of Resources Recycling and Recovery (CalRecycle), 6.
- 43 Chesbro, AB-1826 Solid waste: organic waste.
- 44 California Air Resources Board, “Short-Lived Climate Pollutant Reduction Strategy,” March 2017, https://www.arb.ca.gov/cc/shortlived/meetings/03142017/final_slcp_report.pdf.
- 45 California Air Resources Board, “Proposed Short-Lived Climate Pollutant Reduction Strategy,” April 11, 2016, <https://www.arb.ca.gov/cc/shortlived/meetings/04112016/proposedstrategy.pdf>.
- 46 Energy Vision, “The Largest Anaerobic Digester in the United States Sets the Green Pace in Perris, California,” n.d., https://energy-vision.org/pdf/CR&R_Project_Profile.pdf.
- 47 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 94.
- 48 Garth Schultz, Principal Owner of R3 Consulting Group Inc., interview with author, June 28, 2018.
- 49 Cascadia Consulting Group, “2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California” (California Department of Resources Recycling and Recovery (CalRecycle), September 10, 2015), 4–6, <https://www2.calrecycle.ca.gov/Publications/Download/1177>.
- 50 California Air Resources Board, “Proposed Short-Lived Climate Pollutant Reduction Strategy.”
- 51 Cassandra Profita and Jes Burns, “Recycling Chaos In U.S. As China Bans ‘Foreign Waste,’” *NPR Moring Edition*, December 9, 2017, <https://www.npr.org/2017/12/09/568797388/recycling-chaos-in-u-s-as-china-bans-foreign-waste>.
- 52 Livia Albeck-Ripka, “Your Recycling Gets Recycled, Right? Maybe, or Maybe Not,” *The New York Times*, May 29, 2018, sec. Climate, <https://www.nytimes.com/2018/05/29/climate/recycling-landfills-plastic-papers.html>; Profita and Burns, “Recycling Chaos In U.S. As China Bans ‘Foreign Waste.’”
- 53 California Department of Resources Recycling and Recovery (CalRecycle), “AB 341 Report to the Legislature,” 13, 16.
- 54 California Air Resources Board and California Department of Finance, “2019 Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds,” March 2019, https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/2019_cci_annual_report.pdf.



- 55 California Department of Resources Recycling and Recovery (CalRecycle), “AB 341 Report to the Legislature,” 7.
- 56 U.S. Environmental Protection Agency, “Anaerobic Digestion Facilities Processing Food Waste in the United States in 2015: Survey Results,” Overviews and Factsheets, US EPA, August 14, 2018, <https://www.epa.gov/anaerobic-digestion/anaerobic-digestion-facilities-processing-food-waste-united-states-2015-survey>.
- 57 California Department of Resources Recycling and Recovery (CalRecycle), “California Anaerobic Digestion Projects (a Partial List, May 2017),” May 2017, <https://www.calrecycle.ca.gov/docs/cr/Organics/conversion/ADProjects.pdf>; available via <https://pdfslide.net/documents/california-anaerobic-digestion-projects-a-partial-list-california-anaerobic.html>.
- 58 Mike Silva, Project Engineer with CR&R, July 24, 2018, interview with author.
- 59 California Department of Resources Recycling and Recovery (CalRecycle), “Organics Grant Program” (CA.gov, July 26, 2018), <https://www.calrecycle.ca.gov/climate/grantsloans/organics>.
- 60 Schultz, Principal Owner of R3 Consulting Group Inc.
- 61 Bonnie Lowenthal, “AB-2675 State Agency: Public Contracts,” Chapter 617, Statutes of 2014 (chaptered September 26, 2014), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2675.
- 62 California Department of Resources Recycling and Recovery (CalRecycle), “AB 341 Report to the Legislature,” 17.
- 63 California Department of Resources Recycling and Recovery (CalRecycle), “Product Stewardship and Extended Producer Responsibility (EPR),” October 23, 2018, <https://www.calrecycle.ca.gov/epr>.
- 64 Cole Rosengren, “LA Sanitation: Lawsuit Will Not Delay RecyclLA Franchise System,” *Waste Dive*, June 15, 2017, <https://www.wastedive.com/news/la-sanitation-lawsuit-will-not-delay-recycla-franchise-system/445024/>.
- 65 East Bay Rental Housing Association, “Oakland Property Owners File Landmark Suit Against City Over \$1.5 Billion Garbage Deal,” June 29, 2016, <https://www.ebrha.com/blog/oakland-property-owners-file-landmark-suit-against-city-over-1-5-billion-garbage-deal/>.
- 66 Scott Smithline, “Reviews of Jurisdiction Mandatory Commercial Recycling and Commercial Organics Recycling Programs” (California Department of Resources Recycling and Recovery (CalRecycle), January 10, 2017), <https://www.calrecycle.ca.gov/docs/cr/Recycle/Commercial/JurisReview.pdf>.



67 Legislative Analyst's Office, "2017-18 Cap-and-Trade Expenditure Plan," August 24, 2017, 8, <http://www.lao.ca.gov/handouts/resources/2017/Senate-Cap-and-Trade-Expenditure-Plan-082417.pdf>.

68 Howard Levenson, "Allocation, Eligibility, Scoring Criteria, and Evaluation Process for the Organics Grant Program (Greenhouse Gas Reduction Fund, Fiscal Year 2017-18)," January 16, 2018, <https://www2.calrecycle.ca.gov/PublicNotices/Documents/8718>.

69 California Department of Resources Recycling and Recovery (CalRecycle), "CalRecycle Awards \$25 Million for Organics Recycling Projects—Communities Get Environmental and Economic Boost from California Climate Investments," July 3, 2018, <https://www.calrecycle.ca.gov/newsroom/2018/07july/16>. The governor's proposed 2018-19 expenditure plan for the GGRF includes \$20 million for CalRecycle, but the California Association of Counties, backed by numerous additional organizations, sent a letter in May 2018 to state legislators requesting that the amount allocated to CalRecycle be increased to \$100 million, citing the need for additional green waste processing facilities to comply with AB 1826 and SB 1383. See California State Association of Counties, "Cap and Trade Expenditures: CalRecycle Funding," May 2, 2018, http://www.counties.org/sites/main/files/file-attachments/2018_support_of_calrecycle_ggrf_funding_may_2_version.pdf.

70 CR&R Environmental Services, "Anaerobic Digestion," accessed September 21, 2018, <http://crrwasteservices.com/sustainability/anaerobic-digestion/>.

71 Energy Vision, "The Largest Anaerobic Digester in the United States Sets the Green Pace in Perris, California."

72 California Department of Resources Recycling and Recovery (CalRecycle), "AB 341 Report to the Legislature."

73 California Integrated Waste Management Board, "Diversion Is Good for the Economy: Highlights from Two Independent Studies on the Economic Impacts of Diversion in California," March 2003, <https://www2.calrecycle.ca.gov/Publications/Download/557>.

74 Tellus Institute, "From Waste to Jobs: What Achieving 75 Percent Recycling Means for California," 2.

75 Chesbro, AB-1826 Solid waste: organic waste.

76 Silva, Project Engineer with CR&R.

77 U.S. Census Bureau, "County Business Patterns (CBP)," accessed October 19, 2018, <https://www.census.gov/programs-surveys/cbp.html>. The following NAICS codes



were combined to arrive at a total number of waste workers in the state, not including hazardous waste, remediation, or landfill workers: 562111 (Solid Waste Collection), 562119 (Other Waste Collection), 562213 (Solid Waste Combustors and Incinerators), 562219 (Other nonhazardous waste treatment and disposal), 562920 (Materials recovery facilities), 562998 (All other miscellaneous waste management services).

78 California Department of Finance, “Gross State Product,” accessed December 7, 2018, http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/.

79 Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities”; U.S. Department of Labor, Occupational Safety & Health Administration, “Green Job Hazards: Waste Management and Recycling”; Recycling Today, “CalRecycle Targets Wage Violators,” March 16, 2015, <https://www.recyclingtoday.com/article/calrecycle-targets-wage-violators/>.

80 Robert Nothoff, Director of Waste and Recycling, Los Angeles Alliance for a New Economy, June 19, 2018 personal interview.

81 Recycling Today, “CalRecycle Targets Wage Violators.”

82 Pew Research Center, “America’s Shrinking Middle Class: A Close Look at Changes Within Metropolitan Areas,” May 11, 2016, <http://www.pewsocialtrends.org/2016/05/11/americas-shrinking-middle-class-a-close-look-at-changes-within-metropolitan-areas/>.

83 U.S. Department of Labor, Bureau of Labor Statistics, “OES Research Estimates by State and Industry.”

84 Teamsters, “Solid Waste and Recycling Division,” accessed January 1, 2019, <https://teamster.org/divisions/solid-waste-and-recycling>.

85 Rosengren, “Crackdown on Wage Violations Continues in California Recycling Industry”; also Feldman, “Trashed: Inside the Deadly World of Private Garbage Collection”; also Partnership for Working Families, “Los Angeles Waste Workers Survey.”

86 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Employment and Wages, May 2017: 53-7062 Laborers and Freight, Stock, and Material Movers, Hand,” March 30, 2018, <https://www.bls.gov/oes/current/oes537062.htm>.; U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Employment and Wages, May 2017: 43-5111 Weighers, Measurers, Checkers, and Samplers, Recordkeeping,” accessed November 5, 2018, <https://www.bls.gov/oes/current/oes435111.htm>.

87 Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities”; U.S. Department of Labor, Occupational Safety & Health Administration, “Green Job Hazards: Waste Management and Recycling”; Recycling Today, “CalRecycle Targets Wage Violators.”



- 88 Recycling Today, “CalRecycle Targets Wage Violators”; Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities.”
- 89 Recycling Today, “CalRecycle Targets Wage Violators”; Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities.”
- 90 Partnership for Working Families, “Los Angeles Waste Workers Survey.”
- 91 California Department of Industrial Relations, “Cal/OSHA Issues Citations for Fatal Waste Collection Truck Accident (News Release No. 2018-77),” September 20, 2018, <https://www.dir.ca.gov/DIRNews/2018/2018-77.pdf>.
- 92 U.S. Department of Labor, Occupational Safety & Health Administration, “Green Job Hazards: Waste Management and Recycling.”
- 93 Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities.”
- 94 Partnership for Working Families, “Los Angeles Waste Workers Survey.”
- 95 Bob Costello, “Truck Driver Shortage Analysis” (American Trucking Associations, October 2017), <http://progressive1.acs.playstream.com/truckline/progressive/ATAs%20Driver%20Shortage%20Report%202017.pdf>.
- 96 Cole Rosengren, “Waste Management’s Bell on the Tough Job of MRF Sorters and Life After China,” *Waste Dive*, March 14, 2018, <https://www.wastedive.com/news/waste-management-brent-bell-head-recycling-life-after-china-mrf-sorters/518844/>.
- 97 Chesbro, AB-1826 Solid waste: organic waste.
- 98 LAANE: A New Economy For All, “Waste & Recycling: Don’t Waste Long Beach,” accessed January 1, 2019, <https://laane.org/blog/campaigns/waste-recycling/>.
- 99 LA Sanitation Solid Resources Commercial Franchise Division and Solid Resources Commercial Franchise Division, “Personal Services Contract between the City of Los Angeles and Arakelian Enterprises, Inc. DBA Athens Services for Exclusive Franchise to Provide Collection, Transfer, Processing, and Disposal Services for Solid Resources to Commercial Establishments and Applicable Multifamily Establishments in the West Los Angeles, North Central and Harbor Zones” (City of Los Angeles Department of Public Works, September 15, 2016), <https://www.lacitysan.org/cs/groups/public/documents/document/y250/mde0/~edisp/cnt014118.pdf>.
- 100 Dean Kuipers, “Los Angeles’ Groundbreaking ‘RecycLA’ Program Dumps the Dump,” *Capital & Main*, June 28, 2017, <https://capitalandmain.com/los-angeles-ground-breaking-recycla-program-dumps-the-dump-0628>.



- 101 Steve Lopez, “We Know L.A.’s New Recycling Program Is a Fiasco, but How’d It Get so Screwed Up?,” *Los Angeles Times*, January 10, 2018, <http://www.latimes.com/local/california/la-me-lopez-recycla-20180110-story.html>.
- 102 David Zahniser, “Two Property Owners Sue Over L.A.’s Recycling Program, Saying It Imposes an Illegal Tax,” *Los Angeles Times*, June 15, 2018, <http://www.latimes.com/local/lanow/la-me-ln-trash-lawsuit-20180615-story.html>; Rosengren, “LA Sanitation: Lawsuit Will Not Delay RecyclA Franchise System.”
- 103 City of San Jose, CA, “Commercial Solid Waste and Recyclable Materials Collection Franchises Agreement Between the City of San Jose and Allied Waste Services of North America, LLC, DBA Allied Waste Services of Santa Clara County,” n.d., http://www3.sanjoseca.gov/clerk/Agenda/20110621/20110621_0701bcon.pdf.
- 104 Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities.”
- 105 City of Maywood, CA, “Chapter 13 - Waste Disposal Worker Retention Ordinance,” accessed November 5, 2018, https://library.municode.com/ca/maywood/codes/code_of_ordinances?nodeId=T4_C13; City of Carson, CA, “Chapter 16: Garbage, Trash, and Weeds, Article 2: Solid Waste Collection Regulations, Section 16-41: Employee Retention/Preferential Hiring/Wage Maintenance,” accessed December 7, 2018, <https://www.codepublishing.com/CA/Carson/?Carson09/Carson09010509.html&?f>; City of Santa Ana, CA, “Chapter 16 - Garbage, Trash and Weeds,” accessed December 7, 2018, https://library.municode.com/ca/santa_ana/codes/code_of_ordinances?nodeId=PTIITHCO_CH16GATRWE_ARTIISOWACORE.
- 106 Ahkiam, “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities.”
- 107 Ahkiam.
- 108 Rosengren, “LA Sanitation: Lawsuit Will Not Delay RecyclA Franchise System”; East Bay Rental Housing Association, “Oakland Property Owners File Landmark Suit Against City Over \$1.5 Billion Garbage Deal.”
- 109 Associated Press, “Program Trains Young Garbage Collectors amid U.S. Shortage,” November 24, 2016, <https://www.cbsnews.com/news/program-trains-young-garbage-collectors-amid-u-s-shortage/>.
- 110 Jill Tucker, “Garbage Collectors in Training Bag Good Jobs,” *San Francisco Chronicle*, May 29, 2018, <https://www.sfchronicle.com/bayarea/article/Garbage-collectors-in-training-bag-good-jobs-12948267.php>.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 10: Water

by Roxane Auer and Holly Myers

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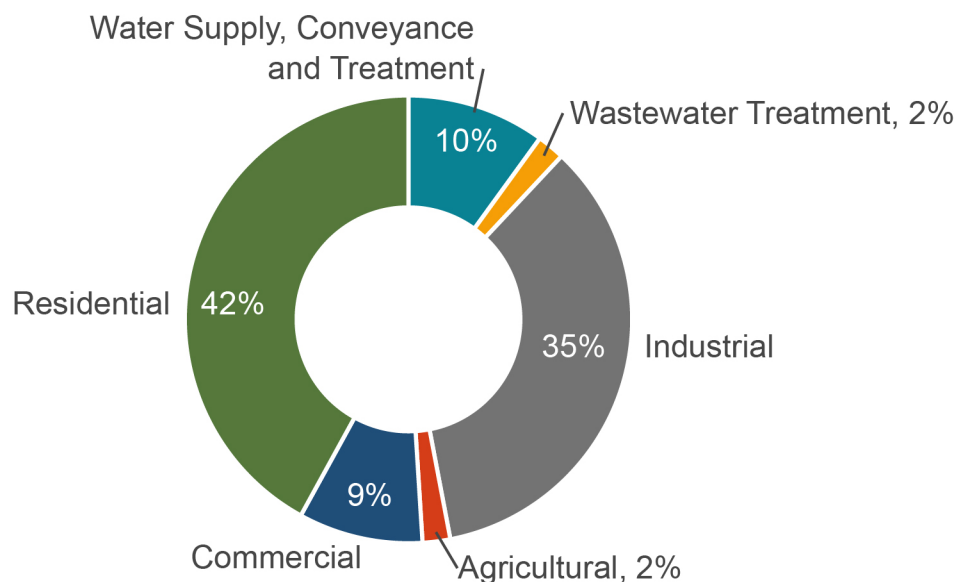


I. Overview of Sector and Key Climate Policies

Water and energy resources are inextricably linked, forming what is referred to as the water-energy nexus. The California water system accounts for 19 percent of the state's total electricity usage, 32 percent of its natural gas consumption,¹ and 10 percent of the state's greenhouse gas emissions.² Water conservation efforts are therefore a key target for climate policy. Saving water saves energy, so conservation in commercial and residential usage and reduction of peak demand has a sizeable impact on energy use and, by extension, emissions. Conversely, as electricity gets cleaner, the water-energy nexus will become less critical to the reduction of emissions.

As illustrated in **Exhibit 10.1**, most of the energy consumed by California's water sector (88 percent) is attributable to residential, industrial, commercial, and agricultural end uses.³ Water supply, conveyance, and treatment accounts for 10 percent, and wastewater treatment for the remaining 2 percent. Supply, conveyance and treatment is the purview of the state's Department of Water Resources, and the vast majority of this agency's climate pollutant emissions (about 98 percent) stem from operations associated with the State Water Project, the world's most extensive system of dams, reservoirs, power and pumping plants, and aqueducts.⁴

Exhibit 10.1. Energy Used by the Water Sector



Source: PPIC Water Policy Center, "Energy and Water" (Public Policy Institute of California, October 2016), http://www.ppic.org/content/pubs/report/R_1016AER.pdf.



Emissions reduction strategies in the water sector are primarily focused on reducing water energy intensity. Energy intensity is a measure of the amount of energy required to take a unit of water from its source to its end user.⁵ Energy intensity varies widely across regions throughout the state, depending on the nature of the source, the method of extraction required, the degree of treatment, and most importantly, the distance and topography between source and end user. Supplying water to Southern California requires approximately 50 times the amount of energy required to supply Northern California because it must be pumped for hundreds of miles and over the Tehachapi Mountain Range.⁶ As a result, Southern California's water energy intensity is roughly triple that of Northern California.⁷

California's rapidly growing population—projected to reach 44 million by 2030⁸—will continue to place pressure on the state's water supply system. As water demand grows, energy demand typically grows at the same rate and in the same regions.⁹ Increased water demand also taxes the state's electricity delivery systems, on which water system reliability depends. The cultivation of the new water supplies that will be needed even with increased conservation efforts, such as water recycling or desalination, will further increase energy demand. Reduced surface water, as during a drought, will also entail an increase in energy usage, due to an increased need for pumping from lower water tables.

This dynamic is further exacerbated by what the California Air Resources Board (CARB) refers to as “the precipitation-population mismatch”¹⁰ between north and south: the fact that Northern California has two-thirds of the state's precipitation, while Southern California has two-thirds of its population.¹¹ Reducing Southern California's reliance on imported water as well as reducing demand across the state through the peak summer months and during periods of drought will thus contribute significantly to reductions in state energy use.

Investment in repairing and upgrading water infrastructure is another important area of focus for improving water-energy efficiency. The state's water infrastructure runs from source to tap and includes drinking water, wastewater, storm water, and water infrastructure systems.¹² These range from traditional “gray” infrastructure (such as pipes, pumps, treatment plants, aqueducts, and levees) to “green” infrastructure (such as rain gardens, watersheds, rivers, lake, ponds, wetlands, and subsurface aquifers), as well as toilets, washing machines, water heaters, and irrigation systems employed by end-users. Some of the best opportunities for water efficiency investments can be found in lower-income areas where water distribution infrastructure may be older or not adequately maintained and where household appliances tend to be older and less efficient.

California has created a comprehensive plan to address both the need for water conservation in a period of growing demand and the need to support the state's climate mitigation efforts.¹³ It is employing multiple strategies to achieve these ends, including:



implementing new conservation targets for agricultural, urban, industrial, and recycling usage standards; promoting water utility efficiency through new reporting standards for system water losses; increasing water savings by certifying innovative technologies for water conservation; requiring updated agricultural and urban water management plans; developing a voluntary registry for greenhouse gas emissions; and continuing to increase the use of renewable energy to operate California's State Water Project (which encompass state-operated water utilities, dams, and pipelines).

The following key policies mentioned in the Scoping Plan affect the water sector:

❖ Water Conservation

➤ **The Water Conservation Act of 2009 (Senate Bill X7-7, Steinberg, Chapter 4, Statutes of 2009)¹⁴**

SB X7-7 established a requirement for a 20-percent reduction in urban per capita water use by December 31, 2020.¹⁵ The bill also promoted the expansion of sustainable water supplies and required agricultural water management plans and new and more efficient management practices for agricultural water suppliers. The State Water Resources Control Board (SWRCB) and Department of Water Resources (DWR) are currently working on stronger water-use efficiency standards that build on SB X7-7. Existing standards that help achieve the water conservation target include appliance efficiency standards, such as those mandated by the California Energy Commission (CEC) for low-flush toilets (state codes set under Title 24 and 20).

➤ **Executive Order B-37-16**

Signed in 2016, this order directs five state agencies to: 1) develop and implement new water-use targets beyond the existing target (established in SB X7-7) of a 20-percent reduction in urban per capita water use by 2020, and 2) establish a long-term water conservation framework. The new targets will strengthen standards for indoor and outdoor irrigation, commercial, industrial, and institutional water. This includes setting performance standards to address water system leakage, increasing the use of renewable energies in water production, establishing new appliance standards, and certifying new technologies for water conservation and energy efficiency. Additional recommendations made in the executive order that will require legislative authorization to be implemented include strengthening urban water shortage contingency plans, improving drought planning for small water suppliers and rural communities, and updating agricultural and urban water management plan requirements.



➤ **Senate Bill 555 (Urban Retail Water Suppliers; Wolk, Chapter 679, Statutes of 2015)¹⁶**

Passed in October 2015 to reduce water loss, SB 555 requires urban retail water suppliers to submit independently audited and certified water loss reports annually as prescribed by rules issued by the DWR. The DWR posts the reports to allow the public to make comparisons between suppliers, informing consumer choice and helping to hold bad actors accountable. The bill also requires the DWR to provide technical assistance to help urban retail suppliers improve their water loss detection programs and requires the SWRCB to adopt new rules mandating performance standards for water suppliers to reduce the volume of water losses.

➤ **Recycled Water, Stormwater Capture, and Building and Landscaping Standards (Assembly Bill 2282, Gatto, Chapter 606, Statutes of 2014)¹⁷**

Health and Safety Codes 17921.5 and 18940.6, as amended by AB 2282 in September 2014, directed the California Department of Housing and Community Development (HCD) and the California Building Standards Commission (BSC) to conduct research during the 2016 Intervening Code Cycle to assist in development of mandatory green building standards for the installation of recycled water systems for newly constructed single-family and multifamily residential buildings and non-residential buildings. The timeline for the adoption, given the 2016 Intervening Code Adoption Cycle, would make the standards effective for applicable new construction beginning July 1, 2018.

➤ **Landscaping (Executive Order B-29-15 and Assembly Bill 2515, Weber, Chapter 576, Statutes of 2016)¹⁸**

In California, about half of urban water is used for landscape irrigation. Substantial water savings can therefore be gained by proper landscape design, installation, and maintenance. Executive Order B-29-15 calls for the DWR to update the Model Water Efficient Landscaping Ordinance (MWELO) to promote efficiencies in new development and retrofitted urban landscaping through new rules mandating more efficient irrigation systems, graywater usage and onsite stormwater capture, as well as by limiting the portion of landscapes that can be covered in turf.¹⁹ AB 2515 requires the DWR, on or before January 1, 2020, and at least every three years thereafter, to either update the MWELO or make a finding that an update is not needed.

➤ **Recycled Water Policy**

Adopted by the SWRCB in 2009, this policy set the goals of: 1) increasing the use of recycled water beyond 2002 levels by at least 1 million acre-feet per year (AFY)



by 2020 and at least 2 million AFY by 2030; 2) increasing the use of stormwater beyond use in 2007 by at least 500,000 AFY by 2020 and by at least 1 million AFY by 2030; 3) increasing the amount of water conserved in urban and industrial uses in comparison to 2007 by at least 20 percent by 2020; and 4) substituting of as much recycled water for potable water as possible by 2030. Water recycling has the potential to reduce greenhouse gas emissions if it replaces—and not merely serves as an alternative to—an existing, higher-carbon water supply.

➤ **California Green Building Standards Code**

This state-adopted green building code, commonly known as the “CALGreen Code,” was the first in the nation. Originally published in 2008, it sets goals for environmentally friendly building materials, energy efficiency, and water conservation. Regulations contain mandatory and voluntary building standards for the reduction of indoor and outdoor water use for residential and commercial construction.

➤ **Sustainable Groundwater Management Act (Senate Bill 1168, Pavley, Chapter 346, Statutes of 2014;²⁰ Assembly Bill 1739, Dickinson, Chapter 347, Statutes of 2014;²¹ Senate Bill 1319, Pavley, Chapter 348, Statutes of 2014²²)**

The most significant legislative water initiative enacted in California in the past half-century by some estimates,²³ this act consists of three bills that require local public agencies and groundwater sustainability agencies (GSAs) in high- and medium-priority basins to develop and implement groundwater sustainability plans (GSPs)—essentially road maps for how groundwater basins will reach long-term sustainability.²⁴ The DWR defines sustainable groundwater management as “the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results,” such as a chronic lowering of groundwater levels or storage levels, significant seawater intrusion, degraded water quality, or depletions of surface water.²⁵ The act does not specify emissions-related standards or goals. The DWR has developed regulations governing the content of GSPs,²⁶ and local stakeholders have until 2022 (or 2020 in critically over-drafted basins) to develop, prepare, and begin to implement them. GSAs will have until 2040 to achieve groundwater sustainability. The act also enhances local management of groundwater; establishes minimum standards for effective, continuous management of groundwater; provides local groundwater agencies with authority and technical and financial assistance to maintain groundwater supplies; helps minimize impacts of land subsidence; improves data collection; increases groundwater storage; and removes impediments to recharge.



❖ Greenhouse Gas Emissions Reduction and Increased Reliance on Renewable Energy

➤ Department of Water Resources Climate Action Plan

The DWR is reducing its environmental impacts and leading by example through its approved, department-wide Climate Action Plan. The vast majority of the DWR's climate pollutant emissions (about 99 percent) stem from operations associated with the State Water Project (SWP), the state's extensive system of dams, reservoirs, power and pumping plants, and aqueducts.²⁷ The SWP's operations account for around 10 percent of the total energy consumed by California's water sector; most of the rest (88 percent) goes to residential use.²⁸ The first phase of the Climate Action Plan is a Greenhouse Gas Emissions Reduction Plan, which guides project development and decision making with respect to energy use and greenhouse gas emissions, with the goal of 50 percent below 1990 levels by 2020 and 80 percent below 1990 levels by 2050. The DWR has identified 11 greenhouse gas emissions reduction measures that it will implement to meet these goals, including: the termination of DWR participation in and associated delivery of electricity from a coal-fired power plant (the Reid Gardner Power Station); the purchase of a greater proportion of its energy from renewable sources; the development of renewable energy generation on buildings and lands that it owns; efficiency improvements for the State Water Project and other existing DWR facilities; the purchase and development of renewable and high-efficiency electricity supplies; comprehensive improvements to DWR construction practices; and improvements to DWR business activities. The DWR currently operates five hydroelectric generating plants and four hybrid pumping/generating plants, making it the fourth-largest producer of energy in the state.²⁹ It also purchases power from outside sources. The majority of this power—81 percent, as of 2016—comes from renewable sources, including solar, hydro, geothermal, and landfill gas; the remainder comes from a high-efficiency natural-gas-fired power plant in Lodi, in which the DWR has a partial ownership interest.³⁰ As of 2014, DWR carbon emissions were already approximately 30 percent below 1990 levels.

➤ Short-Lived Climate Pollutant Strategy

The California Air Resources Board (CARB) Short-Lived Climate Pollutant Strategy was established under Senate Bill 605 (Lara, Chapter 523, Statutes of 2014)³¹ and Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016)³² and approved in March 2017. SB 605 required CARB to develop a plan to reduce emissions of short-lived climate pollutants (SLCPs). SB 1383 required CARB to begin implementing the plan by January 1, 2018. SB 1383 also set targets



for statewide reductions of SLCPs from 2013 levels by 2030; specifically, a 40-percent reduction of methane and hydrofluorocarbons, and a 50-percent reduction of anthropogenic black carbon. The CARB plan also includes new measures to reduce methane from wastewater treatment plants.

➤ **Renewable Energy Self-Generation Bill Credit Transfers (RES-BCT)**

Established by Assembly Bill 2466 (Laird, Chapter 540, Statutes of 2008)³³ and effective as of January 1, 2009, RES-BCT allows local governments—including water agencies—to generate energy from an eligible renewable generating facility for their own use and to export energy not consumed to the electrical grid. The exported energy is converted into bill credits that are applied to eligible benefiting accounts as designated by the local government. Under the legislation, local water and wastewater utilities can develop distributed renewable energy where feasible, using the expanded Local Government Renewable Energy Self-Generation Bill Credit tariff and new net energy metering (which allow for installation without system size limit).

II. Industries and Occupations Affected

The California water system encompasses an elaborate infrastructure designed to facilitate the capture, use, conveyance, storage, conservation, and treatment of water and wastewater across multiple sectors: industrial, commercial, agriculture, and residential. Key players in the system include interrelated government entities at the state, regional, county, and city level as well as regulators, elected leaders, private and public (often municipal) water suppliers, and perhaps most importantly, end users who drive demand. Within this sector, distinct subsystems are responsible for different functions, including the handling, movement, and treatment of drinking water; the construction, operations, and maintenance of water infrastructure; wastewater treatment; flood control; capture of run-off; and standard setting for irrigation control and appliance efficiency.

The water sector as a whole spans numerous industries, encompassing anyone employed in the design, construction, management, or governance of California's multiple water infrastructure systems, including drinking water, wastewater, storm water, and green infrastructure, such as green roofs and rain gardens. Green infrastructure generally refers to systems and practices that use natural landscapes and processes to manage storm water.³⁴ While precise estimates would be difficult to formulate given the complexity entailed in this span, it would be safe to say that the principal industries affected by the climate policies considered here are the utilities and construction industries.



A 2018 Brookings report on water workers nationwide—the most comprehensive workforce analysis available to date—identifies 212 individual occupations in the sector across seven industries at the four- to five-digit NAICS code level.³⁵ The primary industries are utilities and construction, though consulting services, remediation and waste management services, and government are also included. The largest occupation by employment, representing roughly one-fifth of the water-sector workforce—more than double the employment of the next ranking category—is plumbers, pipefitters, and steamfitters, followed by construction laborers (roughly 9 percent) and water and wastewater treatment plant and system operators (roughly 7 percent). Some of these occupations can be found in multiple industries. By the Brookings calculations, around 17 percent of all water workers nationwide are employed in the utility industry. See **Exhibit 10.2** for a list of the major occupations in the water sector.

Exhibit 10.2. Top 10 Occupations in the Water Sector Nationwide³⁶

| Occupation | Total Employment | % of Water Workforce | % in Utility Industry |
|---|------------------|----------------------|-----------------------|
| Plumbers, Pipefitters, and Steamfitters | 324,500 | 19.4% | 4.0% |
| Construction Laborers | 149,513 | 8.9% | 1.7% |
| Water and Wastewater Treatment Plant and System Operators | 115,840 | 6.9% | 88.5% |
| Operating Engineers and Other Construction Equipment Operators | 79,900 | 4.8% | 3.2% |
| Heating, Air Conditioning, and Refrigeration Mechanics and Installers | 70,811 | 4.2% | NA* |
| First-Line Supervisors of Construction Trades and Extraction Workers | 56,021 | 3.3% | 3.3% |
| Office Clerks, General | 47,602 | 2.8% | 20.3% |
| Helpers—Pipelayers, Plumbers, Pipefitters, and Steamfitters | 46,510 | 2.8% | 1.7% |
| Heavy and Tractor-Trailer Truck Drivers | 38,548 | 2.3% | 4.0% |
| Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 35,141 | 2.1% | 20.1% |

* There are fewer than 250 workers from this occupation employed in the utility industry.

Source: Joseph Kane and Adie Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity” (The Metropolitan Policy Program at Brookings, June 2018), <https://www.brookings.edu/research/water-workforce/>.



State-level employment numbers are more difficult to determine due to the smaller scale of the pool and the wide spread across industries. The Brookings report calculates water employment for 10 California metropolitan areas, though not for the state as a whole.³⁷ The combined total for those areas is 142,806 workers, or 1 percent of total employment. The highest concentration is in the Los Angeles area, which at 53,424 is more than double that of the next-ranking metro, San Francisco (23,959).

Water efficiency programs also impact plumbing and construction occupations. A 2011 study by the Economic Roundtable analyzed \$1.2 billion of investment in water efficiency projects in the Los Angeles area—a total of 53 projects—charting the impact across 12 industries.³⁸ It found that the vast majority of impact was in the construction industry (83.3 percent), followed by professional services (11.5 percent). Water conservation projects, the study notes, “have particularly high multiplier effects for local manufacturing, professional services, utilities and wholesaling establishments, along with local environmental organizations, recreation sites, museums, and parks.”

III. Workforce Issues in Key Subsectors and Policies

The following section addresses the workforce issues embedded in the major climate policy areas in the water sector: water conservation and water agency emissions reductions. For each subsector, the analysis describes the relevant climate policies, examines the available evidence on workforce outcomes, and identifies additional workforce policy levers that implementing agencies can use to create good jobs and increase the demand for skilled labor. It also highlights opportunities to develop and leverage the state’s training and education infrastructure to prepare workers for the sector’s climate-driven labor market changes.

A. Water Conservation

Moving to bolster California’s climate and drought resilience and build on temporary statewide emergency conservation efforts, Governor Jerry Brown signed Executive Order B-37-16 in May 2016. The executive order tasked state agencies with establishing a long-term framework for water conservation and drought planning and set forth a list of actions to help California make smarter decisions about water use. These measures include scheduled water-use reporting by water utilities, new urban water-use targets, reducing system leaks, permanently eliminating wasteful practices, strengthening urban drought planning, and improving agricultural water management.³⁹ The executive order directed five state agencies—the California Department of Water Resources (DWR), the



State Water Resources Control Board (SWRCB), the California Department of Food and Agriculture (CFDA), the California Public Utilities Commission (CPUC), and the California Energy Commission (CEC)—to create a framework for implementing the order. Some of the measures recommended by these agencies could be implemented based on existing state administrative authority, others required new statutory authorization.

SB 555, one of the new legislative measures to emerge from the executive order, sets one of the toughest water loss control reporting standards in the nation.⁴⁰ Passed by the state legislature in October 2015, the bill requires water utilities to submit independently verified and certified water loss audits to the DWR. SB 555 also requires the SWRCB to adopt new rules no later than July 1, 2020, that will mandate performance standards for water suppliers to reduce the volume of water losses, including standards for equipment replacement and new infrastructure to address leakage.⁴¹ It also specifies that compliance with the Urban Water Management Planning Act is a prerequisite to receiving state funding for water projects and programs.⁴²

The executive order clears the way for California to become the first state in the nation to set mandatory indoor and outdoor water-use efficiency targets. On May 31, 2018, Governor Brown signed into law two new bills (Senate Bill 606, Hertzberg, Chapter 14, Statutes of 2018⁴³ and Assembly Bill 1668, Friedman, Chapter 15, Statutes of 2018⁴⁴) that will require urban water providers throughout California to set new permanent water-use targets for their service areas by 2022. These bills also establish a framework for implementing and enforcing the new water-use requirements, including: 1) a standard for indoor residential water use of 55 gallons per person per day, dropping to 50 gallons by 2030; 2) new standards for outdoor residential water use based on community climate and landscaped area; and 3) a new standard for water loss due to leaks in water system pipes. These three standards together will be used to calculate overall water-use targets for individual water providers. The State Water Board can fine providers that do not meet their targets up to \$1,000 per day during non-drought years and \$10,000 per day during drought emergencies.⁴⁵

These new measures are part of the broader, multifaceted implementation of the California Water Action Plan, which creates a roadmap for sustainable water management in California.⁴⁶

The Water Action Plan provided the foundation for Prop. 1, the \$7.5-billion water quality and supply bond measure passed in 2014, and the state administration's legislative agenda on water, including groundwater legislation and new mandates for reduced residential and agricultural usage levels.⁴⁷ These and other new water management measures recently passed by the state legislature are still in the implementation phase and have had few discernible labor impacts to date. But they set the stage for significant new investment in state water infrastructure.

These sustainable water conservation and use policies—along with efforts to reduce greenhouse gas emissions—have begun to promote the management of water and



energy in tandem. There is good reason for this twin focus, since continued population growth and disruptions in water supplies caused by a changing climate will place increasing pressure on both water and energy supplies. To meet the challenge, some state programs have provided grants to help pilot new technologies⁴⁸ and programs for water and energy efficiency programs,⁴⁹ and the CPUC is working with utilities to quantify energy savings from water conservation.⁵⁰ In addition, allocations from the Greenhouse Gas Reduction Fund (GGRF) have been used to lower water usage rates.⁵¹

To date, more than \$180 million has been allocated from the state's GGRF to promote water and water-energy use reductions, which includes the following:

- The DWR's Water-Energy Grant Program has provided \$70 million in funds from the GGRF to implement water efficiency programs.⁵² The goal of the program is to reduce greenhouse gas emissions as well as water and energy use by funding commercial and institutional water-energy efficiency projects, residential water-energy efficiency projects, and projects benefiting disadvantaged communities.⁵³ Expected project benefits include savings of more than half a billion gallons of water; a reduction in greenhouse gas emissions by 67 MMTCO₂e (million metric tons of carbon dioxide equivalents); the removal of 170,000 acres of grass; and the installation of thousands of new and more efficient faucets, toilets, washing machines, showerheads, water heaters, and sprinklers.⁵⁴
- The State Water Efficiency Enhancement Program (SWEEP), administered by the California Department of Farm Administration (CDFA), has been awarded \$68 million⁵⁵ to provide financial grants for new farm irrigation systems that reduce greenhouse gas emissions and help save water. So far, the program has funded nearly 600 projects covering 109,000 acres that promote initiatives such as soil moisture monitoring, the installation of low-pressure irrigation, and technology to promote renewable energy on farms.⁵⁶ These initiatives have saved an estimated 31 billion gallons of water and reduced CO₂ emissions by 74,130 metric tons.
- The Department of Fish and Wildlife has so far been allocated \$30 million for wetland and watershed restoration.⁵⁷
- Transformative Climate Communities, a program of the California Strategic Growth Council, awarded \$140 million to help fund the development and implementation of neighborhood-level community plans to reduce greenhouse gas emissions and the deliver local economic, environmental, and health benefits for disadvantaged communities.⁵⁸ Some of the projects include water-energy efficiency as plan components.⁵⁹

These programs are a small down payment on the public investments required to achieve needed gains in water-use efficiency, which are estimated not in the millions, *but in the tens of billions*. Such investments can take many forms, such as storm water capture and treatment infrastructure, groundwater treatment equipment and recharge



systems, graywater systems for homes, sub-metering for multifamily housing, water desalinization facilities, indoor appliance/fixture retrofit campaigns, landscaping and ecosystem restoration, and irrigation system evaluation and repair. The initial focus in the implementation of the executive order and the Water Action Plan has been on setting new usage targets, standardizing data reporting and management planning, and supporting the development of new technology. The next phase of the Water Action Plan, to be laid out in a final report that will be released before the end of 2018,⁶⁰ makes modernizing and rehabilitating water resource management systems a key priority and calls on the state legislature, in concert with the other agencies and stakeholders, to develop a strategy to provide sufficient and sustainable funding to meet that need.⁶¹

Historically, the annual investment in the state's water system has been significant. Between 2005 and 2015, the average total investment in capital and ongoing expenditures by local, state, and federal agencies was approximately \$30 billion per year.⁶² Capital expenditures alone averaged approximately \$5 billion per year, with the majority of the funds (85 percent) coming from local agencies. However, shortfalls are not uncommon. For example, the state has a funding gap of \$2-3 billion per year in water and flood management.⁶³

According to a working draft of the Water Action Plan released in 2018, California's total integrated water management funding need, across all levels of government, is an estimated \$365 billion over the next 50 years.⁶⁴ If current funding levels are maintained, there will be a funding gap of more than \$175 billion over that period. The Water Action Plan estimates that the state's share of funding required just to implement the plan's recommended actions—not to meet the total need outlined above—equates to around \$2 billion per year over the next 50 years. Funding mechanisms have not yet been determined but could include: maximizing state GGRF funding for water infrastructure investment projects; allocating additional money from the state general fund; introducing further state ballot initiatives to gain voter approval for new bond issuances; and novel funding mechanisms such as private/public investment partnerships.

Such a large investment in state water infrastructure would have a significant impact on employment, creating tens of thousands of new jobs.⁶⁵ A significant share of these jobs would be middle-class, family-sustaining positions in construction and water utility operations and management.⁶⁶

Under the plan, California would provide financial incentives for major rehabilitation, replacement, and construction of new facilities that both promote modernization of water and flood-related infrastructure, including natural infrastructure and ecosystem restoration, and support statewide water resource management systems and modernization of the system's operations and maintenance.⁶⁷ These incentives could provide the state with a significant lever to ensure better workforce outcomes for workers employed in the California water sector.



1. Workforce Outcomes

a. Job Growth

Labor impacts from the state’s water conservation initiatives remain largely unknown at this point. As discussed above, many of the state’s water strategies remain in the standard-setting, data-collection, implementation, or pilot phase. In some cases, their impact on state employment to date has been minimal, and in others, any job growth associated with these policies has yet to be captured at the state level.

The potential for job growth, however—particularly with water efficiency measures—is significant. At the regional level, a 2011 study published by the Economic Roundtable found that an investment of \$1.2 billion in water-use efficiency projects in the Los Angeles region provided an estimated 8,654 direct job-years of employment.⁶⁸ The majority of the direct jobs created (81.3 percent) were in the construction industry; 11.5 percent were in the legal, architectural, scientific, and technical services industry; and 2.7 percent in utilities. The remainder were primarily in the government sector, manufacturing, and excavation and mining (each less than 2 percent).

On the basis of this evidence, the study estimates that an investment of \$1 million in the five types of water-use efficiency projects it identifies—water conservation, graywater systems, groundwater management, recycled water, and stormwater—will generate between 6.6 to 9.4 direct jobs in the Los Angeles economy.⁶⁹ This estimate equates to more jobs per \$1 million invested than motion picture and video production or housing construction as well as commercial construction or utility systems construction, in some cases, though the wages are generally lower (see **Exhibit 10.3**).

Exhibit 10.3. Job Impacts of Water-Use Efficiency Projects per Million Dollars Invested, Los Angeles

| Project Type | Direct Jobs Stimulated | Average Wages |
|--------------------|------------------------|---------------|
| Water Conservation | 9.1 | \$37,558 |
| Graywater Systems | 9.4 | \$33,286 |
| Stormwater | 6.6 | \$52,828 |
| Groundwater | 6.8 | \$50,001 |
| Recycled Water | 6.6 | \$49,092 |

Source: Patrick Burns and Daniel Flaming, “Water Use Efficiency and Jobs” (Economic Roundtable, 2011), https://economicrt.org/wp-content/uploads/2011/12/Water_Use_Efficiency_and_Jobs_2011.pdf.



While these estimates are not directly comparable to the state-level investments under discussion here, they offer a framework for a rough calculation. The 2018 update of the California Water Action Plan estimates that modernizing and rehabilitating water resource management systems across the state will require \$102.5 billion in capital investment plus \$43.6 million per year in ongoing funding over the next 50 years—a total of roughly \$104.7 billion over 50 years, or \$2.1 billion per year.⁷⁰ Extrapolating the Economic Roundtable’s localized estimates to this per-year total would result in the creation of between 13,860 and 19,110 direct jobs per year. This calculation relies on at least two major assumptions: that the ratio of jobs created per \$1 million of investment in Los Angeles would be roughly equivalent on the state level; and that the jobs required for the modernization and rehabilitation of water resource management systems, as conceived in the plan, would be roughly equivalent—or similar—to those required in energy efficiency projects.

b. Job Quality

Given the wide variety of occupations covered by the water sector, the quality of jobs created by the state’s investment in water infrastructure and water conservation strategies varies considerably. On the whole, however, these jobs tend to pay well and many, particularly in construction and operations, provide opportunities for career advancement. According to the 2018 Brookings study, “Water occupations not only tend to pay more on average compared to all occupations nationally, but also pay up to 50 percent more to workers at lower ends of the income scale.”⁷¹ Workers at the 10th and 25th percentiles of this spectrum nationwide earn hourly wages of \$14.01 and \$17.67, respectively, as compared to \$9.27 and \$11.60 at the same percentile for all U.S. workers.

In California’s metro regions, the wages are even higher. In Fresno, which has the lowest wages of the 10 cities profiled by the 2018 Brookings study, water workers at the 10th and 25th percentiles made \$14.07 and \$17.32, respectively.⁷² In San Jose, the highest paying city, they made \$19.81 and \$25.81—more than double the wages of all U.S. workers. In the 75th percentile, California water workers made as much as \$36.38 (Los Angeles), \$42.77 (San Jose), and \$43.11 (San Francisco).

Slightly less than one-fifth of water workers—17.5 percent in the United States as a whole, 17 percent in California metro regions—are employed directly by public utilities.⁷³ As mostly unionized public-sector employees, these workers receive decent benefit packages that include health insurance and retirement benefits. The blue-collar occupations that predominate in this sector include: meter readers (98.4 percent of whom are utility employees nationwide); water and wastewater treatment plant system operators (88.5 percent); industrial machinery mechanics (75.3 percent); maintenance and repair workers (53.4 percent), and electricians (42.8 percent). Many of these occupations have certified apprenticeship programs in place. An apprenticeship for water treatment plant operators is available through IUOE Stationary Engineers, Local 39, in



San Francisco.⁷⁴ There are also numerous apprenticeships available for electricians, machinery mechanics, and maintenance mechanics across the state.⁷⁵

The skilled jobs in water utilities generally earn wages at or above the averages for all water workers listed above. A 2016 study by Jewish Vocational Service (JVS), examining career opportunities in the water and wastewater industry in the Bay Area found these types of jobs paid annual salaries ranging from \$70,000 to \$96,000 a year at the journey level. It is worth noting that the majority of California's water systems, excluding small systems like mobile home parks and housing developments, are operated by municipal and public agencies.⁷⁶

Professional and technical water workers employed primarily by utilities include lawyers, architects and landscape architects, surveying and mapping technicians, civil engineering technicians, compliance officers, and managers.⁷⁷ By and large, these jobs are both well paid and well trained.

The majority of water workers—more than 80 percent—are employed outside the utility industry, in private firms in a variety of industries. Most of the blue-collar jobs at this end are construction jobs, including: carpenters, construction laborers, construction equipment operators, and truck drivers. Plumbers, pipefitters, and steamfitters (considered a single occupational category) represent the largest portion of all water workers nationally: 19.6 percent (22.4 percent when combined with plumbers, pipefitters, and steamfitters helpers). Professional and technical jobs in the non-utility arena are generally not construction related. These include sales representatives, management analysts, purchasing agents, bookkeepers, accountants, environmental engineers, and software developers.

The wages among these predominantly non-utility construction occupations are roughly equivalent to those of blue-collar utility workers. The construction labor market in California, however, is highly bifurcated, plagued at the bottom by the underground economy and served at the top by the best training system in the state, with certified apprenticeships. Construction funded by public agencies such as local water utilities generally, but not inevitably, supports quality jobs.

Construction is also an industry where workers with less formal education can gain skills that allow them to earn family-supporting wages. Fewer than 10 percent of construction workers have college degrees.⁷⁸ Construction sectors that use state-certified apprenticeships can help workers with low educational attainment get on a career ladder that leads to significantly higher wages (see Chapter 3).⁷⁹ A journey-level operating engineer working in the Los Angeles area can earn more than \$46 an hour.⁸⁰

Some of the occupations at the lower end of the wage spectrum in the non-utility water sector include landscaping and grounds-keeping workers. Nationwide, workers in these occupations can earn less than \$10 an hour. The 10th-percentile average wage for landscaping and grounds-keeping workers, for instance, is \$9.21 an hour. In many cases, however, these workers are employed by vendors who have agreements with municipal



or other public agencies to maintain landscaping on publicly funded projects, such as rain gardens. In those instances, government procurement offers an opportunity to improve wages in firms contracting with public agencies.

c. Job Access

While some segments of California’s water sector produce well-paid jobs, prospective workers can face significant barriers to entry. Lack of relevant work experience is one potential barrier. The Brookings analysis found that a majority of water workers—53 percent—have a high school diploma or less, which suggests few formal educational barriers to entry.⁸¹ Instead, employers place a premium on experience, preferring to hire workers who are already familiar with the necessary tools and technologies. The study also found that more than two-thirds of water workers needed at least one year of related work experience to get a job, and 16 percent need four years or more.

In addition, water workers tend to be older and significantly less diverse than the U.S. workforce as a whole. Eighty-five percent of the U.S. water workforce is male, according to the Brookings study, and 72 percent of workers employed by water utilities are white.⁸² In many water occupations—particularly in construction—women are a vanishingly small percentage of the workforce. Only 1.4 percent of plumbers, pipefitters, and steamfitters are women, for example. Asian and African American workers were also underrepresented, comprising 12 percent of the water workforce, as compared with 18 percent of the U.S. workforce as a whole. The water workforce is also aging, with a significant portion expected to retire within the next few years.

The construction industry also offers great opportunities to incorporate training and career ladders for entry-level workers. Construction is one of the few industries in which someone with little formal education can gain the skills that lead to higher family-sustaining wages. Construction Careers Policy (CCP), a Los Angeles-area initiative, is a contracting approach that includes targeted hiring provisions for certain designated populations that can be based on income, geography, or historic barriers to entry, such as those experienced by military veterans or the formerly incarcerated (See Chapters 2 and 3).⁸³ It has been embraced by the City of Los Angeles and the Los Angeles County Board of Supervisors on multi-billion-dollar construction projects at the Port and on the Metro line. CCP has covered tens of thousands of jobs on \$12.3 billion worth of Los Angeles-area infrastructure projects since 2008⁸⁴ and could similarly be applied to needed water infrastructure improvements around the state. New workers on CCP projects gain valuable on-the-job training through apprenticeship training programs. The Los Angeles Building and Construction Trades Council has sought to further bolster the career ladder with its Multi-Craft Core Curriculum, partnering with local community and educational groups to offer standardized, comprehensive apprenticeship readiness programs. See Chapter 3 for a description of pre-apprenticeship and apprenticeship.

One training initiative directly related to the policies under consideration here was launched by the State Water Resources Control Board (SWRCB) in January 2016.



SWRCB allocated \$3.2 million for the California Water Loss Collaborative, which executed a Technical Assistance Program (TAP) and Water Audit Validator (WAV) Certificate Program to aid water suppliers in producing validated water audits, helping to ensure compliance with SB 555.⁸⁵ Modeled in part on a successful statewide initiative in Georgia, the TAP was made available to utilities at no cost in 2016 and 2017 and was conducted via a series of workshops and teleconferencing sessions between utility employees and water auditing experts. It trained more than 1,500 incumbent water utility employees and completed more than 400 Level 1 validated water audits, providing the necessary water audit review for 93 percent of the legislatively mandated suppliers. The SWRCB subsequently partnered with the California-Nevada American Water Works Association (CA-NV AWWA) to develop the WAV Certificate Program, an auditor validator training certification program aimed at increasing the availability of qualified validators in California. This program was due to be launched in 2018.

As the state continues to implement mandates that require water suppliers to meet lower water-use targets, efforts to promote water efficiency will increase. Some of the best opportunities to make conservation and water efficiency gains are to be found in the lower-income areas of the state where water distribution infrastructure has been inadequately maintained or updated and where household and commercial appliances tend to be older and less efficient. In the 1990s, the Los Angeles Department of Water and Power (LADWP) pioneered a community-based organization (CBO) model for promoting ultra-low-flush toilet installation.⁸⁶ LADWP teamed up with local nonprofits, including the Korean Youth Community Center, the Watts Labor Community Action Committee, and ADVANCE, to canvas residents of Hollywood and southwest Los Angeles to offer the delivery of free new toilets that significantly reduced water use and helped lower the cost of monthly utility bills. Working with the CBO helped the city replace more than two million toilets and also created employment opportunities in communities with high unemployment rates. Such a program could be improved moving forward with the introduction of a viable career pathway into union utility jobs, much in the same way as the Utility Pre-Craft Training Program has done for weatherization work (See Chapter 6 on low-carbon energy).

The California Conservation Corps (CCC) prepares at-risk youth for jobs and careers in the natural environment, combining classroom education with paid, on-the-job training.⁸⁷ The Los Angeles Conservation Corps, for example, helps improve the watershed by planting trees and building community gardens and provides participants with expertise in landscaping, irrigation, storm water and erosion control, and tree planting. With a state grant received under the Clean Energy Act, the CCC has also trained participants to conduct water audits in commercial facilities. If a direct link to utility careers can be systematically developed, these programs could serve as an effective pre-apprenticeship pathway into good construction and utility jobs. More explicit partnerships with employers and unions can improve the impact of CCC and CBO training programs, capitalizing on their excellent track record in supporting and mentoring young participants but making a much needed explicit link to career job placement.



PROMISING PRACTICE #10.1

BAYWORK Water Utility High Road Training Partnership

Because the sector already generates family-supporting jobs in utility operations, it is a good target for efforts aimed at inclusion of workers from disadvantaged communities. The coming wave of retirements in the utility industry offers both a challenge and an opportunity, as one successful Bay Area program exemplifies. In 2009, the San Francisco Public Utilities Commission (SFPUC), the Santa Clara Valley Water District, East Bay Municipal District and Union Sanitary District organized to create BAYWORK to help find qualified candidates and train them to operate the latest water utility technologies. The SFPUC already has a strong infrastructure for inclusion that BAYWORK can build on. It includes a community benefits policy with workforce development and diversity mandates⁸⁸ and a host of in-house workforce development programs, ranging from high school internships like SSIP CityWorks and Youthworks to pre-apprenticeship and formal apprenticeship training programs.⁸⁹ In addition, the SFPUC has adopted a project labor agreement with local, regional, and national construction trade unions for its Water System Improvement Program that includes, among other things, a jobs training and opportunities component.⁹⁰

Beginning in 2016, BAYWORK collaborated with Jewish Vocational Service (JVS) in San Francisco to reassess industry needs and training program offerings. A report released the following year found that water and wastewater

agencies and utilities in six Bay Area counties projected that they would need to make more than 825 new hires in nine occupations—water treatment operator, water distribution operator, wastewater treatment operator, wastewater collections operator, machinist, electrician, electronic maintenance/instrument technician, high-voltage electrician, and heavy equipment operator—over the next three years, and more than one-half of these agencies and utilities were having trouble finding workers with the requisite skills.⁹¹ The report also identified training gaps, such as a need for increased English, math, and science proficiency, among high school graduates interested in making the leap into the skilled trades. After securing funding through a California Workforce Development Board (CWDB) Accelerator grant, BAYWORK and JVS worked with Bay Area community colleges and other educational partners to assess existing certification, apprenticeship, and other training programs and worked to develop new curriculum, including applied learning, to help prepare prospective candidates for entry-level industry positions. JVS has also received funding for the project from the CWDB's High Road Training Partnership (H RTP) initiative which is funding development of partnerships with existing pre-apprenticeship programs and other community organizations focused on helping underrepresented job seekers (see Chapter 3).⁹²



As in other sectors, there is a connection between skill standards and work quality. A North Carolina State University (NCSU) study demonstrates the link between proper training and successful outcomes in implementing new green infrastructure. The NCSU analysis found that prior to the launch of a green infrastructure worker certification program, roughly 95 percent of the 425 green infrastructure projects implemented in Cary, North Carolina, failed inspections because they were not properly maintained.⁹³ However, “After owners better appreciated the value of maintenance and hired workers certified by NCSU, roughly 95 percent of BMPs *passed* a second inspection.”

Given the California Water Action Plan’s identification of the need to invest in this area, the state should encourage efforts to define and standardize certification requirements. “Stackable” credentialing programs in particular, which help workers build skills over time, could help create a career ladder in this field.

d. Risk of Job Loss or Job Degradation

While data relating to labor impacts of the state’s water conservation and efficiency strategies remain scant, there appears to be little risk of job loss or degradation in the sector based on state policies at this time. Due to the projected increase in state population and growth in infrastructure investment fueled by state mandates, it is more likely that the water sector workforce will continue to grow.

Two potential areas of concern bear further review, however. One is the SWRCB mandate to promote water system consolidation and regionalization initiatives.⁹⁴ The state should consider workforce impacts in cases that involve the absorption of water utilities from disadvantaged communities unable to supply a sufficient quantity of safe drinking water into larger, more viable systems.

The other is the state’s intention, stated in the Draft 2018 Water Action Plan, to explore novel funding mechanisms to help cover the gap in funding for water infrastructure capital expenditures and operations maintenance.⁹⁵ To the extent that public/private partnerships are under consideration, labor standards governance and a just transition for workers at risk of job loss should be considered in any assessment.

Workers employed by water utilities will need training to be able to adapt as the state moves forward with mandates requiring the adoption of new technologies, such as those used in leak reduction. In the professional occupations, continuing education is a requirement for license renewal, there is often a strong monetary incentive for professional development, and established organizations and funding currently exists to provide such training. In most other occupations, the commitment of employers to training current workers is essential. To support incumbent worker training, the state could invest in the identification of skill gaps; curriculum upgrades and instructor professional development; and training itself. The high-road training partnership



BAYWORK, described above, is an example of an industry training partnership that could be replicated in other regions of the state.

2. Workforce Recommendations

a. Demand-Side Workforce Policy Levers for Job Quality and Access

As the state continues to implement mandates requiring water suppliers to meet lower water-use targets and invest heavily in water infrastructure improvements to promote efficiency, it should take steps to encourage partner agencies and local and regional government entities to employ best practices in choosing construction contractors and outside vendors.

Utility industry jobs in the water sector are good quality and largely union. Many of these workers are employed by public agencies, with good wages and benefits. The need in this segment is for better inclusion policies, more certified apprenticeship and pipeline programs, and incumbent worker training, addressed through High Road Training Partnerships, below.

Utility industry jobs, however, represent less than one-fifth of all water workers. Many of the rest are in the overwhelmingly private construction industry, sometimes in companies that do not pay family-supporting wages and benefits. Not all construction jobs are good jobs. To protect taxpayer-funded investments and to ensure that construction contractors are employing a reliable, well-trained workforce, projects that utilize state funds should come with attached responsible contractor requirements and inclusionary hiring practices.

There are a number of ways in which public water utilities can take steps to ensure and improve job quality and job access for disadvantaged workers:

❖ Use community workforce agreements (CWAs) when utilities award contracts for large-scale water infrastructure construction projects

As described in Chapter 2, CWAs that include language to broaden access to good jobs can be used to ensure access for disadvantaged communities. These are pre-hire collective bargaining agreements with one or more labor unions that set the terms and conditions for the project including wages and working conditions, and set goals for the hiring of workers from disadvantaged communities. A common minimum threshold for CWAs is projects over one million dollars.



❖ Use inclusive procurement policies in contracts for public services.

Government entities like utilities can encourage contractors to enter into community benefit agreements (contracts between developers and community groups that require the developer to provide specific amenities or mitigations in exchange for community support of the project). Contractors can boost their bid scores by committing to strong community benefits standards in their proposal, by incorporating the U.S. Employment Plan or similar policies into solicitations for public procurement, discussed in Chapters 2 and 7. This is a way to encourage service providers to provide job and other benefits to the local community and for awarding agencies to identify the “best in class” proposals, rather than prescribing a specific wage or other labor standard. For water utilities providing grant funding for the installation of water efficiency measures, utilities can set minimum criteria that ensures that vendors meet threshold job quality standards. These steps would help ensure better working conditions for entry-level, low-wage workers in the water sector. This is particularly important for projects designed to promote increased water efficiency in disadvantaged communities, where the state expects to reap some of its biggest water efficiency gains.

❖ Use job impact metrics to measure the effect of climate policies on job numbers, job quality, and job access.

As California implements new data collection and reporting requirements for state water suppliers and operators, it should consider incorporating labor equity data metrics. One program that could serve as a model is RePower LA, a community-based coalition that promotes clean energy and increased access to good jobs at the Los Angeles Department of Water and Power (LADWP), which succeeded in persuading the agency to implement an Equity Metrics Data Initiative (EMDI).⁹⁶ The EMDI semi-annually tracks and posts data on the DWP’s programs, jobs, and services in low-income communities.⁹⁷

❖ Incorporate workforce analysis into emerging technology support programs addressing water conservation, reuse, and other low carbon practices.

California’s Draft 2018 Water Action Plan highlights the need for the state to identify funding for ongoing operations and maintenance to maximize the benefits of new “green” and “gray” technologies and infrastructure investments.⁹⁸ The state is establishing several task forces to consider needs in this area. Identifying workforce training and certification needs and assessing potential sources of funding should be part of this discussion to ensure the state is protecting and maximizing its investment in infrastructure.



b. Supply-Side Workforce Development Strategies

❖ Participate in the CWDB’s High Road Training Partnership and High Road Construction Careers initiatives.

California’s water industry can create pathways to the middle class for workers who traditionally have not been well represented in the industry and those from disadvantaged communities through investment in workforce training tied to job placement agreements. The state is encouraging the regional-scale development of pre-apprenticeship and certified apprenticeship training programs, as discussed in Chapter 3. These can apply to the water sector and could integrate industry-recognized credentials such as the Green Infrastructure Certification described above. Such apprenticeships could incorporate partnership with the California Conservation Corps and other pipeline programs to reduce barriers to entry for job seekers and provide additional connections to career-track jobs in the water sector.

Industry-led partnerships like the JVS BAYWORK initiative, which have been successful in fostering collaborative efforts to create bridge programs to identify and train workers interested in water careers, can help expand the existing pipeline of skilled and experienced workers ready to replace those retiring.

B. Water Agency Emissions Reductions

Senate Bill 350 (de León, Chapter 547, Statutes of 2015)⁹⁹ requires that half the state’s electricity come from renewable resources by 2030.¹⁰⁰ Meeting this mandate will lead to increased use by state agencies of Renewables Portfolio Standard-eligible resources, such as solar, wind, biomass, and geothermal energy. In line with this mandate, the California Department of Water Resources (DWR) is implementing efforts to reduce the agency’s environmental impacts and lead by example through its approved, department-wide Climate Action Plan. DWR has set a goal for itself of cutting its emissions levels to 80 percent below 1990 levels by 2050.¹⁰¹ DWR estimates that its total greenhouse gas emissions in 1990 were nearly 3.5 MMTCO₂e, roughly the equivalent of the emissions produced by 680,000 automobiles. DWR has identified 11 greenhouse gas emissions reduction measures it will take to meet its goals, including the termination of its ownership interest in the coal-powered Reid Gardner Power Station in Nevada; increasing the proportion of renewable energy used to run the State Water Project (SWP); exploring new ways of developing renewable energy on DWR-owned land; and increasing the energy efficiency of pumps and turbines through the SWP.

The vast majority of the DWR’s climate pollutant emissions (about 98 percent) stem from the generation of electricity needed to move water through the SWP, which DWR



owns and operates.¹⁰² The SWP is one of the largest single users of electricity in California,¹⁰³ accounting for around 3 percent of all electricity consumed in the state.¹⁰⁴ DWR uses the hydroelectric power it generates throughout the system to power most of its needs and sells the surplus.¹⁰⁵ When the hydroelectric energy on hand is not enough, DWR uses the energy market to fill the gap. By being more conscious in its choices of energy purchases—for example, by terminating its participation and delivery of energy from a coal-fired power plant in Nevada—DWR has already exceeded the state’s goal of reducing 1990 emission levels by a third by 2020. DWR expects it will achieve greenhouse gas emissions reductions of more than 60 percent below 1990 levels by 2020.

Construction is another component of DWR efforts to cut emissions. Though construction only accounts for a little more than 1 percent of total DWR emissions, it is the department’s second-largest source of emissions.¹⁰⁶ (All other DWR operations account for less than 1 percent of the agency’s emissions.) The primary source of DWR construction emissions is the operation of diesel-powered construction equipment. The DWR has adopted best management practices for construction and maintenance activities and made significant changes to its construction project specifications requirements that will lead to important reductions in construction emissions. In addition, improvements in statewide regulations governing construction equipment and fuel standards, driven by Assembly Bill 32 (Núñez, Chapter 488, Statutes of 2006)¹⁰⁷ and other initiatives, will also contribute to the adoption of new technologies that will further reduce emissions.

DWR efforts to reduce emissions are extensive, but given the department’s relatively small 1990-level emissions footprint, its main contribution to reducing emissions in the water sector lies in being an industry leader and early adopter of new technologies. The DWR also can serve as an industry model for good labor policy and practice.

1. Workforce Outcomes

a. Job Growth

Labor impacts from DWR water-related emissions initiatives are largely unknown at this point, as many of the department’s initiatives are in the early stages or have yet to be implemented. Ultimately, DWR efforts to procure renewable electricity—like those of every state agency—are likely to stimulate employment in construction, particularly solar installation. Efforts to improve the energy efficiency of pumps and turbines throughout the SWP system may also have a positive impact on employment in construction occupations such as electricians, mechanics, and maintenance and repair workers, as well as manufacturing, albeit indirectly. None of these initiatives are likely to have a major impact on the utility industry, as they involve infrastructure and energy sources rather than water treatment, transport, or distribution.



b. Job Quality

Water sector construction jobs—the jobs mostly likely to be created by DWR emissions reduction measures—are good paying jobs that generally fall under the state’s prevailing wage and apprenticeship standards for public works construction. Through the state-certified apprenticeship system, construction is an industry where workers with less formal education can gain access to jobs with family-supporting wages and a full benefits package, with training and wage increases as skills are acquired in a “earn while you learn” model (see Chapters 2 and 3).

As detailed in Chapter 6 on Energy, job quality in the construction of utility-scale renewables—another segment likely to be stimulated by the DWR initiative—is high, encompassing middle-class careers built on skills acquired in a state-certified apprenticeship system. Job quality has been ensured because most utility-scale renewable energy construction projects in California have been governed by collectively bargained PLAs (see Chapters 2 and 6).¹⁰⁸ Under these PLAs, workers have received a compensation package that includes prevailing wage rates, full benefits (pension and healthcare contributions), and ongoing funding for apprentice training. Wages for journey-level workers averaged about \$37.00 per hour in 2015.¹⁰⁹

c. Job Access

Prospective construction workers in California’s water sector can face significant barriers to entry, including lack of relevant work experience. However, there are pre-apprentice programs in place that have proved successful in increasing the number of underrepresented workers in apprenticeship, and the state is expanding funding for these programs through its High Road Construction Careers initiative, discussed in Chapter 3.

d Risk of Job Loss or Job Degradation

There is little to no risk of job loss or degradation as a result of the water sector’s emissions reduction efforts. Nearly all of the emissions reduction measures detailed in the DWR’s Water Action Plan are constructive rather than eliminatory. The only negative impact likely to follow from any of these initiatives would be at the Reid Gardner Power Station, a coal-powered plant in Nevada, where DWR terminated its ownership stake.¹¹⁰ The plant ceased operations entirely in 2015.¹¹¹

2. Workforce Recommendations

The greenhouse gas reduction measures pursued by the DWR in its California Water Action Plan are in keeping with those of all other state agencies charged with similar mandates, and the DWR should follow the best practices outlined for those agencies in other chapters of this report. See the renewables section of Chapter 6 on low-carbon energy for an example of these best practices.



V. Recommendations for the Water Sector

Exhibit 10.4. Key Recommendations for the Water Sector

| | |
|--|--|
| <p>Water Conservation—Utility Operations</p> | <p>Demand Side</p> <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement of large capital equipment, contracts for services, and in grants programs. ❖ Incorporate workforce analysis into support for emerging technologies addressing water conservation, reuse, and other low carbon practices. <p>Supply Side</p> <ul style="list-style-type: none"> ❖ Expand high-road training partnerships and participate in the state’s High Road Construction Careers initiative to promote inclusion of workers from disadvantaged communities. |
| <p>Water Conservation—Utility Infrastructure Construction</p> | <p>Demand Side</p> <ul style="list-style-type: none"> ❖ Use community workforce agreements (CWAs) when utilities award contracts for water infrastructure construction projects or renewable generation on water utility land. ❖ Use job impact metrics to measure the effect of climate policies on job numbers, job quality, and job access. <p>Supply Side</p> <ul style="list-style-type: none"> ❖ Participate in statewide initiative for pre-apprenticeship for construction careers. ❖ Expand High-road industry training partnerships. ❖ Provide funding for ongoing identification of skills gaps and development of plans to fill gaps. |
| <p>All Water Sectors</p> | <ul style="list-style-type: none"> ❖ Use job impact metrics to measure the impact of climate incentive and investment programs on quantity of jobs, job quality and job access. ❖ Incorporate workforce analysis into emerging technology support programs. ❖ Track training program outcomes for graduation rates, attainment of industry-recognized credentials, job placement, retention, wages and wage progression. |



Endnotes

- 1 The 19 percent electricity use in the water sector breaks down as follows: 11 percent residential, commercial, and industrial water end use; 3 percent residential, commercial, and industrial water supply and treatment; 3 percent agricultural end use; 1 percent agricultural water supply and treatment; and 1 percent wastewater treatment. California Public Utilities Commission, “Water/Energy Nexus,” accessed September 24, 2018, http://www.cpuc.ca.gov/nexus_calculator/. The 19 percent was originally formulated in this report: Gary Klein et al., “California’s Water-Energy Relationship,” Final Staff Report (California Energy Commission, November 2005), <http://large.stanford.edu/courses/2012/ph240/spearrin1/docs/CEC-700-2005-011-SF.PDF>.
- 2 Jon Zerolnick, “Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity” (LAANE: A New Economy For All, March 2018), http://laane.org/wp-content/uploads/2018/03/LAANE_Liquid-Assets_Stormwater-Report.pdf.
- 3 PPIC Water Policy Center, “Energy and Water” (Public Policy Institute of California, October 2016), http://www.ppic.org/content/pubs/report/R_1016AER.pdf.
- 4 Andrew Schwarz, “Climate Action Plan Phase 1: Greenhouse Gas Emissions Reduction Plan” (California Department of Water Resources, May 2012), <https://water.ca.gov/LegacyFiles/climatechange/docs/Final-DWR-ClimateActionPlan.pdf>.
- 5 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” November 2017, 92, https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- 6 Klein et al., “California’s Water-Energy Relationship.”
- 7 Klein et al.
- 8 California Department of Finance, “Population Projections (Baseline 2016),” accessed September 24, 2018, <http://www.dof.ca.gov/Forecasting/Demographics/projections/>.
- 9 Klein et al., “California’s Water-Energy Relationship.”
- 10 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 92.
- 11 Klein et al., “California’s Water-Energy Relationship.”
- 12 Joseph Kane and Adie Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity” (The Metropolitan Policy Program at Brookings, June 2018), <https://www.brookings.edu/research/water-workforce/>.



- 13 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” 92–95.
- 14 Darrell Steinberg, “SBX7-7 Water Conservation,” Chapter 4, Statutes of 2009 § (2009), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200920107SB7.
- 15 Unless otherwise noted, information on the policies listed in this section is taken from: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan Appendix H Major Climate Statutes and Regulations,” November 2017, https://ww3.arb.ca.gov/cc/scopingplan/2030sp_apph_climatestatutesref_final.pdf.
- 16 Lois Wolk, “SB-555 Urban Retail Water Suppliers: Water Loss Management,” Chapter 679, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB555.
- 17 Mike Gatto, “AB-2282 Building Standards: Recycled Water Systems,” Chapter 606, Statutes of 2014 § (2014), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2282.
- 18 Shirley Weber, “AB-2515 Water Conservation in Landscaping Act: Model Water-Efficient Landscaping Ordinance,” Chapter 576, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB2515.
- 19 California Department of Water Resources, “Model Water Efficient Landscape Ordinance” (California Code of Regulations, 2015), <https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance>.
- 20 Fran Pavley, “SB-1168 Groundwater Management,” Chapter 346, Statutes of 2014 § (2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1168.
- 21 Roger Dickenson, “AB-1739 Groundwater Management,” Chapter 347, Statutes of 2014 § (2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1739.
- 22 Fran Pavley, “SB-1319 Groundwater,” Chapter 348, Statutes of 2014 § (2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1319.
- 23 University of California, Division of Agriculture and Natural Resources, “Sustainable Groundwater Management Act,” accessed September 24, 2018, <http://groundwater.ucdavis.edu/SGMA>.



- 24 California Department of Water Resources, “Groundwater Sustainability Plans,” accessed September 24, 2018, <https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Groundwater-Sustainability-Plans>.
- 25 Fran Pavley and Roger Dickenson, “Sustainable Groundwater Management Act [And Related Statutory Provisions from SB1168 (Pavley), AB1739 (Dickinson), and SB1319 (Pavley) as Chaptered]” (2016), <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Files/2014-Sustainable-Groundwater-Management-Legislation-with-2015-amends-1-15-2016.pdf?la=en&hash=ADB3455047A2863D029146E9A820AC7DE16B5CB1>.
- 26 California Department of Water Resources Sustainable Groundwater Management Program, “Groundwater Sustainability Plan Emergency Regulations” (2016), https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GSP_Emergency_Regulations.pdf.
- 27 California Department of Water Resources, “Clean Energy for the State Water Project,” May 12, 2016, <https://water.ca.gov/LegacyFiles/climatechange/docs/2016/CleanEnergyforSWPFinal.5.19.16.pdf>.
- 28 PPIC Water Policy Center, “Energy and Water.”
- 29 California Department of Water Resources, “Producing and Consuming Power” (California Department of Water Resources), accessed September 24, 2018, <https://water.ca.gov/What-We-Do/Power>.
- 30 California Department of Water Resources, “Clean Energy for the State Water Project.”
- 31 Ricardo Lara, “SB-605 Short-Lived Climate Pollutants,” Chapter 523, Statutes of 2014 § 39730 (2014), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB605.
- 32 Ricardo Lara, “SB-1383 Short-Lived Climate Pollutants: Methane Emissions: Dairy and Livestock: Organic Waste: Landfills,” Chapter 395, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383.
- 33 John Laird, “AB-2466 Local Government Renewable Energy Self-Generation Program,” Chapter 540, Statutes of 2008 § (2008), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080AB2466.
- 34 U.S. Environmental Protection Agency, “What Is Green Infrastructure?,” accessed September 24, 2018, <https://www.epa.gov/green-infrastructure/what-green-infrastructure>.



35 Only one of the eight industries is at the five-digit level: Plumbing, Heating, and Air-Conditioning Contractors (NAICS 23822). The others are: Water, Sewage, and Other Systems (NAICS 2213); Utility System Construction (NAICS 2371); Other Heavy and Civil Engineering Construction (NAICS 2379); Other Specialty Trade Contractors (NAICS 2389); Management, Scientific, and Technical Consulting Services (NAICS 5416); and Remediation and Other Waste Management Services (NAICS 5629). Kane and Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity.”

36 Only one of the eight industries is at the five-digit level: Plumbing, Heating, and Air-Conditioning Contractors (NAICS 23822). The others are: Water, Sewage, and Other Systems (NAICS 2213); Utility System Construction (NAICS 2371); Other Heavy and Civil Engineering Construction (NAICS 2379); Other Specialty Trade Contractors (NAICS 2389); Management, Scientific, and Technical Consulting Services (NAICS 5416); and Remediation and Other Waste Management Services (NAICS 5629). Kane and Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity.”

37 The ten metropolitan areas are: Bakersfield, Fresno, Los Angeles-Long Beach-Anaheim, Oxnard-Thousand Oaks-Ventura, Riverside-San Bernardino-Ontario, Sacramento-Roseville-Arden-Arcade, San Diego-Carlsbad, San Francisco-Oakland-Hayward, San Jose-Sunnyvale-Santa Clara, and Stockton-Lodi. Kane and Tomer.

38 Patrick Burns and Daniel Flaming, “Water Use Efficiency and Jobs” (Economic Roundtable, 2011), https://economicrt.org/wp-content/uploads/2011/12/Water_Use_Efficiency_and_Jobs_2011.pdf.

39 California Department of Water Resources et al., “Making Water Conservation a California Way of Life: Implementing Executive Order B-37-16,” April 2017, https://water.ca.gov/LegacyFiles/wateruseefficiency/conservation/docs/20170407_EO_B-37-16_Final_Report.pdf.

40 Electro Scan Inc., “New Law for Reporting Water Loss (SB 555): Electro Scan Applauds New California Law for Reporting Water Losses; Senate Bill 555 to Require Water Suppliers to Meet New Performance Standards,” October 12, 2015, <https://www.electroscan.com/new-law-for-reporting-water-loss-sb-555/>.

41 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan.”

42 Wolk, SB-555 Urban retail water suppliers: water loss management.

43 Robert Hertzberg, “SB-606 Water Management Planning,” Chapter 14, Statutes of 2018 § (2018), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB606.



- 44 Laura Friedman, “AB-1668 Water Management Planning,” Chapter 15, Statutes of 2018 § (2018), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB1668.
- 45 California Water Efficiency Partnership, “Fact Sheet on Long-Term Conservation Legislation,” June 22, 2018, http://www.allianceforwaterefficiency.org/uploadedFiles/Resource_Center/Library/United_States/California/CalWEP-FAQ-Fact-Sheet-on-Long-Term-Conservation-Legislation.pdf.
- 46 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan.”
- 47 California Natural Resources Agency, California Department of Food and Agriculture, and California Environmental Protection Agency, “California Water Action Plan: 2016 Update,” 2016, http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf.
- 48 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan.”
- 49 California Air Resources Board.
- 50 California Public Utilities Commission, “Water/Energy Nexus.”
- 51 California Air Resources Board, “California’s 2017 Climate Change Scoping Plan.”
- 52 Legislative Analyst’s Office, “2017-18 Cap-and-Trade Expenditure Plan,” August 24, 2017, <http://www.lao.ca.gov/handouts/resources/2017/Senate-Cap-and-Trade-Expenditure-Plan-082417.pdf>.
- 53 Kings Basin Water Authority, “DWR Announce Solicitation for 2016 Water-Energy Grant Program,” September 7, 2016, <http://www.kingsbasinauthority.org/dwr-announce-solicitation-for-2016-water-energy-grant-program/>.
- 54 California Department of Water Resources, “Water Energy Grant Program,” accessed September 24, 2018, <https://water.ca.gov/Work-With-Us/Grants-And-Loans/Water-Energy-Grant-Programs>.
- 55 Legislative Analyst’s Office, “2017-18 Cap-and-Trade Expenditure Plan.”
- 56 California Department of Food and Agriculture, “State Water Efficiency and Enhancement Program,” accessed October 9, 2018, <https://www.cdfa.ca.gov/oefi/sweep/>.
- 57 Legislative Analyst’s Office, “2017-18 Cap-and-Trade Expenditure Plan.”
- 58 Legislative Analyst’s Office; Autumn Burke, “AB 2722, Burke. Transformative Climate Communities Program,” Chapter 371, Statutes of 2016 (chaptered September 14, 2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB2722.



59 California Department of Finance, “Governor’s Budget Summary 2018-19 (Proposed): Climate Change,” January 10, 2018, <http://www.ebudget.ca.gov/2018-19/pdf/BudgetSummary/ClimateChange.pdf>.

60 According to Kamyar Guivetchi, Division Chief and Manager of the Statewide Integrated Water Management Division for the Department of Water Resources: “Unlike the last two or three where we let the deadlines slip, the deadline can’t slip. It has to be out by the end of December of 2018 under this administration. When the recall happened in 2003, it added two years to the release of the Water Plan because the new administration came in and they needed time to get their arms and minds around the Water Plan. This one, we have a hard stop at the end of 2018.” Chris Austin, “California Water Plan Update 2018: Envisioning Statewide Water Sustainability,” *Maven’s Notebook* (blog), November 29, 2017, <https://mavensnotebook.com/2017/11/29/california-water-plan-update-2018-envisioning-statewide-water-sustainability/>.

61 California Department of Water Resources, “Water Plan Update 2018 Draft Reviewer’s Guide,” January 9, 2018, <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Water-Plan-Updates/Files/Update-2018/Water-Plan-Update-2018-Working-Draft.pdf>.

62 California Department of Water Resources.

63 California Natural Resources Agency, California Environmental Protection Agency, and California Department of Food and Agriculture, “California Water Action Plan Implementation Report: 2016 Summary of Accomplishments,” January 9, 2017, http://resources.ca.gov/docs/california_water_action_plan/CA_WAP_Impl_Rpt_2016.pdf.

64 California Department of Water Resources, “Water Plan Update 2018 Draft Reviewer’s Guide.”

65 David Mitchell, Thomas Chesnutt, and David Pikelney, “Transforming Water: Water Efficiency as Infrastructure Investment,” Position Paper (Alliance for Water Efficiency, December 2017), <http://www.allianceforwaterefficiency.org/Transforming-Water.aspx>.

66 Burns and Flaming, “Water Use Efficiency and Jobs.”

67 California Department of Water Resources, “Water Plan Update 2018 Draft Reviewer’s Guide.”

68 Burns and Flaming, “Water Use Efficiency and Jobs.”

69 Burns and Flaming.

70 California Department of Water Resources, “Water Plan Update 2018 Draft Reviewer’s Guide.”



- 71 Kane and Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity.”
- 72 Kane and Tomer.
- 73 These percentages exclude those occupations with fewer than 250 employees in the utility industry. Kane and Tomer.
- 74 California Department of Industrial Relations, Division of Apprenticeship Standards, “Apprenticeship Program Information: Water Treatment Plant Operator,” accessed November 9, 2018, https://www.dir.ca.gov/databases/das/results_aigdetail.asp?varOcclid=550.
- 75 California Department of Industrial Relations, Division of Apprenticeship Standards, “Find an Apprenticeship Program,” September 23, 2018, <https://www.dir.ca.gov/databases/das/aigstart.asp?Flag1=NR>.
- 76 Wes Strickland, “The Organization of Water Utilities in California,” *Private Water Law* (blog), September 25, 2013, <https://privatewaterlaw.com/2013/09/25/the-organization-of-water-utilities-in-california/>.
- 77 Kane and Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity.”
- 78 Burns and Flaming, “Water Use Efficiency and Jobs.”
- 79 Burns and Flaming.
- 80 Zerolnick, “Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity.”
- 81 Kane and Tomer, “Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity.”
- 82 Kane and Tomer.
- 83 Zerolnick, “Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity.”
- 84 Ashley K. Thomas, “Successes of Construction Careers” (LAANE: A New Economy For All, August 2014), <https://www.laane.org/wp-content/uploads/2015/04/Successes-of-Construction-Careers-Report.pdf>.
- 85 Water Systems Optimization, Inc. and Cavanaugh & Associates, “Water Loss Technical Assistance Program Final Report,” prepared for The California Nevada Section of the American Water Works Association, 2018, <https://ca-nv-awwa.org/canv/downloads/2018/WLTapFinalReport.pdf>; California State Water Resource Control



Board, “Water Loss Control,” September 18, 2018, https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/water_loss_control.html; Sue Mosburg, “Implementing SB 555: Validated Water Loss Audits and Reporting,” <http://www.calwaterassn.com/wp-content/uploads/2016/11/Implementing-SB-555.pdf>.

86 Pat Lenius, “Los Angeles Offers Free Delivery of Low-Flow Toilets to Homes,” *Supply House Times*, September 12, 1999, <https://www.supplyht.com/articles/86340-los-angeles-offers-free-delivery-of-low-flow-toilets-to-homes>; Business Wire, “LADWP Provides Water-Saving Toilets and Installation Service Free of Charge; Program Also Supports Jobs in Diverse Communities,” September 25, 2003, <https://www.businesswire.com/news/home/20030925005452/en/LADWP-Water-Saving-Toilets-Installation-Service-Free-Charge>.

87 Zerolnick, “Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity.”

88 San Francisco Public Utilities Commission, “SFPUC Community Benefits Program Social Impact Partnerships,” May 10, 2018, <https://sfwater.org/Modules/ShowDocument.aspx?documentid=11622>.

89 San Francisco Public Utilities Commission, “Internships, Apprenticeships and Youth Employment,” accessed February 12, 2018, <http://sfwater.org/index.aspx?page=888>.

90 San Francisco Public Utilities Commission, “Project Labor Agreement,” accessed September 24, 2018, <https://sfwater.org/index.aspx?page=113>.

91 Jewish Vocational Service, Baywork, and The Centers of Excellence, “Water and Wastewater Career Pathways: Connecting People to Water Industry Jobs in the Bay Area,” 2016, <https://www.jvs.org/wp-content/uploads/2018/07/BAYWORK-JVS-Water-Report-2017.pdf>.

92 Stephanie Colosi, “The Future of (Water) Work” (Jewish Vocational Service, July 16, 2018), <https://www.jvs.org/search/baywork/>; California Workforce Development Board, “Model High Road Training Partnership Awards,” December 21, 2017, <https://cwdb.ca.gov/wp-content/uploads/sites/43/2018/01/HRTPAmentedAwardAnnouncement122117.pdf>.

93 Zerolnick, “Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity.”

94 Michelle Frederick and Caitlin Juarez, “Consolidation and Regionalization Efforts” (State Water Resources Control Board, Division of Drinking Water, 2017), https://calafco.org/sites/default/files/resources/2017_Staff_Workshop/Water%20Consolidations_SWRCB%20presentation.pdf.



- 95 California Department of Water Resources, “Water Plan Update 2018 Draft Reviewer’s Guide.”
- 96 LAANE: A New Economy for All, “Repower LA,” accessed September 26, 2018, <https://laane.org/blog/campaigns/energy-and-water/>.
- 97 Los Angeles Department of Water and Power, “Equity Metrics Data Initiative,” accessed September 26, 2018, https://www.ladwp.com/ladwp/faces/wcnav_externalId/au-fr-corporateperformance-emdi;jsessionid=Fp8qbrnBDd22rGZL19TZTTBIJMvc-9mvF4n7v0w3pSXpvJ3bvXPfY!210892335?_afrWindowId=null&_afrLoop=9966663789852&_a%29%29=&_afrWindowMode=0&_adf.ctrl-state=18bc96x2hu_4#%40%3F_afrWindowId%3Dnull%26_afrLoop%3D9966663789852%26_a%2529%2529%3D%26_afrWindowMode%3D0%26_adf.ctrl-state%3D3877zxy63_4.
- 98 California Department of Water Resources, “Water Plan Update 2018 Draft Reviewer’s Guide.”
- 99 Kevin de León, “SB-350 Clean Energy and Pollution Reduction Act of 2015,” Chapter 547, Statutes of 2015 § (2015), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.
- 100 California Energy Commission, “Clean Energy & Pollution Reduction Act: SB 350 Overview,” accessed February 26, 2018, <http://www.energy.ca.gov/sb350/>.
- 101 Schwarz, “Climate Action Plan Phase 1: Greenhouse Gas Emissions Reduction Plan.”
- 102 Schwarz.
- 103 California Department of Water Resources, “Power,” accessed September 26, 2018, <https://water.ca.gov/Programs/State-Water-Project/SWP-Power>.
- 104 Lon W. House, “Water Supply-Related Electricity Demand in California,” prepared for Public Interest Energy Research, California Energy Foundation (Water and Energy Consulting and the Demand Response Research Center, November 2007), <https://drrc.lbl.gov/publications/water-supply-related-electricity>.
- 105 Schwarz, “Climate Action Plan Phase 1: Greenhouse Gas Emissions Reduction Plan.”
- 106 Schwarz.
- 107 Fabian Núñez, “AB-32 Air Pollution: Greenhouse Gases: California Global Warming Solutions Act of 2006,” Chapter 488, Statutes of 2006 § (2006), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32.



108 Betony Jones, Peter Philips, and Carol Zabin, “The Link Between Good Jobs and a Low Carbon Future” (UC Berkeley Donald Vial Center on Employment in the Green Economy, July 2016), <http://laborcenter.berkeley.edu/the-link-between-good-jobs-and-a-low-carbon-future/>.

109 Jones, Philips, and Zabin.

110 Schwarz, “Climate Action Plan Phase 1: Greenhouse Gas Emissions Reduction Plan.”

111 Nevada Division of Environmental Protection, “Reid Gardner Power Station,” accessed July 8, 2019, <https://ndep.nv.gov/environmental-cleanup/site-cleanup-program/active-cleanup-sites/reid-gardner-power-station>.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Chapter 11: Natural and Working Lands

by Robert Collier

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I. Overview of Sector and Key Climate Policies

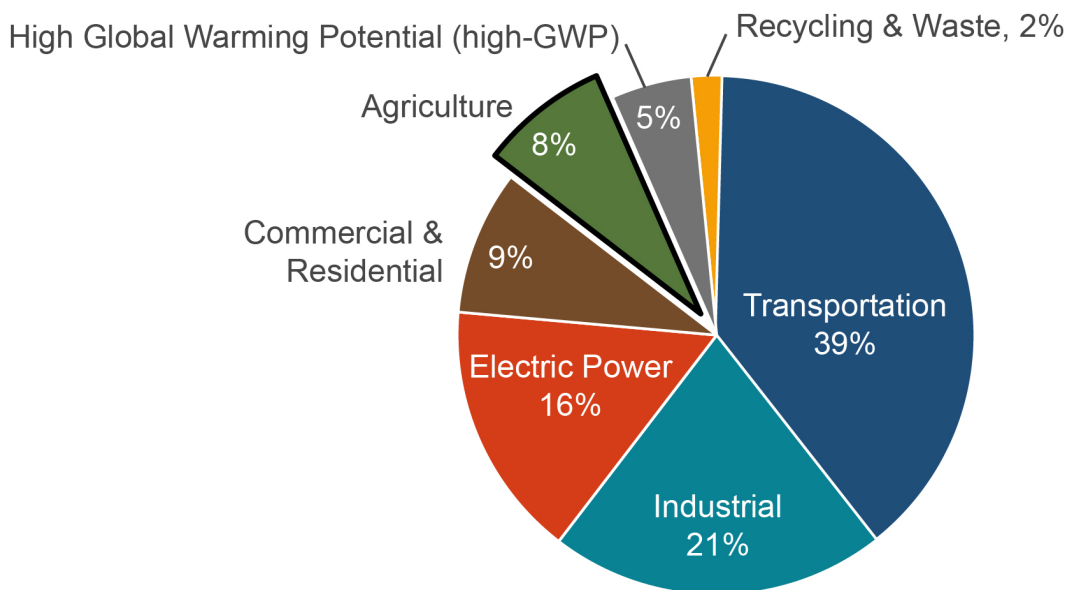
The sector of natural and working lands (NWL), which includes wildlands firefighting, forest and wildlands vegetation management, biomass, wetlands, green urban spaces, and agriculture, is a critical area for state climate policy, but its impact on greenhouse gas emissions is still unpredictable. The sector could have divergent impacts over the coming years, serving either as a carbon sink for absorbing emissions or as a major source of short-lived climate pollutants (SLCPs), especially black carbon from wildfires and methane from livestock.

The California Air Resources Board (CARB) Scoping Plan contains only general analysis and policy framing for the NWL sector, and its greenhouse gas inventory lacks full quantitative estimates of NWL emissions because of methodological challenges throughout the sector.¹ CARB, together with the California Natural Resources Agency (CNRA), the California Department of Food and Agriculture (CDFA), and California Environmental Protection Agency (CalEPA), are currently developing a NWL greenhouse gas emissions inventory as called for in Senate Bill 859 (Committee on Budget and Fiscal Review, Chapter 368, Statutes of 2016).² Also developed alongside this inventory will be an implementation plan to set goals and strategies for NWL emissions reduction.³ The Scoping Plan proposes a general reduction goal from NWL of at least 15-20 million metric tons by 2030, and this goal will be reevaluated in the sector-specific implementation plan.

As seen in **Exhibit 11.1**, the agriculture sector accounts for 8 percent of total emissions in the statewide greenhouse gas inventory. About three-fifths of agricultural emissions are from methane in dairy and livestock, with the rest from energy use and fertilizer use. **Exhibit 11.2** shows emissions from the agricultural sector in 1990 and 2017 and finally, the estimated range of emissions in 2030 from implementing the measures identified in the Scoping Plan.

Perhaps the most pressing challenge of California's NWL sector is wildfire. Because of climate change and related factors, wildfires have become more frequent and intense in recent years, and this trend is expected to increase. The methodology of calculating wildfire greenhouse gas emissions is uncertain, and for that reason CARB has not yet included wildfires in its statewide greenhouse gas emissions inventory.⁴ However, the U.S. Geological Survey estimated that California's record-breaking wildfire season of 2018 emitted 68 MMTCO₂e, roughly 15 percent of the total annual emissions statewide and almost exactly the same as the entire electric power sector.⁵ The Forest Carbon Plan, published in May 2018, estimated that under a business-as-usual scenario, statewide wildfire emissions could increase by 56 percent by 2100.⁶

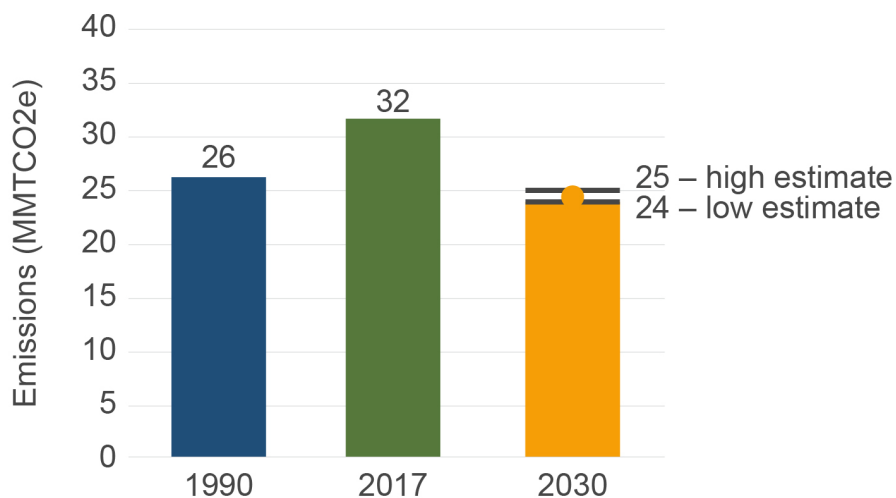


Exhibit 11.1. Agriculture Sector Emissions (MMTCO₂E) as of 2017

Source: California Air Resources Board, “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019, https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf.

California’s programs to address the NWL sector are slated for expansion in the coming years following passage of Senate Bill 901 (Dodd, Chapter 626, Statutes of 2018),⁷ which authorized \$200 million per year through FY 2023-24 from the Greenhouse Gas Reduction Fund (GGRF) for work on fire prevention and vegetation management. This much-needed expansion will have the unintended effect of highlighting the dichotomy between high-road and low-road approaches within the fire- and vegetation management segments of this Scoping Plan sector. Some workers in these fields—primarily the full-time employees of Cal Fire and other public firefighting agencies—have generally high wages, full benefits packages, and collective-bargaining contracts. Much of the rest of the sector, however, demonstrates characteristics of a low-road economic path, with poor job quality and extreme social marginalization, as described later in this chapter. As a result, state investment in the NWL sector could run the risk of simply increasing the number of poverty-level jobs, and the impact of public investment in training in some segments of this sector could be diminished by high worker turnover and low-wage economic competition.



Exhibit 11.2. Agriculture Sector Emissions and 2030 Target

Sources: 1990 levels and 2030 GHG emissions targets: California Air Resources Board, “California’s 2017 Climate Change Scoping Plan,” page 31, table 3, November 2017, https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf; 2017 levels from: California Air Resources Board, “California Greenhouse Gas Inventory for 2000-2017—by Category as Defined in the 2008 Scoping Plan,” August 12, 2019, https://ww3.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-17.pdf.

This chapter addresses the following key measures affecting the various subsectors of the natural and working lands sector:

❖ Forest and Wildlands Management

- Increased fire suppression work to reduce the spread of wildfires once they start.
- Intensive management of forests and other wildlands to increase their resiliency to wildfires, decrease the likelihood of catastrophic fires, reduce greenhouse gas emissions from wildfires, and increase the carbon sink capacity of forests and wildlands. In May 2018, Governor Jerry Brown issued an executive order requiring a significant acceleration of climate-related forest restoration and fuels treatment.⁸

❖ Biomass Energy and Wood Products Manufacturing

- Expansion of the use of forest by-products for bioenergy generation.
- Expansion of the market for timber for manufactured wood products, such as pre-engineered wood.



❖ Urban Forests, Wetlands, and Coastal Carbon Sinks

- Expansion of Cal Fire's Urban and Community Forestry Program to increase the carbon sink effect of street trees. Most of this program consists of grant programs for community street tree-planting groups.
- GGRF funding for the Natural Resources Agency's Urban Greening Grant Program, which provides grants for tree planting (to sequester or store carbon and/or for shade to reduce energy consumption) and active transportation infrastructure.
- GGRF funding for other state grant programs to plan and execute projects to increase the carbon sink effect of wetlands and coastal areas. These programs include the Coastal Conservancy's Climate Ready Program, the Department of Fish and Wildlife's Wetland Restoration for Greenhouse Gas Reduction Program, and the Wildlife Conservation Board's Climate Adaptation Program.

❖ Agriculture

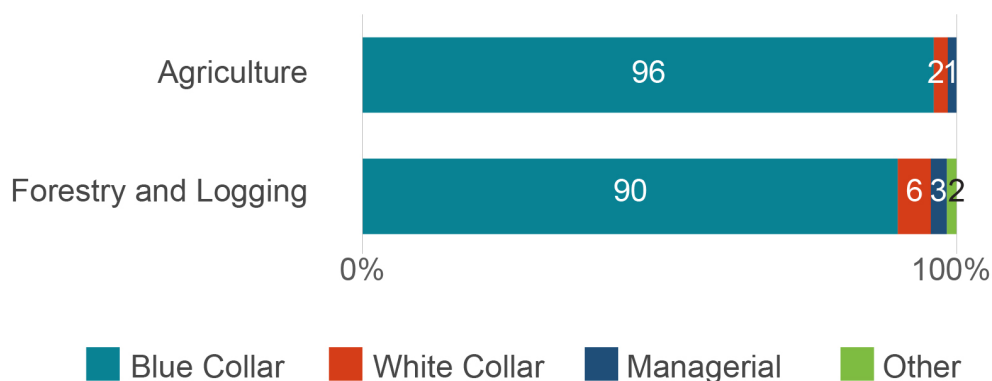
- Subsidies to farmers to install systems to increase the capture of methane emissions from livestock through the California Department of Food and Agriculture (CDFA) Dairy Digester Research and Development Program and Alternative Manure Management Program.
- Grants to farmers to improve local air quality by replacing high-polluting farm vehicles and equipment through the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program.
- Grants to farmers to purchase and install water-efficient irrigation systems. State Water Efficiency and Enhancement Program (SWEEP), administered by CDFA, which provides grants to implement water-efficient irrigation systems.
- The Healthy Soils Program, which helps farmers adopt energy-efficient irrigation systems and other conservation measures to increase the carbon sink effect of farmland.
- Partial exemptions on sales and use taxes for the installation of renewable energy generation and energy storage equipment on farms.
- Funding from the Sustainable Groundwater Planning Grant Program of the Department of Water Resources to develop and implement sustainable groundwater planning and projects.



II. Industries and Occupations Affected

A wide variety of industries are included in the NWL sector: firefighting (state and local fire agencies, and private firefighting contractors); logging (timber extraction, trucking and lumber milling); forestry services (thinning, tree planting and other vegetation management); biomass power plants; wood products manufacturing; and agriculture (farming, livestock, and companies providing services for irrigation, methane capture, and rural electricity). Occupations include a wide variety of skilled and unskilled manual laborers, power plant and manufacturing workers, and professional services. As shown in **Exhibit 11.3**, the vast majority of jobs are blue-collar—90 percent in forestry and logging, and 96 percent in agriculture. Bureau of Labor Statistics occupation data do not provide information at the more detailed levels of disaggregation for the subsectors described in this chapter.

Exhibit 11.3. Occupations by Industry in the Natural and Working Lands Sector



Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]

Exhibit 11. 3. Shows the broad occupational distribution of the two main industries, agriculture and forestry and logging. More detail on industries and occupations is provided in the sections below.



III. Workforce Issues in Key Subsectors and Policies

The following sections address the workforce issues stemming from major climate policies in the various subsectors of the natural and working lands sector. Each section first examines available evidence on labor conditions in each subsector and the workforce outcomes from the main climate policies thus far. It then identifies where and how workforce policy can be aligned with these climate policies. Specifically, it identifies complementary demand-side workforce policy levers, described in Chapter 2, that the agencies responsible for implementing the climate policies can use to create good jobs and support the demand for skilled labor. It also highlights opportunities to develop, utilize, and leverage the state’s workforce development, training, and education infrastructure to prepare workers for the labor market changes that will occur due to the climate policies in this sector, using the recommendations described in Chapter 3.

A. Forest and Wildlands Management

The Scoping Plan designates the Forest Carbon Plan (FCP), finalized in May 2018, as the detailed implementation plan for wildlands greenhouse gas emission reduction targets.⁹ The FCP was produced by the multi-agency Forest Climate Action Team, co-led by the state’s Department of Forestry and Fire Protection (Cal Fire), the Natural Resources Agency, and CalEPA.¹⁰ The FCP is also designated by CARB’s Proposed Short-Lived Climate Pollutant Reduction Strategy as the mechanism for addressing black carbon emissions from wildfire.

California forests comprise three main categories:

- Federal lands: 19 million acres, 57 percent of total
- State lands: 1 million acres, 3 percent of total
- Private lands: 13.3 million acres, 40 percent of total

The FCP states that a dramatically increased amount of fuels treatment—primarily commercial and pre-commercial thinning—is required in order to maintain forests’ role as a carbon sink while increasing forest health and decreasing wildfire danger. Much of this need is caused by California’s fast-escalating tree die-off from bark beetles and drought, comprising an estimated 129 million dead trees in forests statewide.¹¹ The FCP recommends the following:

- “By 2020, increase the rate of fuels treatment from the recent average of 17,500 acre/years to 35,000 acres/year.”



- “By 2030, further increase the rate of fuels treatment to 60,000 acres/year. By 2030, increase the area reforested annually by 25 percent above the current level.”
- By a non-specified date after 2030, “increase rate of treatment to approximately 500,000 acres per year on non-federal lands to make an ecologically meaningful difference at a landscape scale. This estimate provided by Cal Fire is an aspirational goal based on consideration of ecological need and predictions of capacity to implement treatments. This acreage is currently more than what Cal Fire considers operationally feasible. It should be considered a target to work toward and is achievable pending increased resources.”

The FCP notes that the state is increasing its programs for forest health and fire prevention programs. The FY 2018-19 Budget Act included \$99 million from the General Fund for state and local fire agencies for fire prevention and suppression, and \$223 million from the GGRF for state and local agencies for fire prevention, forest health, and vegetation management.¹² In addition, SB 901, enacted in September 2018, directed that \$200 million from the GGRF shall be appropriated annually through FY 2023-24 in grants to local governments, tribal agencies, and nonprofits for this work. These programs, as summarized in Cal Fire’s 2018 Strategic Fire Plan, are carried out on state and private lands by a wide mix of entities, including Cal Fire, county and municipal government agencies, and Fire Safe Councils, which are local nonprofits that carry out fire prevention work.¹³ These funding appropriations do not specify the acreage that can be treated with the added expenditures and do not make clear whether the funds will put the state on track to achieve its 2020 treatment goals. However, the goals for 2030 and beyond seem so ambitious that they will require continued major growth in funding and the associated workforce.

The FCP does not include any detailed policy tools for federal lands, where the state has limited jurisdiction. However, the U.S. Forest Service has set a 2020 goal of increasing forest and fuel reduction treatment on its lands from the current level of approximately 250,000 acres per year to 500,000 acres per year, and the U.S. Bureau of Land Management has a goal of increasing treatment on its California lands from the current 9,000 acres per year to 10-15,000 acres per year by 2020. Relevant federal programs include the Forest Service’s Good Neighbor Authority (which involves cooperation with state authorities) and the U.S. Department of the Interior’s Wildland Fire Resilient Landscapes Program.¹⁴ It is unclear whether sufficient federal funding has been appropriated to attain these expanded forest treatment goals.

Another limitation of the FCP is related to workforce development. The FCP describes a “limited appropriately trained or licensed supporting workforce” as one of the key “major impediments to forest restoration and ongoing forest management.” However, the FCP does not propose any specific training programs to increase workforce skills and availability, nor does it identify or incorporate standards for skills or occupational safety



and health as program requirements. Clear skill and safety standards are necessary to address the need for, and ensure demand for, trained workers and to provide signals to training institutions about what skills are needed.

The FCP does not propose detailed policy tools for mandates or other regulations to ensure that private timberland—ranging from small owners to large firms such as Sierra Pacific (the second-largest lumber producer in the United States)—meets the state’s goals for more intensive forest management. Some funding and technical assistance for forest landowners is provided by the U.S. Department of Agriculture through its Natural Resources Conservation Service.¹⁵

1. Industries and Occupations Affected

The two leading industries involved in the forest and wildlands management subsector are firefighting and vegetation management.¹⁶ Firefighting or fire suppression is a well-understood occupation and is discussed in the next section on workforce outcomes. The category of vegetation management encompasses a range of forestry services work, including tree planting, commercial and pre-commercial thinning, brush clearing, and other forms of vegetation reduction to decrease the intensity of fires in forests and scrublands, increase forest resiliency, and increase the carbon sink effect of forests. Vegetation management overlaps with the logging industry, because logging includes commercial thinning, with large trees removed for timber production and other debris sold to the forest products industry. This category also includes pre-commercial thinning,¹⁷ which is a form of vegetation management that involves leaving the larger trees while cutting smaller trees and brush, most or all of which is left on site. Industries involving the products and byproducts of forestry services work include biomass power generation and wood products manufacturing, which are detailed in Part 2 of this chapter.

Professional occupations in firefighting and vegetation management include fire engineers, foresters, ecological restoration scientists, while the blue-collar occupations include wildland firefighters, loggers, tree planters, thinners, brush-pilers, ecological restoration workers, and *equipment operators*.

At the peak of each year’s fire season, roughly 13,000 firefighters are working on wildfires statewide. Cal Fire’s 6,100 year-round employees comprise almost one-half of this total.¹⁸ State prison inmates enrolled in a joint Cal Fire and state Department of Corrections and Rehabilitation (CDCR) program account for up to forty percent of the wildland firefighters in California.¹⁹

Full-time Cal Fire employees do a considerable amount of fire prevention and vegetation management work as well, primarily during the winter-spring fire offseason; some of Cal Fire’s work lies outside the NWL sector as the agency serves as the local fire department in towns and small cities, under contract to many counties and rural municipalities. A



large share of vegetation management and forestry services work is carried out by independent contractors that work on federal, state, and private lands;²⁰ this contracted workforce is described in greater detail below. A small share of this work in the state is carried out under the California Conservation Corps (CCC), an entry-level, one-year program for roughly 1,400 young adults (18- to 25-year-olds).

2. Workforce Outcomes to Date

a. Job Growth

In recent years, employment in these sectors has been stagnant or declining, at least by U.S. Census data—although as described below, the data may be partially underreported.

i. Fire Suppression

Some wildlands firefighting and vegetation management work is carried out by state, city and county fire agencies that are primarily dedicated to urban and suburban firefighting. There is no industry classification (NAICS category) in government data specifically for wildlands firefighting, thus no current or projected job numbers are available.

ii. Fire Prevention, Management and other Forestry Services

Data for employment in this subsector vary by source, possibly because the category definitions are slightly different. According to U.S. Census County Business Patterns, employment in logging decreased 12 percent during 2005-2016 to 1,668 people, while workers in “Support Activities for Forestry” (including vegetation management and other jobs) shrank 29 percent to 601 people during the same period.²¹ These numbers are slightly different from those of the U.S. Bureau of Labor Statistics, whose data for May 2017 show 1,810 logging jobs and 1,780 “Forest and Conservation” jobs.²² In any case, the number of forestry services workers may be significantly undercounted.²³ Some researchers and advocacy groups assert that forestry services workers are especially difficult to count because many of their employers are small contractors, some of which are domiciled out of state and whose crews migrate from one remote job site to the next as often as every few weeks.²⁴

b. Job Quality

Wildlands firefighting, fire prevention, and vegetation management jobs inherently involve grueling, dangerous work, often including long hours in remote locations. In 2015, the agriculture and forestry sector (including firefighting, forestry services, and



logging) had the highest fatality rate of any major industry in the state, with 17.1 fatalities per 100,000 full-time workers, according to Cal-OSHA data.²⁵ The next-highest industry (construction) had 6.8 fatalities per 100,000 workers.

As described below, wages and conditions in the sector are generally low, except for Cal Fire employees, and available data are thin.

i. Fire Suppression

Wages and working conditions for year-round Cal Fire firefighters provide middle-class livelihoods. These workers are represented by Cal Fire Local 2881, and while their starting pay is only the state's minimum wage of \$11.00 per hour, there is a clear career path with pay rates that rise rapidly—for example, mid-level paramedic firefighters average about \$11,000 a month in total compensation.²⁶ Nevertheless, a 2014 study by the state Department of Human Resources showed that Cal Fire firefighters earn an average 33 percent less in total compensation (wages and benefits) and work more hours than their full-time counterparts at local fire agencies.²⁷

A much lower-paid component of the firefighting workforce is prison labor, which can comprise up to forty percent of California's wildlands firefighting workforce in a given year. Their pay is \$2 per day, plus \$1 an hour while fighting an active fire; they also earn credits toward reducing their sentences. This work does not count as job training for post-release employment, however.²⁸ Cal Fire and most other firefighting agencies do not hire workers with felony records, in part because such individuals are barred from obtaining Emergency Medical Technician and Paramedic certifications, which are required by most local fire departments.²⁹

ii. Fire Prevention and Forestry

Much forestry services and vegetation management work in California (and other Western states) is seasonal and irregular, with periods of unemployment or unpaid downtime because of weather or gaps between contracts. This work is also often migratory and occurs in remote locations.

Workers in the Forest and Conservation category (which includes thinners, tree planters, and other vegetation management workers) had a median hourly wage of \$10.66, the lowest of all 747 occupations statewide, according to U.S. Bureau of Labor Statistics' occupational data for 2018.³⁰ Workers in the Logging category were better paid, with a median hourly wage ranging from \$19.77 to \$24.43 depending on job description.³¹

Wages on U.S. Forest Service and Bureau of Land Management (BLM) land should be markedly higher than wages on state and private land, because forestry services contractors with a federal contract of more than \$2,500 must pay the local prevailing



wage under the Service Contract Act.³² In California, the 2018 prevailing wage levels for forest workers on U.S. Forest Service and BLM contracts ranged from \$14.13 per hour for tree planters to \$15.88 for thinners and slash pilers, up to \$35.51 for (logging) fallers, plus benefits.³³ Federal enforcement of prevailing wage standards (and other important labor laws and regulations), however, is lacking which means workers may not experience a real wage premium when carrying out contracted work on federal versus state or private forest lands; enforcement challenges are detailed below.

A relatively small share of the workforce in forestry services and vegetation management in the state is employed by the California Conservation Corps (CCC), an entry-level, one-year program for roughly 1,400 young adults (18- to 25-year-olds). Corps members work on fire prevention, tree-planting and vegetation management, as well as parks restoration, fish habitat, backcountry trails work, and energy conservation. The CCC pays the state minimum wage, plus benefits, and is intended to prepare youth for further career steps.³⁴

A more significant share of the forestry services workforce is hired by private contractors. These employers have contracts predominantly on national forest lands, although they also have contracts on private lands (commercial and residential), and to a lesser extent on state forest land. These private contractors rely in part on foreign guest workers with temporary work authorization under the federal H2-B visa program. Industry and labor experts estimate that H-2B workers account for 10 to 15 percent of the contracted forestry services workforce, which has grown over the past decade. Some portion of the privately-contracted forestry services workforce is comprised of undocumented immigrants, although it is difficult to estimate the extent.³⁵ Much of the contracted forestry services work takes place in remote locations, which is one challenge to enforcement of labor and employment laws in this sector—and workers not on federal lands are not covered by wage requirements other than minimum wage.³⁶

As noted above, the federal government has not consistently enforced labor laws—including prevailing wage requirements—in California’s forestry sector due to the nature of the contracted work and negligence or malpractice on the part of forestry services contractors. Victoria Lipnic, former U.S. Assistant Secretary of Labor for Employment Standards, admitted to inadequate enforcement in her 2006 testimony to the U.S. Senate regarding foreign guest workers (viz., H-2B visa-holders) employed on tree-planting and other service contracts on national forest land citing particular challenges such as “the short duration of the contracts; the remote, constantly changing work sites; the temporary residence of the workers in this country; the typically poor or nonexistent recordkeeping practices of the contractors; and the need to personally inspect and document safety, housing, and transportation violations when they occur... [and] significant trust, language, and literacy barriers.”³⁷ Subsequent research, news articles, and court cases have shown continued allegations of employer mistreatment of forest workers, including wage theft, and suggest that workers may sometimes have little recourse to



effective enforcement of labor laws.³⁸ U.S. Department of Labor (DOL) data show that from 2005-2017, 22 forestry employers on National Forest and BLM lands were fined \$789,145 by the DOL's Wage and Hour Division for a total of 1,570 violations. The state Division of Labor Standards Enforcement does not track this information.³⁹

The U.S. Forest Service and BLM require contractors to use the E-Verify system to check their employees' immigration status—although as mentioned above, enforcement appears to be uneven and/or irregular. Contractors on federal lands in California that comply with E-Verify often use foreign citizens working on temporary H-2B visas.⁴⁰ DOL's Office of Foreign Labor Certification does not provide disaggregated data for H-2B visa holders by sector per state, but DOL data on companies employing workers on these visas show that in 2017, four forestry services contractors in California were certified to bring in 329 workers on H-2B visas.⁴¹

The H-2B visa program, which grants temporary non-agricultural work authorization to foreign nationals, has significant weaknesses in terms of safeguarding labor rights. Under the program, each worker's visa is sponsored by their original employer, and the visa is valid only as long as the worker remains with that employer. Once the worker loses that job, they must leave the United States within 10 days. This restriction reduces workers' ability to organize for better pay and conditions. A 2013 report by the Southern Poverty Law Center about H-2B visa programs stated: "The most fundamental problem with guest worker programs, both historically and currently, is that the employer—not the worker—decides whether a worker can come to the United States and whether [they] can stay. Because of this arrangement, the balance of power between employer and worker is skewed so disproportionately in favor of the employer that, for all practical purposes, the worker's rights are nullified. At any moment, the employer can fire the worker, call the government, and declare the worker to be 'illegal.'"⁴²

c. Job Access and Workforce Training

i. Fire Suppression

Rigorous training is required through the California Firefighter Joint Apprenticeship Committee (Cal-JAC) for the roughly one-third of California wildland firefighters who are year-round Cal Fire employees. Cal-JAC is co-sponsored by California Professional Firefighters (CPF) and the California State Fire Marshal, and is a best-practice model for the NWL sector, as described in **Promising Practice #11.1**.⁴³

ii. Fire Prevention and Forestry

The state does not require any skill standards for workers in fire prevention, forestry services, vegetation management, or related fields.⁴⁴ The only training program identified in this report for blue-collar work in these activities is the California Conservation Corps



(CCC), described above. The central purpose of the CCC is to provide job skills to young workers, especially youth from disadvantaged communities. Although the CCC does recruit at-risk youth of color, only about one-fourth of Corps members complete the one-year program, and there is little data available on job outcomes for graduates.⁴⁵ Like many other workforce training programs, the CCC is challenged by the lack of clear career paths and an insufficient number of good jobs in the graduates’ fields—which in this case includes forestry, vegetation management, fire prevention, and firefighting. A February 2018 report from the Legislative Analyst’s Office concluded that, “the lack of measurable programmatic objectives or collection of outcome data on how the CCC performs in key areas makes it difficult to evaluate the program’s performance.”⁴⁶ The lack of other training programs in fire prevention is not surprising because, as described above, the jobs in this segment of the industry are largely very low wage.

PROMISING PRACTICE #11.1 Firefighter Pre-Apprenticeship Training and Inclusive Hiring Program

The pre-apprenticeship program under Cal-JAC is a best practice in the NWL sector because it provides a hiring pathway for underrepresented communities into family-supporting middle class careers. The program links to certified apprenticeship, a form of training and employment with clearly-defined wage increases as skills are acquired (See Chapter 3 for a description of the advantages of this earn-while-you-learn training model). Like all apprenticeship programs, Cal-JAC has clear skill standards that

are periodically updated and reviewed by the California Division of Apprenticeship Standards (DAS).⁴⁷ Under the mandate of Assembly Bill 579 (Flora, Chapter 344, Statutes of 2017),⁴⁸ Cal Fire and the DAS worked with the Cal-JAC to develop a statewide firefighter pre-apprenticeship program to recruit candidates from underrepresented groups. For the first class of this program, starting in January 2018, substantial diversity has been achieved, as shown in **Exhibit 11.4**, below.⁴⁹

Exhibit 11.4. Diversity of First Class of Firefighter Pre-Apprenticeship Training and Inclusive Hiring Program

| People who: | Latinos | African Americans | Asians | Women of All Groups | Total |
|-------------|---------|-------------------|--------|---------------------|-------|
| Applied | 27% | 22% | 4% | 17% | 228 |
| Admitted | 20% | 22% | 7% | 20% | 54 |
| Enrolled | 17% | 17% | 8% | 29% | 24 |



Pre-apprenticeship graduates are placed on the Firefighter Candidate Testing Center’s Statewide Eligibility List, which applicants must be on to be considered for hire by fire departments throughout California, and are guaranteed an oral interview with the Sacramento Fire Department—both key measures to increase access to these jobs. The robust training infrastructure of certified apprenticeship combined with this pre-appren-

ticeship program sets skill standards, increases wages as skills are acquired, and creates pipelines for inclusion of underrepresented groups. However, it only exists for year-round Cal Fire employees, as apprenticeship programs have not been developed for other segments of the workforce in fire prevention, forestry services, and vegetation management.

3. Workforce Recommendations

a. *Demand-Side Workforce Policy Levers for Job Quality and Job Access*

To achieve the goals of the Forest Carbon Plan and Governor Brown’s May 2018 Executive Order, the state will need an expanded labor force for both fire suppression and prevention: firefighters, thinners, forestry technicians, heavy machine operators, truck drivers, and others. This undertaking could be a major economic boon for rural, economically depressed California communities, if measures are taken to ensure local hiring and good-quality jobs, rather than the low-wage prison labor and contractor work crews. To enable this expansion, increased funding and stronger workforce requirements may be needed for related programs, even beyond the commitments made in the 2018 budget and SB 901.

Our recommendations for demand-side workforce interventions for Forest and Wildlands Management are:

- ❖ **Use inclusive procurement policies for public contracts for work in fire suppression and fire prevention, including vegetation management, tree thinning and planting, and habitat restoration. This includes:**
 - **Verification of compliance with labor and employment laws for all forestry contractors.**
 - **Setting of wage floors, which could be at the same levels as the federally mandated prevailing wages for forestry work on federal lands.**



- **Prioritize in-state firms. Contract bidding should comply with Governor Brown’s May 2018 Executive Order to ensure prioritization of local hiring over out-of-state forestry services contractors.**
- **For all firefighting, including seasonal workers who currently receive much less training, use a skilled and trained workforce standard to employ enrollees and graduates of the Cal-JAC apprenticeship program.**

b. Supply-Side Workforce Development Strategies

The forestry sector’s high fatality rates indicate a need for additional safety and skills training requirements for all forestry workers, including logging, thinning, and wildland firefighting. The governor’s May 2018 Executive Order instructs the Labor and Workforce Development Agency to “work with relevant state agencies and local workforce development boards to develop pilot training programs in forest thinning and biomass processing in areas where there is inadequate labor capacity to support such activities.”⁵⁰

❖ Expand the state-certified apprenticeship program for firefighters.

The Cal-JAC apprenticeship and pre-apprenticeship programs could be used as models for the training of all firefighters, including seasonal employees and employees of businesses that contract with the state for firefighting activities. If the state expands its fire suppression and prevention programs, this would cause an expansion of the Cal-JAC program. As new apprenticeship slots open up, this is an opportunity to explore using the CCC forestry services workers training program as a feeder program to the CPF pre-apprenticeship program.

❖ Expand high-road industry partnership initiatives to include fire prevention and forestry.

There is an opportunity for workforce intermediaries to convene employers, relevant state agencies, and nonprofit groups (such as worker centers) to explore the creation of a high-road industry training partnership for state contractors that carry out fire prevention (vegetation management, tree thinning and planting, and habitat restoration). This could eventually become a certified apprenticeship program as is the case for firefighting.



❖ **Train workers on Know-Your-Rights for fire prevention and forestry contract work.**

Research has shown that worker centers can serve as intermediaries to improve labor and employment law enforcement in cases of worker marginalization, as in the forestry services.⁵¹ Such an outreach plan is needed in California fire prevention and forestry services because of the extreme conditions of many workers, as described above. This plan could be modeled in part on the Spanish-language program *Si Sé: Salud y Seguridad en el Trabajo* (Yes, I Know: Health and Safety at Work), developed by the Northwest Forest Worker Center, the Labor Occupational Health Program at UC Berkeley, the Pacific Northwest Agricultural Safety and Health Center at University of Washington, and the Lomakatsi Restoration Project.⁵²

❖ **Continue efforts to unblock the prison-to-job pipeline for inmate firefighters.**

Public safety concerns are likely to continue to weigh against allowing the hiring of people with a previous felony conviction for jobs as front-line professional firefighters who interact with members of the public. However, firefighting experience while in prison could serve as part of a more comprehensive post-release, re-entry training program in forestry services and other fire prevention work.

B. Biomass Energy and Wood Products Manufacturing

Because fire prevention and forest restoration work is expensive, development of an associated revenue stream has long been viewed as an important component of policymaking for the sector. The woody biomass removed from forests via thinning is often not of adequate size or quality for lumber production at traditional sawmills. Forest landowners and communities need development of markets for this biomass to help defray the costs associated with forest restoration work.

Several policies have been passed by California Legislature to encourage the utilization of biomass from forests. These policies were modest in scale, and their impact to date has been limited. For example, an initial measure to mandate the expansion of bioenergy production from forest waste was Senate Bill 1122 (Rubio, Chapter 612, Statutes of 2012),⁵³ which called for utilities to procure 50 megawatts (MW) of biomass power. This law was codified in CPUC Resolution E-4770, which required that the three investor-owned utilities solicit 50 MW from bioenergy facilities that use waste from zones designated as high hazard for tree deaths or wildfires.⁵⁴



In 2016, SB 859 called for procurement of 125 MW of biomass power from facilities that source the majority of their feedstock from specific tree mortality high-hazard zones on private, state, and federal lands, as designated by Cal Fire according to the 2015 State of Emergency declaration about dead trees.⁵⁵ More recently, SB 901 required all electricity providers that had bioenergy contracts during 2018 to extend those contracts until at least 2024.

These policies to stimulate the biomass power market do not appear to have had the desired effect. From 2012 to 2017, statewide biomass energy generation declined from 6,031 gigawatt-hours (GWh) to 5,827 GWh, for reasons that are outside the scope of this report.⁵⁶

As with SB 1122, the 125-MW target has not yet been met. In October 2017, the Natural Resources Agency's Wood Products Working Group called for a series of steps to expand wood products manufacturing and biomass energy production.⁵⁷ Among other actions, it recommended:

- Development and promotion of “innovative wood products,” such as pre-engineered wood.
- Creation of a California Wood Innovations Small Grants Program for grants of \$50,000-\$150,000 for “innovative wood products and manufacturing concepts.” However, in the 2018 legislative session, AB 2842 (Bigelow), which would appropriate \$20 million in GGRF funds for this program, died in committee.⁵⁸
- Creation of a Wood Products Corps program under the California Conservation Corps (CCC). Like other CCC programs, this one-year program would be open to 18- to 25-year-olds and pay minimum wage. The Working Group report said this would “create and work with various training partnerships including community colleges and industry apprenticeships to connect graduating Corps members to employment opportunities, related community college associate degree programs, and continuing education.”⁵⁹

1. Industries and Occupations Affected

The main industries involved are the operation of biomass power plants, truck transportation of forest products, and manufacture of wood products. White-collar occupations in this sector are engineers and other technicians, while blue-collar occupations are power plant operators, electricians, boilermakers, carpenters, and assembly-line manufacturing workers.⁶⁰ However, the vast majority of the logging and wood products manufacturing industries are unrelated to climate policies and thus are outside the scope of this report.⁶¹



2. Workforce Outcomes to Date

a. Job Growth

The biomass energy sector has been shrinking over the past decade and directly employed only 77 people in 2016, down from 119 in 2013.⁶² The wood products manufacturing sector—which sources an estimated 80 percent of its lumber and other wood material from out of state—employed 21,766 people in 2016, down from 36,750 in 2005, largely because of increased automation technologies.⁶³ Most employment in wood products manufacturing is unrelated to state climate policy, however, as mentioned above.

A comprehensive approach to avoiding greenhouse gas emissions from wildfire and increasing the carbon sink of forests could include economic development policies to expand incentives for biomass conversion. Such policies might reverse the stagnation in this sector, although the feasibility and degree of reversal would depend on an improvement in the price competitiveness of bioenergy, the ability of manufacturers to develop new market niches for alternative wood products, and the amount of new state funding.

b. Job Quality and Job Access

Because the Scoping Plan's policies regarding forest biomass and wood products manufacturing have not yet been implemented, it is difficult to assess future impacts on job quality or access.

3. Workforce Recommendations

a. Demand-Side Workforce Policy Levers for Job Quality and Job Access

- ❖ **Use inclusive public procurement policies for large capital equipment purchases, public contracts for services, and in grant programs.**

The California Wood Innovations Small Grants Program can require that the evaluation of proposals offers bidders the opportunity to disclose estimates of jobs created, wages, and job access, with these rankings considered as part of the overall points calculated in the final award selection process. See Chapters 2 and 7 for discussions and examples of inclusive procurement policies.



The grant programs also should require and verify that all contractors and subcontractors, including nonprofit organizations, meet pre-established, clearly defined minimum standards of contractor responsibility, including possession of all applicable licenses, bonding, and insurance (including workers' compensation), as well as compliance with employment, occupational health and safety, and labor laws.

C. Urban Forests, Wetlands, and Coastal Carbon Sinks

Urban forestry is clearly related to climate policy because street trees and parklands play an important role as carbon sinks and in combatting the “heat island” effect of cities. Although many programs are funded through climate-related funding sources, much of this work has been operating under one program or another for decades because of its role in improving urban quality of life apart from greenhouse gas emission reduction.

For urban forestry, CARB planned two steps in late 2018 or early 2019: 1) to update its NWL emissions inventory to include urban forestry; and 2) to create an implementation plan that includes urban forests, which are important not just as carbon sinks, but to counteract the “heat island” effect of urban areas during hot weather.⁶⁴ Under Assembly Bill 1530 (Gonzalez Fletcher, Chapter 720, Statutes of 2017),⁶⁵ Cal Fire was instructed to expand the scope of its urban forestry program, especially its grant programs to community street tree-planting groups. AB 1530 also authorized Cal Fire to carry out “development and coordination of training programs for neighborhood and local agency tree-planting and maintenance crews.” As of the writing of this report, these programs were still under development.

In FY 2017-18, the Legislature allocated GGRF monies to two main programs to help cities increase the size and resilience of urban forests: \$20 million for the Urban and Community Forestry Program (Cal Fire)⁶⁶ and \$26 million for the Urban Greening Program (California Natural Resources Agency).⁶⁷ Other GGRF grant programs to increase carbon sinks, adaptation, and resilience include the Wildlife Conservation Board's Climate Adaptation Program,⁶⁸ which funds conservation easements; the Department of Fish and Wildlife's Wetlands Restoration for Greenhouse Gas Reduction Program,⁶⁹ which funds restoration of coastal and delta wetlands and mountain meadows; and the Coastal Conservancy's Climate Ready Program,⁷⁰ which funds planning and implementation of projects for sea-level-rise adaptation.



1. Industries and Occupations Affected

Much of California’s urban and suburban tree planting is carried out by nonprofits that are members of the California Urban Forests Council, which receives funding from Cal Fire and the U.S. Forest Service. Examples include TreePeople in Los Angeles, Urban Releaf in Oakland, and Friends of the Urban Forest in San Francisco. These organizations primarily use volunteer labor, such as neighborhood groups and homeowners who plant trees in front of their houses. Maintenance of existing trees on streets and in parks is carried out by municipal or county employees from the parks or urban forestry departments, which also typically serve in a supervisory or coordinating capacity for the nonprofit tree-planting efforts.⁷¹

2. Workforce Outcomes to Date

a. Job Growth

Much of the state’s urban greening work predates implementation of climate-related programs, but the GGRF provides a new source of funding. These programs are generally small and create only a few jobs. For example a 2018 study by the Luskin School of Public Affairs at the University of California, Los Angeles (UCLA) estimated that the state’s Urban & Community Forestry Program funded by the GGRF had created a total of 146 direct job-years in FY 2013-14 through FY 2015-16 from a total of \$15.7 million in grants.⁷²

b. Job Quality and Job Access

Urban tree maintenance or planting programs directly operated by local government agencies are covered by collective bargaining agreements in cases where they exist for those agencies. No specific wage information is available for the many tree-planting programs operated by nonprofits—although as mentioned, most nonprofits rely on volunteer labor of local residents. Jobs in urban greening that are contracted out may be covered by local living wage ordinances in jurisdictions where they exist, providing a floor on wages and benefits for covered workers.⁷³

The grants provided under the Wetlands Restoration and Climate Ready programs have also been small. Since 2014, the former has funded 12 projects for \$21 million total, while the latter has given \$7.3 million to 42 projects. Most are carried out by municipal and county government agencies, while a few are carried out by nonprofit organizations. No information is available about wages or benefits.



c. Workforce Training

As mentioned above, the training programs authorized under AB 1530 have not yet started operations. Some nonprofits run their own training programs with state funds, such as the Green Teens program run by Friends of the Urban Forest in San Francisco. This program pays minimum wage for low-income, at-risk youth age 14 to 19 to learn tree care, planting, and landscaping, but it has no defined career pathways to employment upon graduation.⁷⁴

3. Workforce Recommendations

a. Demand-Side Workforce Policy Levers for Job Quality and Job Access

❖ Use inclusive public procurement policies for large capital equipment purchases, contracts for public services, and in grant programs.

Grant programs for urban forestry, wetlands, and coastal carbon sinks can require that the evaluation of proposals offers bidders the opportunity to disclose estimates of jobs created, wages, and job access, with these rankings considered as part of the overall points calculated in the final award selection process. See Chapters 2 and 7 for discussions and examples of inclusive procurement policies.

The grant programs also should require and verify that all contractors and sub-contractors, including nonprofit organizations, meet pre-established, clearly defined minimum standards of contractor responsibility, including possession of all applicable licenses, bonding, and insurance (including workers' compensation), as well as compliance with employment, occupational health and safety, and labor laws.

❖ Use in-sourcing or exclusive franchise contracting models to support labor and environmental standards for public services and some incentive and low-income programs.

While it is important to continue encouraging volunteer labor in tree planting by community members, grants for urban forestry and wetlands and coastal restoration have the opportunity to encourage local governments to use in-house workers, and/or put minimum standards on wages and benefits or wage parity requirements on work performed by contractors.



b. Supply-Side Workforce Development Strategies

❖ Expand high-road industry partnership initiatives to include urban forestry and related activities.

AB 1530 did not specify the type of training programs to be created with its funds. The state should explore the creation of career pathways from tree-planter to arborist, or other more highly-skilled careers. At this time, there is insufficient information to assess the feasibility of career paths in the urban forestry area. Career planning efforts should follow the best practices laid out in Chapter 3, using the high road industry-led training partnership model.

D. Agriculture

Employment in the agriculture sector is similar to the forestry sector with respect to job quality, including wages and working conditions for vulnerable workers. Specifically, the agriculture sector includes many of the state's lowest paid workers. The 2017 statewide median hourly wage for farm and nursery workers was \$11.23, only slightly higher than for forestry workers.⁷⁵ Undocumented immigrants are believed to comprise a high share of the workforce in the crop, dairy, and livestock segments of the agriculture sector, and these workers face significant barriers to accessing labor law protections.⁷⁶

D1. Methane Capture from Animal Husbandry

Under Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016),⁷⁷ CARB is to create a strategy for reducing short-lived climate pollutants, including methane emissions from dairies and poultry and swine farms, by 40 percent below 2013 levels by 2030. CARB advises three-quarters of the emissions reduction should come from dairies, mostly through the installation of anaerobic digesters to process methane emissions. The reductions are voluntary until 2024, after which the state will impose mandatory cuts on dairies that fail to meet their targets. Methane capture outside of the agriculture/dairy sector is addressed in Chapter 9 on waste.

Under Assembly Bill 1613 (Blakeslee, Chapter 713, Statutes of 2007),⁷⁸ \$50 million was appropriated for reducing dairy methane emissions through development of anaerobic digesters and alternative manure management practices. Grant funding is being administered through the California Department of Food and Agriculture (CDFA) Dairy Digester Research and Development Program (DDRDP). As of July 2018, 18 projects totaling \$35 million had been funded by the DDRDP, with \$79 million in matching funds from the recipients.⁷⁹ In addition, the Alternative Manure Management Program (AMMP)



provides grants to livestock operations for practices that involve handling manure without an anaerobic digester. The AMMP is slated to receive between \$19 million and \$33 million in GGRF funding in 2018.⁸⁰ It is unclear whether the current funding levels will be sufficient to allow the state to attain its ambitious 2030 methane emission reduction goals, so additional appropriations for these programs may be needed.

1. Industries and Occupations Affected

Dairy digester grant recipients are selected by the CDFA. The digesters are built and operated by a small number of specialized contractors who can provide all related services, including development, financing, regulatory, marketing/sales, and operations.⁸¹ Typically, the contractor or a team of contractors are the official grant applicant in partnership with the dairy. In some cases, however, the dairy acts as the grant applicant and then contracts to the contractors for turnkey installation and other services. Actual ownership of the equipment varies—the dairy may own the system directly and pay for construction and maintenance, or the contractor may own the digester and pay a lease fee to the dairy. In all cases, day-to-day operation of the methane-capture equipment requires little skilled labor and is carried out by the dairy's own employees. These tasks typically occupy a small portion of workers' normal daily activities. In most cases, the contractors come periodically to maintain the equipment and systems.⁸²

Since methane capture is an emerging technology, most of the contractors have developed out of other industries and continue to work in them—for example, construction of biogas generators for the urban waste and recycling industry and many fields of engineering and public works.⁸³

There are two primary destinations for the bio-methane produced in these projects. Eleven of the 18 projects feed SoCalGas lines and are led by a project team of California Bioenergy, 4 Creeks Engineering, Anaergia, 4C Global, and SoCalGas, while seven projects are owned by Calgren Dairy Fuels and feed the new Calgren ethanol plant in Tulare County, which will connect to utility pipelines.⁸⁴

In addition, under a 2017 CPUC initiative, SoCalGas, PG&E, SDG&E and Southwest Gas have issued a request for proposals allowing dairies to carry out pilot projects.⁸⁵ As part of this initiative, in July 2018, Montauk Energy, a Pennsylvania firm that operates the Bowerman landfill in Irvine, signed a 20-year joint venture agreement to create a biogas refining facility south of Merced.⁸⁶



2. Workforce Outcomes to Date

a. Job Growth

Statewide dairy employment was 5,475 in 2016, a decrease of only 10 since 2013.⁸⁷ Climate policy has had little, if any influence on the number of jobs in this industry subsector. The UCLA Luskin study estimated that the state's dairy digester grants of \$11.3 million from FY 2013 through FY 2015 created a total of 32 direct job-years.

b. Job Quality and Access

No wage data are available for this subsector. Wages and working conditions are likely poor nonetheless, because the work to operate the digesters is primarily carried out by dairy workers who had a statewide median hourly wage of \$13.02 in 2017.⁸⁸

c. Workforce Training

Engineering services for dairy digesters require significant professional training. No specialized training programs are known to exist for the blue-collar jobs in dairy digesters (manufacturing, installation, and maintenance), or for the dairy workers who operate digester facilities.

3. Workforce Recommendations

a. Demand-Side Workforce Policy Levers for Job Quality and Job Access

❖ Use inclusive procurement policies grant programs for dairy digesters.

The dairy digester program relies on a handful of medium to large contractors that offer a comprehensive package of specialized, turnkey services. For the installation of dairy digesters, since the turnkey contractors rely heavily on grant funding, the inclusive procurement policies can have substantial influence on the development of this small but critical emerging industry.

As with all grant programs under state climate policy, grants for dairy digesters and other methane capture projects can require that the evaluation of proposals offer bidders the opportunity to disclose estimates of jobs created, wages, and job access, with these rankings considered as part of the overall points calculated in the final selection process. See Chapters 2 and 7 for discussions and examples of inclusive procurement policies.



The grant programs also should require and verify that all contractors and subcontractors meet pre-established, clearly defined minimum standards of contractor responsibility, including all applicable licenses, bonding and insurance (including workers' compensation), employment and labor law compliance, and no OSHA violations.

b. Supply-Side Workforce Development Strategies

❖ Expand High Road Industry Partnership initiatives to include methane digestion.

At this time, there is insufficient information to assess the need for or feasibility of high road industry training partnerships in this emerging industry. As with other emerging technologies, analysis of skill needs in pilot projects can help anticipate the need for skills upgrading and identify potential training partnerships, as described in Chapter 2.

D2. Agricultural Water Management and Other Programs

A variety of programs exist in this sub-sector, with relatively little impact on job growth, job quality, or job access to date. They are intended to improve energy efficiency in agricultural operations, particularly related to water usage. This objective is particularly important because agriculture uses about 40 percent of the state's managed water supply, roughly four times more than cities, which requires energy to pump, transport, and distribute. See Chapter 10 on the water sector for a more comprehensive discussion of water.

The State Water Efficiency and Enhancement Program (SWEET), administered by the CDFA, provides grants to install irrigation systems, soil moisture monitoring systems, and other technologies that reduce greenhouse gas emissions and save water in agricultural operations. Eligible system components include soil moisture monitoring, drip systems, switching to low-pressure irrigation systems, and installation of renewable energy systems to reduce on-farm water use and energy consumption. From the program's beginning in 2014 until mid-2018, a total of 614 projects had been funded at \$62.7 million, and more than \$40.8 million in local matching funds.⁸⁹

The Sustainable Groundwater Planning Grant Program of the Department of Water Resources (DWR) provides funds authorized under Prop. 1 to develop and implement sustainable groundwater planning and projects.⁹⁰ These funds support the goals of the 2014 Sustainable Groundwater Management Act, which requires local agencies to sustainably manage the state's groundwater basins. In the 2018 funding cycle, a total of 78 grants were made, totaling \$85.8 million.



The Water-Energy Grant Program, administered by the DWR, uses GGRF funds to provide grants to implement water efficiency programs or projects that reduce greenhouse gas emissions and reduce water and energy use. Eligible applicants are local agencies, joint powers authorities, and nonprofit organizations. Eligible projects include water efficiency programs (targeting residential, commercial, and institutional buildings), or projects that reduce greenhouse gases and/or water and/or energy use. While the agriculture sector is eligible for these funds, no agriculture-related project has been funded through the two grant cycles (2014 and 2016).⁹¹

The Healthy Soils Program is another program in this subsector, and is a collaboration of state agencies and departments led by the CDFA to install irrigation systems on farms that save energy and reduce greenhouse gas emissions. The program provides grants to commercial farmers to help them purchase and install energy-efficient irrigation equipment, such as soil moisture monitors as well as drip and low-pressure irrigation systems. As of August 2018, the program had made a total of \$13 million in grants.⁹² All of these grants are directly to the farms themselves, which then contract with specialized firms as needed. Installation of water- and/or energy-efficient irrigation equipment under the Healthy Soils Program does not require new specialized skills and is typically done by regular farm employees; some eligible equipment requires specialized skills to install however.

The Strategic Growth Council's Sustainable Agricultural Lands Conservation (SALC) Program was created in the 2014 state budget and provides GGRF grants for conservation easements to protect at-risk farmland from development. In 2018, the program awarded \$33.9 million to 27 land protection projects on 46,253 acres.⁹³

In addition, the state has several key policies to help the agriculture sector adopt distributed generation, including the partial exemption for sales and use tax for renewable energy generation and storage equipment at agricultural facilities.⁹⁴ This policy includes 100 percent exemption on state taxes levied when at least one-half of the electricity used to power a farm's agricultural equipment is generated by solar photovoltaics, biomass, wind, or other renewable energy technology.⁹⁵

To help cut greenhouse gas emissions from farm equipment, Assembly Bill 134 (Committee on Budget, Chapter 254, Statutes of 2017)⁹⁶ and Assembly Bill 109 (Ting, Chapter 249, Statutes of 2017)⁹⁷ authorized \$135 million for the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program.⁹⁸ This program, administered by local air districts, provides grants for agricultural harvesting equipment, heavy-duty trucks, agricultural pump engines, tractors, and other equipment used in agricultural operations that will achieve greenhouse gas emission reductions from the agriculture sector.



1. Workforce Outcomes to Date

The wide variety of agricultural activities promoted by the climate measures just described affect many segments of the agriculture industry in California. Data was not available to identify particular occupations within agriculture where activities are concentrated.

a. Job Growth

The UCLA Luskin study estimated that the state's \$55 million in grants from FY 2013 through FY 2015 in energy-efficient irrigation and water conservation created 120 direct job-years. No estimates are available for the other farm-related programs.

b. Job Quality and Access

No wage data are available for the specific agricultural work in this subsector.

c. Workforce Training

No specialized training programs are known to exist for this subsector.



III. Key Recommendations for the Natural and Working Lands Sector

Exhibit 11.5. Key Recommendations for the Natural and Working Lands Sector

| Demand Side | |
|--|---|
| Forest and Wildlands Management (Fire suppression and prevention) | <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement of contracts for work in firefighting and fire prevention, including vegetation management, tree thinning and planting, and habitat restoration. |
| Biomass Energy and Woods Products Manufacturing | <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement grants programs for biomass energy and wood products manufacturing. |
| Urban Forests, Wetlands, and Coastal Carbon Sinks | <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement grants programs for urban forests, wetlands, and coastal carbon sinks. ❖ Use in-sourcing to support labor and environmental standards for activities performed by public-sector workers, such as landscaping or responsible contractor requirements for contracted work. |
| Agriculture | <ul style="list-style-type: none"> ❖ Use inclusive procurement policies for public procurement grants programs for agriculture. |
| All Natural and Working Lands Subsectors | <ul style="list-style-type: none"> ❖ Use job impact metrics to measure the impact of climate incentive and investment programs on quantity of jobs, job quality and job access. ❖ Incorporate workforce analysis into emerging technology support programs. |



| Supply Side | |
|--|---|
| Forest and Wildlands Management (Fire suppression and prevention) | <ul style="list-style-type: none"> ❖ Expand the state-certified apprenticeship program for firefighters. ❖ Expand high-road industry partnership initiatives to include fire prevention and forestry. ❖ Train workers on Know-Your-Rights for fire prevention and forestry contract work. ❖ Continue efforts to unblock the prison-to-job pipeline for inmate firefighters. |
| Urban Forests, Wetlands, and Coastal Carbon Sinks | <ul style="list-style-type: none"> ❖ Expand high-road industry partnership initiatives to include urban forestry and related activities. |
| All Natural and Working Lands Subsectors | <ul style="list-style-type: none"> ❖ Track training program outcomes for graduation rates, attainment of industry-recognized credentials, job placement, retention, wages and wage progression. |



Endnotes

- 1 California Air Resources Board, “California Greenhouse Gas Inventory - Forests and Other Lands,” accessed April 19, 2018, available via Internet archive at <https://web.archive.org/web/20171218210713/https://www.arb.ca.gov/cc/inventory/sectors/forest/forest.htm>.
- 2 Committee on Budget and Fiscal Review, “SB-859 Public Resources: Greenhouse Gas Emissions and Biomass,” Chapter 368, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB859.
- 3 California Air Resources Board et al., “California 2030 Natural and Working Lands Climate Change Implementation Plan: Concept Paper,” May 2018, <https://arb.ca.gov/cc/natandworkinglands/nwl-implementation-plan-concept-paper.pdf>.
- 4 California Air Resources Board, “Greenhouse Gas Emissions Inventory - Query Results: Greenhouse Gas Emissions Inventory Summary [2000 - 2016],” June 22, 2018, https://www.arb.ca.gov/app/ghg/2000_2016/ghg_sector_data.php. Ben Bradford, “Extreme California Wildfires Emit More Greenhouse Gases—But Scientists Don’t Know Exactly How Much,” *Capitol Public Radio*, August 7, 2018, <http://www.capradio.org/120977>.
- 5 U.S. Department of the Interior, “New Analysis Shows 2018 California Wildfires Emitted as Much Carbon Dioxide as an Entire Year’s Worth of Electricity,” November 30, 2018, <https://www.doi.gov/pressreleases/new-analysis-shows-2018-california-wildfires-emitted-much-carbon-dioxide-entire-years>.
- 6 Forest Climate Action Team, “California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate” (Cal Fire, California Natural Resources Agencies, California Environmental Protection Agency, May 2018), <http://resources.ca.gov/wp-content/uploads/2018/05/California-Forest-Carbon-Plan-Final-Draft-for-Public-Release-May-2018.pdf>.
- 7 Bill Dodd, “SB-901 Wildfires,” Chapter 626, Statutes of 2018 § (2018), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB901.
- 8 Office of Governor Edmund G. Brown Jr., “Governor Brown Issues Executive Order to Protect Communities from Wildfire, Climate Impacts,” May 10, 2018, <https://www.ca.gov/archive/gov39/2018/05/10/governor-brown-issues-executive-order-to-protect-communities-from-wildfire-climate-impacts/index.html>.
- 9 Forest Climate Action Team, “California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate.”



10 Cal Fire, “Forest Climate Action Team (FCAT),” accessed April 19, 2018, available via Internet archive at <https://web.archive.org/web/20180328173604/https://www.fire.ca.gov/fcat>.

11 Tree Mortality Task Force, “Tree Mortality: Facts and Figures,” April 2018, https://accensus.org/wp-content/uploads/2018/06/TMFacts_and_Figures_April_2018.pdf.

12 California Air Resources Board, “Greenhouse Gas Reduction Fund Appropriations by Fiscal Year (As of August 31, 2018),” August 31, 2018, https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/detail_appropriation_8_31_18.pdf?_ga=2.201584529.1667454696.1538277478-312316492.1505438054.

13 State Board of Forestry and Fire Protection and California Department of Forestry and Fire Protection (Cal Fire), “2018 Strategic Fire Plan for California,” August 22, 2018, available via Internet archive at <https://web.archive.org/web/20190511010810/http://cdfdata.fire.ca.gov/pub/fireplan/fpupload/fpppdf1614.pdf>; California Fire Safe Council, “Mobilizing Californians to Protect Their Homes, Communities and Environments from Wildfire,” accessed October 19, 2018, <http://www.cafiresafecouncil.org/>.

14 U.S. Forest Service, “Good Neighbor Authority,” accessed October 19, 2018, <https://www.fs.fed.us/managing-land/farm-bill/gna>; U.S. Department of the Interior Office of Wildland Fire, “Wildland Fire Resilient Landscapes Activities,” 2015, available via Internet archive at <https://web.archive.org/web/20150912025640/https://www.doi.gov/wildlandfire/wildland-fire-resilient-landscapes-program>.

15 Natural Resources Conservation Service California, “Forestry,” November 3, 2017, <https://www.nrcs.usda.gov/wps/portal/nrcs/main/ca/technical/landuse/forestry/>.

16 BLS OES reports include data for commercial logging but not the forestry thinning and other vegetation management work that is relevant to state climate policies. Fire prevention is included in protective services. We therefore use information only on key occupations, rather than industry and occupation.

17 Forest Climate Action Team, “California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate.”

18 California Senate Governmental Organization Committee, “The Utilization of Current and Emerging Technologies to Monitor Wildfire Activity in California” (Sacramento, California, March 6, 2019), https://sgov.senate.ca.gov/sites/sgov.senate.ca.gov/files/tech_info_hearing_background_3.4.19.pdf.

19 Megan Cassidy, “Plum Gig or Slave Labor? California Inmates Fight Wildfires for \$1 an Hour - SFChronicle.Com,” *San Francisco Chronicle*, August 11, 2018, <https://www.sfchronicle.com/bayarea/article/Plum-gig-or-slave-labor-California-in-mates-fight-13148532.php>.



20 Carl Wilmsen, Executive Director, Northwest Forest Worker Center, interview with author, August 21, 2018.

21 U.S. Census Bureau, “County Business Patterns (CBP),” accessed October 19, 2018, <https://www.census.gov/programs-surveys/cbp.html>.

22 U.S. Census Bureau. For U.S. Census County Business Patterns, the NAICS codes referenced here are 113 (Forestry and Logging) and 115310 (Support Activities for Forestry). For Bureau of Labor Standards, the Standard Occupational Classification (SOC) codes referenced for logging are 45-4021 (Fallers), 45-4022 (Logging Equipment Operators), 45-4023 (Log Graders and Scalers), and 45-4029 (Logging Workers, All Other); the SOC code referenced for forestry services is 45-4011 (Forest and Conservation Workers). As mentioned, the definitions appear to be imprecise and may overlap.

23 Edward Kissam, “Differential Undercount of Mexican Immigrant Families in the U.S. Census,” *Statistical Journal of the IAOS* 33 (2017): 797–816, <https://doi.org/10.3233/SJI-170388>.

24 Carl Wilmsen, Executive Director, Northwest Forest Worker Center, interview with author, August 21, 2018; Carl Wilmsen, Diane Bush, and Dinorah Barton-Antonio, “Working in the Shadows: Safety and Health in Forestry Services in Southern Oregon,” *Journal of Forestry* 113, no. 3 (May 2015): 315–24, <https://doi.org/10.5849/jof.13-076>.

25 Juliann Sum, Debra Lee, and Cora Gherga, “State OSHA Annual Report (SOAR), FY 2016” (California Occupational Safety and Health Program, December 2016), [https://www.dir.ca.gov/dosh/reports/State-OSHA-Annual-Report-\(SOAR\)-FY-2016.pdf](https://www.dir.ca.gov/dosh/reports/State-OSHA-Annual-Report-(SOAR)-FY-2016.pdf).

26 Cal Fire Local 2881, “Representing the Professional Firefighters of Cal Fire,” accessed October 22, 2018, <http://www.calfirelocal2881.org/>; California Department of Human Resources, “Labor Relations Unit 8 - Firefighters,” accessed October 22, 2018, <http://www.calhr.ca.gov/labor-relations/Pages/Unit-08-Firefighters.aspx>.

27 California Department of Human Resources Office of Financial Management and Economic Research, “2014 California Firefighter Total Compensation Survey,” May 30, 2014, <https://www.calhr.ca.gov/Documents/2014-California-Firefighter-Total-Compensation-Survey.pdf>.

28 Amika Sergejev, “A Skilled Cal Fire Firefighter as an Inmate, She’s Barred from Career Now That She’s Free,” *The Mercury News*, November 21, 2017, <https://www.mercurynews.com/2017/11/21/opinion-a-skilled-cal-fire-firefighter-as-an-inmate-shes-barred-from-career-now-that-shes-free/>.

29 California Health and Human Services Agency and California Emergency Medical Services Authority, “State of California Emergency Medical Services Law,” January 1, 2016, <https://emsa.ca.gov/wp-content/uploads/sites/47/2017/07/2016-Statute-Book.pdf>.



- 30 U.S. Department of Labor, Bureau of Labor Statistics, “May 2018 OES State Occupational Employment and Wage Estimates - California (45-4011 - Forest and Conservation Workers),” accessed April 2, 2019, https://www.bls.gov/oes/current/oes_ca.htm#45-0000.
- 31 U.S. Department of Labor, Bureau of Labor Statistics.
- 32 U.S. Department of Labor, Wage and Hour Division, “McNamara-O’Hara Service Contract Act (SCA),” accessed June 20, 2018, <https://www.dol.gov/whd/govcontracts/sca.htm>.
- 33 U.S. General Services Administration, “Wage Determination 1977-0727: Forestry and Land Management Services,” Wage Determinations Online, July 3, 2018, <https://beta.sam.gov/search?keywords=1977-0727&page=1&index=wd>.
- 34 Shawn Martin, “Improving Outcomes for California Conservation Corpsmembers” (Legislative Analyst’s Office, February 9, 2018), http://www.lao.ca.gov/Publications/Report/3742#Multiple_Program_Goals_and_Lack_of_Outcome_Data_Make_Program_Assessment_Difficult_.
- 35 Information and conclusions in this paragraph are based on: Wilmsen, Executive Director, Northwest Forest Worker Center, May 21, 2019; Wilmsen, Executive Director, Northwest Forest Worker Center, June 3, 2019; see also Wilmsen, Bush, and Barton-Antonio, “Working in the Shadows”; Alliance of Forest Workers and Harvesters, “A Guide to Job Quality and Remaining Competitive in Forest Ecosystem Restoration” (prepared for the Forest Guild, June 2010), <https://firebasestorage.googleapis.com/v0/b/nwforestworkers-f633c.appspot.com/o/PDF%2FHandbook.pdf?alt=media&token=77aacec1-9b77-4c87-bb9b-b9a17eeaccb2>.
- 36 “Forest Service Workers,” Pub. L. No. S. Hrg. 109-427, § Subcommittee on Public Lands and Forests of the Committee on Energy and Natural Resources (2006), <https://www.gpo.gov/fdsys/pkg/CHRG-109shrg28144/html/CHRG-109shrg28144.htm>.
- 37 Forest Service Workers.
- 38 Denny Walsh and Sam Stanton, “Court Documents Reveal Probe into Complaints by Mexican Forest Laborers,” *Sacramento Bee*, July 17, 2014, <https://www.sacbee.com/news/politics-government/article2604061.html>; Sean P. Gates, Doe I, et al. v. Pure Forest, LLC et al., No. Case 2:14-cv-00879-LKK-CMK (United States District Court Eastern District of California April 8, 2014 [filed]); Cassandra Moseley, “Chapter 9: Job Quality for Forest Workers,” in *Forest Community Connections: Implications for Research, Management, and Governance*, by Ellen Donoghue and Victoria Sturtevant (Washington, DC: Resources for the Future, 2008), 162–81; Brinda Sarathy, *Pineros: Latino Labour and the Changing Face of Forestry in the Pacific Northwest* (Vancouver, BC: UBC Press, 2012); Hal Herring, “The Changing Politics of Woods Work,” *High*



Country News, October 30, 2017, <https://www.hcn.org/issues/49.18/timber-how-the-out-sourcing-of-forestry-jobs-seeps-into-our-public-lands-debates>; Tom Knudson and Hector Amezcua, “The Pineros: Men of the Pines,” *Sacramento Bee*, November 13, 2005, <http://www.sethlondon.com/portfolio/sacbee/pineros/index.html>.

39 Mark Janatpour, Division of Labor Standards Enforcement, California Department of Industrial Relations, email to author, January 22, 2019.

40 Daniel Costa, “The H-2B Temporary Foreign Worker Program: For Labor Shortages or Cheap, Temporary Labor?” (Economic Policy Institute, January 19, 2016), <https://www.epi.org/publication/h2b-temporary-foreign-worker-program-for-labor-short-ages-or-cheap-temporary-labor/#epi-toc-13>.

41 U.S. Department of Labor, Employment and Training Administration, “OFLC Performance Data,” accessed October 9, 2018, <https://www.foreignlaborcert.doleta.gov/performancecdm.cfm>.

42 Mary Bauer and Meredith Stewart, “Close to Slavery: Guestworker Programs in the United States” (Southern Poverty Law Center, February 19, 2013), <https://www.splcenter.org/20130218/close-slavery-guestworker-programs-united-states>.

43 Cal Fire, “CAL FIRE Firefighter Training,” October 2009, http://calfire.ca.gov/communications/downloads/fact_sheets/Firefightertraining.pdf.

44 Cal Fire, “Fire Protection Careers - Firefighter Hiring,” accessed April 19, 2018, http://calfire.ca.gov/about/about_careers_fireprotection_seasonal.

45 Martin, “Improving Outcomes for California Conservation Corpsmembers.”

46 Martin.

47 Cal Fire, “CAL FIRE Firefighter Training.”

48 Heath Flora, “AB-579 Apprenticeship: Fire Protection: Firefighter Preapprenticeship Program.,” Pub. L. No. 579, Chapter 344, Statutes of 2017 (2017), https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB579.

49 California Firefighter Joint Apprenticeship Committee, “Demographics From Application to Cohort,” June 2018.

50 Office of Governor Edmund G. Brown Jr., “Governor Brown Issues Executive Order to Protect Communities from Wildfire, Climate Impacts.”

51 Janice Fine and Jennifer Gordon, “Strengthening Labor Standards Enforcement through Partnerships with Workers’ Organizations,” *Politics & Society* 38, no. 4 (December 2010): 552–85, <https://doi.org/10.1177/0032329210381240>.



- 52 Northwest Forest Worker Center, “Occupational Safety and Health,” accessed October 22, 2018, <https://nwforestworkers.org/programs/occupational-safety-and-health>.
- 53 Michael J. Rubio, “SB-1122 Energy: Renewable Bioenergy Projects,” Chapter 612, Statutes of 2012 § (2012), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201120120SB1122.
- 54 California Public Utilities Commission, Energy Division, “Resolution E-4770,” March 17, 2016, <http://docs.cpuc.ca.gov/publisheddocs/published/g000/m159/k652/159652363.pdf>.
- 55 Office of Governor Edmund G. Brown Jr., “Tree Mortality State of Emergency,” October 30, 2015, https://www.ca.gov/archive/gov39/wp-content/uploads/2017/09/10.30.15_Tree_Mortality_State_of_Emergency.pdf.
- 56 California Energy Commission, “2012 Total Electricity System Power,” accessed January 14, 2019, https://energyarchive.ca.gov/almanac/electricity_data/system_power/2012_total_system_power.html.
- 57 California Natural Resources Agency, “Recommendations to Expand Wood Products Markets in California” (on behalf of Wood Products Working Group, October 2017), <http://resources.ca.gov/wp-content/uploads/2014/07/Wood-Products-Recommendations.pdf>.
- 58 Frank Bigelow, “AB-2842 Wood Products,” Public Resources Code § (2018), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2842.
- 59 California Natural Resources Agency, “Recommendations to Expand Wood Products Markets in California.”
- 60 Missing data and small numbers of workers preclude using BLS occupational data for this sector.
- 61 Missing data and small numbers of workers preclude using BLS occupational data for this sector.
- 62 U.S. Census Bureau, “County Business Patterns 2016,” April 19, 2018, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=B-P_2016_00A1&prodType=table.
- 63 U.S. Census Bureau; Stephen A. Brink, “Vice President for Public Resources, California Forestry Association,” January 11, 2019.
- 64 David L. Ulin, “Synonymous with Sun, Los Angeles Needs More Shade,” *Los Angeles Times*, August 30, 2018, <http://www.latimes.com/opinion/op-ed/la-oe-ulin-tree-cover-20180830-story.html>.



- 65 Lorena Gonzalez Fletcher, “AB-1530 Urban Forestry,” Chapter 720, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB1530.
- 66 California Natural Resources Agency and Cal Fire, “Expenditure Record for Urban & Community Forestry Program, Fiscal Year 2017/2018,” January 9, 2018, https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/calfire-urbanforestry-atte-er.pdf?_ga=2.52808107.2080290525.1524169459-800290699.1505934573; California Air Resources Board, “Cap-and-Trade Auction Proceeds: Funding Guidelines for Agencies That Administer California Climate Investments,” December 2015, <https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/arb-funding-guidelines-for-ca-climate-investments.pdf>.
- 67 California Natural Resources Agency and Cal Fire, “Expenditure Record for Urban & Community Forestry Program, Fiscal Year 2017/2018.”
- 68 California Wildlife Conservation Board, “Climate Adaptation Program,” accessed October 9, 2018, <https://wcb.ca.gov/Programs/Climate-Adaptation>.
- 69 California Department of Fish and Wildlife, “Wetlands Restoration for Greenhouse Gas Reduction Program,” accessed October 9, 2018, <https://www.wildlife.ca.gov/Conservation/Watersheds/Greenhouse-Gas-Reduction>.
- 70 California Coastal Conservancy, “Climate Ready Program,” accessed October 22, 2018, <http://scc.ca.gov/climate-change/climate-ready-program/>.
- 71 BLS industry and occupational data are not available for this subsector.
- 72 J.R. DeShazo et al., “Employment Benefits from California Climate Investments and Co-Investments” (UCLA Luskin Center for Innovation, August 14, 2018), https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Employment_Benefits_from_CA_Climate_Investments_and_Co-investments.pdf.
- 73 UC Berkeley Center for Labor Research and Education, “California City and County Living Wage Ordinances,” accessed September 26, 2018, <http://laborcenter.berkeley.edu/minimum-wage-living-wage-resources/california-city-and-county-living-wage-ordinances/>.
- 74 Friends of Urban Forest, “Green Teens,” 2016, <https://www.fuf.net/programs-services/community-engagement-education/green-teens/>.
- 75 U.S. Department of Labor, Bureau of Labor Statistics, “May 2017 OES State Occupational Employment and Wage Estimates- California (Farming, Fishing, and Forestry Occupations),” Occupational Employment Statistics, March 30, 2018, https://www.bls.gov/oes/2017/may/oes_ca.htm#45-0000.



- 76 Dee J. Hall and Riley Vetterkind, “Undocumented Workers Are The Backbone Of Dairies. Will Trump Change That?,” Listen to America (HuffPost, Wisconsin Center for Investigative Journalism, June 4, 2018), https://www.huffpost.com/entry/wisconsin-dairy-industry-undocumented-workers_n_59c3cfb7e4b06f93538cfd3f?n_cid=engmodushpmsg00000004; U.S. Department of Labor, Employment and Training Administration, “California Demographic Characteristics: Crop Workers,” n.d., available via Internet archive at https://web.archive.org/web/20171127190607/https://doleta.gov/news/pages/research/docs/Table13.NAWS_California_Demographics.xlsx.
- 77 Ricardo Lara, “SB-1383 Short-Lived Climate Pollutants: Methane Emissions: Dairy and Livestock: Organic Waste: Landfills,” Chapter 395, Statutes of 2016 § (2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383.
- 78 Sam Blakeslee, “AB-1613 Energy: Waste Heat and Carbon Emissions Reduction Act,” Chapter 713, Statutes of 2007 § (2007), http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200720080AB1613.
- 79 California Climate & Agriculture Network, “Methane from Dairies,” November 12, 2015, <http://calclimateag.org/methanedairies/>. (Available now via <https://web.archive.org/web/20180901023624/http://calclimateag.org/methanedairies/>.)
- 80 California Department of Food and Agriculture, “Alternative Manure Management Program (AMMP),” accessed October 24, 2018, <https://www.cdfa.ca.gov/oefi/AMMP/>.
- 81 No BLS data are available for this subsector.
- 82 Alessandro Hall, “Under New Pollution Regulations, Milk Producers Seek Profit in Dairy Air,” Stanford University, The Bill Lane Center for the American West, ... & the West (blog), April 24, 2018, <https://west.stanford.edu/news/blogs/and-the-west-blog/2018/california-methane-dairy-farms>.
- 83 Hall.
- 84 California Department of Food and Agriculture, “2017 Dairy Digester Research and Development Program: Projects Selected for Award of Funds,” September 14, 2018, https://www.cdfa.ca.gov/oefi/ddrdp/docs/2017_DDRDP_ProjectsAwarded.pdf.
- 85 Maritza Correa et al., “Renewable Natural Gas: Insights and Recommendations for California” (TomKat Center for Sustainable Energy, Stanford University, April 2018), <https://stanford.app.box.com/s/6lfnipidxeoec4ix4rwg1xz7w0m8tdq>.
- 86 Lisa Steyn, “Montauk Energy Strikes Biogas Deal with US Dairy Farm,” *Business Day*, August 2, 2018, <https://www.businesslive.co.za/bd/companies/energy/2018-08-02-montauk-energy-strikes-biogas-deal-with-us-dairy-farm/>.



- 87 U.S. Census Bureau, “County Business Patterns (CBP).”
- 88 U.S. Department of Labor, Bureau of Labor Statistics, “Occupational Employment and Wages, May 2018: 45-2093 Farmworkers, Farm, Ranch, and Aquacultural Animals,” accessed January 14, 2019, <https://www.bls.gov/oes/current/oes452093.htm>.
- 89 California Department of Food and Agriculture, “State Water Efficiency and Enhancement Program,” accessed October 9, 2018, <https://www.cdffa.ca.gov/oefi/sweep/>.
- 90 California Department of Water Resources, “Sustainable Groundwater Planning Grant Program,” accessed June 11, 2018, <https://water.ca.gov/Work-With-Us/Grants-And-Loans/Sustainable-Groundwater>.
- 91 California Department of Water Resources, “Water Energy Grant Program,” accessed September 24, 2018, <https://water.ca.gov/Work-With-Us/Grants-And-Loans/Water-Energy-Grant-Programs>.
- 92 California Air Resources Board, “California Climate Investments: Appropriations from the Greenhouse Gas Reduction Fund as of August 31, 2018, Sustainable Communities and Clean Transportation,” August 31, 2018, available via Internet archive at https://web.archive.org/web/20181202233236/https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/summary_appropriation_table_8_31_18.pdf.
- 93 California Strategic Growth Council, “Sustainable Agricultural Lands Conservation,” accessed October 9, 2018, <http://sgc.ca.gov/programs/salc/>.
- 94 California Department of Tax and Fee Administration, “Sales & Use Tax Exemptions,” accessed October 9, 2018, <https://www.cdtfa.ca.gov/taxes-and-fees/sales-and-use-tax-exemptions.htm#Farm-Equipment-and-Machinery>.
- 95 California Department of Tax and Fee Administration, “Sales and Use Taxes: Exemptions and Exclusions; California Revenue and Taxation Code Part 1, Division 2,” March 2018, <https://www.cdtfa.ca.gov/formspubs/pub61.pdf>.
- 96 Committee on Budget, “AB-134 Budget Act of 2017,” Chapter 254, Statutes of 2017 § (2017), http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB134.
- 97 Philip Ting, “AB-109 Budget Act of 2017,” Chapter 249, Statutes of 2017 § (2017), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB109.
- 98 California Air Resources Board, “FARMER Program,” accessed October 9, 2018, <https://ww2.arb.ca.gov/our-work/programs/farmer-program>.



Putting California on the High Road: A Jobs and Climate Action Plan for 2030

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Appendices

Appendix A. Mapping Sectors to Industries and Occupations

This appendix reports the detailed industry, occupation, and wage distributions for each subsector discussed in the six Scoping Plan sector chapters in this report. It identifies the key industries, as defined by the North American Industry Classification System (NAICS), lists the occupations within those industries, as defined by the Standard Occupational Classification (SOC), and reports the wage distributions for the main occupations in each identified industry. This analysis uses data from the Bureau of Labor Statistics (BLS) Occupational Employment Statistics (OES), at the greatest level of disaggregation (reflected in greater NAICS digits) that is available (https://www.bls.gov/oes/current/oes_research_estimates.htm).

Methodology and Limitations

Using information from the Scoping Plan about the economic activities that will be undertaken to reach the state's climate goals, this analysis first identifies the industries that each Scoping Plan subsector belongs in (e.g., zero-emissions car manufacturing is a segment of all auto manufacturing). In some sectors, the industry is self-evident—for example, waste, which has its own specific NAICS code. However, in other cases, the Scoping Plan subsectors do not correspond to a NAICS industry, and in those cases the analysis identifies the appropriate corresponding NAICS industries using the best available information from secondary literature or expert knowledge. The NAICS does not generally distinguish between higher and lower carbon segments of each industry although this can sometimes be discerned at the more disaggregated 4 and 5 digit levels of industry classification. The reader should keep in mind that the BLS OES data may not reflect the particular characteristics of the businesses affected by state climate policy in each subsector, but rather describe the entire industry in which they are classified.

This mismatch between industries categorized by NAICS codes and the subsectors identified in this report is a limitation of this analysis and the reader should be aware that it may in some cases reduce the accuracy of the reported occupation distribution in this appendix. This divergence is likely to be greater for specific detailed occupation categories such as rail car repairers than for the broad categories such as blue-collar workers. In addition, this analysis of BLS OES data cannot be used to generate estimates of total employment by subsector, again because only segments of the identified industries correspond to the subsectors affected by climate policy. For example, the OES data cannot quantify the jobs involved in the production of zero-emissions cars as a share of the entire auto manufacturing industry, so it is not possible to report employment counts for zero-emissions auto manufacturing from this data.



For this reason, the sector chapters incorporate more specific information whenever it can be gleaned from industry studies and experts, rather than rely solely on the BLS OES results reported here. In some cases, previous research has documented detailed information about the specific businesses and occupations that define the subsectors, including information on job quality, job access, training, and other information which cannot be discerned from the BLS OES data.

The SOC codes are reported at the *major* and *detailed* level. At the major SOC code level, the analysis classifies occupations into the broad categories of Professional, Blue Collar, White Collar, Managerial, and Other Miscellaneous, as shown in **Exhibit A.1**.

The analysis also reports the top ten detailed occupations in each industry, e.g. those representing the largest proportion of total workers in the industry. Again, the accuracy of this ranking depends on how closely the subsector aligns with the NAICs industry.

As much as possible, California-specific data on occupations by industry were used. However, some state-level occupation data were missing in some of the industries. To partially remedy this data deficit, national-level data replaced state data when at least 10 percent of an industry's major-level occupation data were missing.

Finally, the analysis reports the hourly wage distribution percentiles reported by the BLS OES for the 25th, 50th (median), and 75th percentile wage for both major and detailed SOC codes in each industry. Here it should be noted that for industries where violations of labor and employment law are significant, these wage distributions may not capture the actual level or share of low-wage jobs. As the sector chapters note, wage theft, misclassification, and/or other violations have been documented in a number of industries identified here, including residential construction, trucking, waste, and forestry services.

Results

Exhibit A.2 presents an overview of the subsectors, their corresponding industries, and the share of blue-collar jobs within those industries for each Scoping Plan sector. **Exhibit A.3** presents detailed information on the occupation and wage distribution for each industry.



Exhibit A.1. Occupation Categories by Professional, Blue Collar, White Collar, Managerial, and Other Miscellaneous

| Occupation Category | Standard Occupational Classification (SOC) Code | Occupation Name |
|---------------------|---|--|
| Professional | 17-0000 | Architecture and Engineering Occupations |
| | 15-0000 | Computer and Mathematical Occupations |
| | 19-0000 | Life, Physical, and Social Science Occupations |
| | 29-0000 | Healthcare Practitioners and Technical Occupations |
| | 23-0000 | Legal Occupations |
| Blue Collar | 47-0000 | Construction and Extraction Occupations |
| | 51-0000 | Production Occupations |
| | 53-0000 | Transportation and Material Moving Occupations |
| | 49-0000 | Installation, Maintenance, and Repair Occupations |
| | 37-0000 | Building and Grounds Cleaning and Maintenance Occupations |
| | 45-0000 | Farming, Fishing, and Forestry Occupations |
| White Collar | 41-0000 | Sales and Related Occupations |
| | 43-0000 | Office and Administrative Support Occupations |
| Managerial | 13-0000 | Business and Financial Operations Occupations |
| | 25-0000 | Education, Training, and Library Occupations |
| | 11-0000 | Management Occupations |
| Other Miscellaneous | 31-0000 | Healthcare Support Occupations |
| | 21-0000 | Community and Social Service Occupations |
| | 33-0000 | Protective Service Occupations |
| | 27-0000 | Arts, Design, Entertainment, Sports, and Media Occupations |
| | 39-0000 | Personal Care and Service Occupations |
| | 35-0000 | Food Preparation and Serving Related Occupations |



Exhibit A.2. Scoping Plan Sector, Subsector, Industry, and Percent Blue-Collar Employment

| Scoping Plan Sector | Subsector | Industry by NAICS | % Blue-Collar Jobs |
|-----------------------|---|--|--------------------|
| Energy | Utility Scale Renewables—Construction | Utility System Construction | 78% |
| | Utility Scale Renewables—Operations | Electric Power Generation, Transmission and Distribution | 38% |
| | Distributed Generation | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |
| | Energy Efficiency | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |
| | Natural Gas Leakage Abatement | Natural Gas Distribution* | 42% |
| Transportation | Cleaner Vehicles | Motor Vehicle Manufacturing | 87% |
| | | Automotive Repair and Maintenance | 78% |
| | Trucking | Truck Transportation | 77% |
| | Public Transit | Transit and Ground Passenger Transportation | 83% |
| | Clean Fuel Infrastructure | Electrical Contractors and Other Wiring Installation | 75% |
| | Transit Infrastructure | Other Heavy and Civil Engineering Construction | 76% |
| | Infill and Transit-Oriented Development | Residential Building Construction | 69% |
| | | Nonresidential Building Construction | 59% |



| Scoping Plan Sector | Subsector | Industry by NAICS | % Blue-Collar Jobs |
|----------------------------------|--|---|--------------------|
| Industry | Emissions Intensive Manufacturing | Various* | 58%** |
| | Fossil Fuel Production, Refining, and Distribution | Oil and Gas Extraction | 41% |
| | | Petroleum and Coal Products Manufacturing | 55% |
| | | Pipeline Transportation | 63% |
| | Emissions and Leakage Abatement | Other Specialty Contractors | 79% |
| Electrification | Electrical Contractors and Other Wiring Installation | 75% | |
| Waste | Waste Diversion and Methane Capture | Waste Management and Remediation Services | 76% |
| Water | Water Conservation in Drinking Water, Storm Water, Waste Water, Efficient Water Infrastructure | Water, Sewage and Other Systems | 58% |
| | | Utility System Construction | 78% |
| | | Remediation and Other Waste Management Services | 72% |
| Natural and Working Lands | Forestry Services, Fire Prevention and Suppression | Forestry and Logging | 90% |
| | Lower Carbon Soil Management and Crop Production; Manure Management for Methane Capture | Agriculture, Forestry, Fishing and Hunting | 96% |
| | Wetlands Restoration, Urban Greening, etc. | Various* | N/A |

Notes:

* Detailed occupation profile of this industry is not available.

** Employment-weighted average of proportions of blue-collar workers within the NAICS industries listed as eligible for receiving allowances under the Cap-and-Trade Program Vintage 2018 Allowance Allocation. See California Air Resources Board, "Cap-and-Trade Program: Vintage 2018 Allowance Allocation," December 5, 2017, <https://ww3.arb.ca.gov/cc/capandtrade/allowanceallocation/v2018allocation.pdf>.

Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Exhibit A.3. Detailed Occupational and Wage Profiles for Key Industries

Subsector: Utility Scale Renewable Energy—Construction
Occupation Profile for: Utility System Construction (4 digit)
NAICS Code: 237100

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 3% | \$28.80 | \$37.60 | \$51.90 |
| | SUBTOTAL | | 3% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 55% | \$19.10 | \$27.20 | \$36.50 |
| | 51-0000 | Production Occupations | 3% | \$16.20 | \$22.30 | \$31.80 |
| | 53-0000 | Transportation and Material Moving Occupations | 4% | \$17.80 | \$24.00 | \$30.30 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 15% | \$18.80 | \$26.20 | \$36.60 |
| | SUBTOTAL | | 78% | | | |
| White Collar | 43-0000 | Office and Administrative Support Occupations | 8% | \$15.80 | \$20.60 | \$27.30 |
| | SUBTOTAL | | 9% | | | |
| Managerial | 11-0000 | Management Occupations | 6% | \$37.90 | \$51.30 | \$72.00 |
| | 13-0000 | Business and Financial Operations Occupations | 4% | \$28.00 | \$37.00 | \$48.70 |
| | SUBTOTAL | | 10% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2061 | Construction Laborers | 16% | \$16.50 | \$21.50 | \$29.40 |
| | 47-2073 | Operating Engineers and Other Construction Equipment Operators | 8% | \$27.40 | \$35.80 | \$44.00 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 7% | \$28.00 | \$36.90 | \$46.40 |
| | 47-2151 | Pipelayers | 6% | \$19.80 | \$24.50 | \$29.80 |
| | 47-5071 | Roustabouts, Oil and Gas | 6% | \$19.20 | \$28.50 | \$37.10 |
| | 49-9051 | Electrical Power-Line Installers and Repairers | 5% | \$28.20 | \$40.20 | \$54.20 |
| | 49-9052 | Telecommunications Line Installers and Repairers | 4% | \$16.70 | \$20.70 | \$26.40 |
| | 51-4121 | Welders, Cutters, Solderers, and Brazers | 3% | \$17.90 | \$24.30 | \$33.70 |
| | 47-2152 | Plumbers, Pipefitters, and Steamfitters | 2% | \$19.00 | \$24.50 | \$30.60 |
| White Collar | 43-9061 | Office Clerks, General | 2% | \$14.00 | \$18.00 | \$23.30 |
| TOTAL | | | 58% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Utility Scale Renewable Energy—Operations
Occupation Profile for: Electric Power Generation, Transmission and Distribution (4 digit)
NAICS Code: 221100

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 7% | \$53.10 | \$64.00 | \$74.40 |
| | 15-0000 | Computer and Mathematical Occupations | 4% | \$52.30 | \$60.20 | \$69.60 |
| | 19-0000 | Life, Physical, and Social Science Occupations | 2% | \$46.60 | \$55.70 | \$61.20 |
| | 29-0000 | Healthcare Practitioners and Technical Occupations | < 1% | \$53.60 | \$59.70 | \$65.00 |
| | 23-0000 | Legal Occupations | < 1% | \$70.20 | \$93.10 | — |
| | SUBTOTAL | | | 14% | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 2% | \$45.70 | \$54.50 | \$61.30 |
| | 51-0000 | Production Occupations | 8% | \$42.70 | \$54.00 | \$60.30 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 28% | \$45.50 | \$55.70 | \$61.10 |
| | SUBTOTAL | | | 38% | | |
| White Collar | 41-0000 | Sales and Related Occupations | 3% | \$42.10 | \$49.50 | \$59.00 |
| | 43-0000 | Office and Administrative Support Occupations | 13% | \$26.00 | \$32.80 | \$45.00 |
| | SUBTOTAL | | | 16% | | |
| Managerial | 11-0000 | Management Occupations | 11% | \$66.30 | \$81.40 | \$97.70 |
| | 13-0000 | Business and Financial Operations Occupations | 16% | \$40.20 | \$49.00 | \$60.10 |
| | SUBTOTAL | | | 27% | | |
| Other Miscellaneous | 27-0000 | Arts, Design, Entertainment, Sports, and Media Occupations | < 1% | \$56.10 | \$65.50 | \$74.00 |
| | SUBTOTAL | | | < 1% | | |
| TOTAL | | | 96% | | | |



| Occupation Distribution, Detailed Level (Top 10) | | | | | | |
|--|--------------|---|----------------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 15-1121 | Computer Systems Analysts | 3% | \$52.80 | \$60.00 | \$67.80 |
| Blue Collar | 49-9051 | Electrical Power-Line Installers and Repairers | 12% | \$52.30 | \$57.60 | \$60.70 |
| | 51-8013 | Power Plant Operators | 5% | \$39.20 | \$49.00 | \$58.00 |
| | 49-2095 | Electrical and Electronics Repairers, Powerhouse, Substation, and Relay | 5% | \$41.50 | \$47.60 | \$54.70 |
| | 49-1011 | First-Line Supervisors of Mechanics, Installers, and Repairers | 4% | \$58.80 | \$68.10 | \$74.90 |
| | 49-9012 | Control and Valve Installers and Repairers, Except Mechanical Door | 3% | \$38.20 | \$45.10 | \$50.20 |
| | White Collar | 43-4051 | Customer Service Representatives | 6% | \$23.50 | \$27.80 |
| Managerial | 13-1111 | Management Analysts | 5% | \$39.90 | \$48.20 | \$58.90 |
| | 11-1021 | General and Operations Managers | 5% | \$61.20 | \$72.30 | \$81.20 |
| | 13-2011 | Accountants and Auditors | 4% | \$37.10 | \$42.70 | \$47.70 |
| TOTAL | | | 37% | | | |

Note: * Due to missing data, results may not total to 100%

Data Source: May 2016 OES Research Estimates by State and Industry
[\[https://www.bls.gov/oes/current/oes_research_estimates.htm\]](https://www.bls.gov/oes/current/oes_research_estimates.htm)



Subsector: Distributed Generation
Occupation Profile for: Residential Building Construction (4 digit)
NAICS Code: 236100

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 1% | \$24.70 | \$32.50 | \$44.30 |
| | SUBTOTAL | | 2% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 67% | \$17.20 | \$23.50 | \$30.10 |
| | SUBTOTAL | | 69% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 3% | \$13.40 | \$24.30 | \$33.30 |
| | 43-0000 | Office and Administrative Support Occupations | 11% | \$15.00 | \$20.60 | \$27.00 |
| | SUBTOTAL | | 14% | | | |
| Managerial | 11-0000 | Management Occupations | 11% | \$31.60 | \$46.00 | \$67.90 |
| | 13-0000 | Business and Financial Operations Occupations | 4% | \$23.60 | \$34.20 | \$47.90 |
| | SUBTOTAL | | 15% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2031 | Carpenters | 33% | \$18.90 | \$25.50 | \$30.70 |
| | 47-2061 | Construction Laborers | 15% | \$15.20 | \$18.30 | \$24.30 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 7% | \$26.00 | \$35.50 | \$45.20 |
| | 47-2141 | Painters, Construction and Maintenance | 3% | \$16.90 | \$21.30 | \$25.90 |
| | 47-2081 | Drywall and Ceiling Tile Installers | 2% | \$16.90 | \$21.50 | \$26.70 |
| | 47-2051 | Cement Masons and Concrete Finishers | 2% | \$16.80 | \$22.10 | \$29.00 |
| White Collar | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 3% | \$17.60 | \$24.30 | \$28.90 |
| | 43-9061 | Office Clerks, General | 3% | \$13.20 | \$16.80 | \$21.80 |
| | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 2% | \$13.20 | \$19.60 | \$25.10 |
| | 41-3099 | Sales Representatives, Services, All Other | 2% | \$15.10 | \$26.40 | \$33.90 |
| TOTAL | | | 71% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Distributed Generation
Occupation Profile for: Nonresidential Building Construction (4 digit)
NAICS Code: 236200

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 4% | \$30.00 | \$38.40 | \$49.90 |
| | SUBTOTAL | | 4% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 55% | \$19.60 | \$28.20 | \$39.00 |
| | 51-0000 | Production Occupations | 1% | \$18.60 | \$27.40 | \$41.10 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 2% | \$17.20 | \$22.50 | \$30.20 |
| | SUBTOTAL | | 59% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 1% | \$19.60 | \$28.20 | \$43.00 |
| | 43-0000 | Office and Administrative Support Occupations | 13% | \$16.50 | \$22.00 | \$28.50 |
| | SUBTOTAL | | 14% | | | |
| Managerial | 11-0000 | Management Occupations | 16% | \$38.60 | \$52.30 | \$71.20 |
| | 13-0000 | Business and Financial Operations Occupations | 7% | \$28.40 | \$38.50 | \$51.20 |
| | SUBTOTAL | | 23% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2031 | Carpenters | 15% | \$21.80 | \$29.40 | \$41.50 |
| | 47-2061 | Construction Laborers | 14% | \$16.50 | \$20.50 | \$28.40 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 12% | \$31.40 | \$39.30 | \$48.50 |
| | 47-2051 | Cement Masons and Concrete Finishers | 3% | \$16.20 | \$25.00 | \$32.90 |
| | 47-2081 | Drywall and Ceiling Tile Installers | 3% | \$20.30 | \$26.00 | \$36.60 |
| | 17-2051 | Civil Engineers | 2% | \$30.80 | \$39.20 | \$50.30 |
| | 47-2152 | Plumbers, Pipefitters, and Steamfitters | 1% | \$24.90 | \$29.80 | \$35.90 |
| White Collar | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 3% | \$14.80 | \$19.40 | \$24.50 |
| | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 3% | \$19.40 | \$24.90 | \$30.80 |
| | 43-9061 | Office Clerks, General | 2% | \$13.90 | \$19.40 | \$24.40 |
| TOTAL | | | 58% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Energy Efficiency

Occupation Profile for: Residential Building Construction (4 digit)

NAICS Code: 236100

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 1% | \$24.70 | \$32.50 | \$44.30 |
| | SUBTOTAL | | 2% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 67% | \$17.20 | \$23.50 | \$30.10 |
| | SUBTOTAL | | 69% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 3% | \$13.40 | \$24.30 | \$33.30 |
| | 43-0000 | Office and Administrative Support Occupations | 11% | \$15.00 | \$20.60 | \$27.00 |
| | SUBTOTAL | | 14% | | | |
| Managerial | 11-0000 | Management Occupations | 11% | \$31.60 | \$46.00 | \$67.90 |
| | 13-0000 | Business and Financial Operations Occupations | 4% | \$23.60 | \$34.20 | \$47.90 |
| | SUBTOTAL | | 15% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2031 | Carpenters | 33% | \$18.90 | \$25.50 | \$30.70 |
| | 47-2061 | Construction Laborers | 15% | \$15.20 | \$18.30 | \$24.30 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 7% | \$26.00 | \$35.50 | \$45.20 |
| | 47-2141 | Painters, Construction and Maintenance | 3% | \$16.90 | \$21.30 | \$25.90 |
| | 47-2081 | Drywall and Ceiling Tile Installers | 2% | \$16.90 | \$21.50 | \$26.70 |
| | 47-2051 | Cement Masons and Concrete Finishers | 2% | \$16.80 | \$22.10 | \$29.00 |
| White Collar | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 3% | \$17.60 | \$24.30 | \$28.90 |
| | 43-9061 | Office Clerks, General | 3% | \$13.20 | \$16.80 | \$21.80 |
| | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 2% | \$13.20 | \$19.60 | \$25.10 |
| | 41-3099 | Sales Representatives, Services, All Other | 2% | \$15.10 | \$26.40 | \$33.90 |
| TOTAL | | | 71% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Energy Efficiency**Occupation Profile for: Nonresidential Building Construction (4 digit)****NAICS Code: 236200**

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 4% | \$30.00 | \$38.40 | \$49.90 |
| | SUBTOTAL | | 4% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 55% | \$19.60 | \$28.20 | \$39.00 |
| | 51-0000 | Production Occupations | 1% | \$18.60 | \$27.40 | \$41.10 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 2% | \$17.20 | \$22.50 | \$30.20 |
| | SUBTOTAL | | 59% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 1% | \$19.60 | \$28.20 | \$43.00 |
| | 43-0000 | Office and Administrative Support Occupations | 13% | \$16.50 | \$22.00 | \$28.50 |
| | SUBTOTAL | | 14% | | | |
| Managerial | 11-0000 | Management Occupations | 16% | \$38.60 | \$52.30 | \$71.20 |
| | 13-0000 | Business and Financial Operations Occupations | 7% | \$28.40 | \$38.50 | \$51.20 |
| | SUBTOTAL | | 23% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2031 | Carpenters | 15% | \$21.80 | \$29.40 | \$41.50 |
| | 47-2061 | Construction Laborers | 14% | \$16.50 | \$20.50 | \$28.40 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 12% | \$31.40 | \$39.30 | \$48.50 |
| | 47-2051 | Cement Masons and Concrete Finishers | 3% | \$16.20 | \$25.00 | \$32.90 |
| | 47-2081 | Drywall and Ceiling Tile Installers | 3% | \$20.30 | \$26.00 | \$36.60 |
| | 17-2051 | Civil Engineers | 2% | \$30.80 | \$39.20 | |
| | 47-2152 | Plumbers, Pipefitters, and Steamfitters | 1% | \$24.90 | \$29.80 | \$35.90 |
| White Collar | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 3% | \$14.80 | \$19.40 | \$24.50 |
| | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 3% | \$19.40 | \$24.90 | \$30.80 |
| | 43-9061 | Office Clerks, General | 2% | \$13.90 | \$19.40 | \$24.40 |
| TOTAL | | | 58% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Cleaner Vehicles**Occupation Profile for: Motor Vehicle Manufacturing (4 digit)****NAICS Code: 336100**

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 5% | \$46.50 | \$58.30 | \$69.10 |
| | SUBTOTAL | | 5% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 3% | \$24.00 | \$34.40 | \$41.40 |
| | 51-0000 | Production Occupations | 77% | \$17.10 | \$23.60 | \$31.00 |
| | 53-0000 | Transportation and Material Moving Occupations | 2% | \$27.10 | \$29.90 | \$34.00 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 5% | \$34.80 | \$38.00 | \$47.40 |
| | SUBTOTAL | | 87% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | < 1% | \$43.10 | \$49.90 | \$73.10 |
| | 43-0000 | Office and Administrative Support Occupations | 1% | \$28.20 | \$37.10 | \$45.10 |
| | SUBTOTAL | | 2% | | | |
| Managerial | 11-0000 | Management Occupations | 2% | \$58.50 | \$76.80 | \$95.80 |
| | 13-0000 | Business and Financial Operations Occupations | 2% | \$38.00 | \$48.30 | \$59.10 |
| | SUBTOTAL | | 5% | | | |
| TOTAL | | | 99% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-2112 | Industrial Engineers | 3% | \$38.00 | \$45.70 | \$52.40 |
| Blue Collar | 51-2092 | Team Assemblers | 56% | \$16.80 | \$22.50 | \$29.60 |
| | 51-1011 | First-Line Supervisors of Production and Operating Workers | 4% | \$35.90 | \$46.20 | \$56.30 |
| | 47-2111 | Electricians | 2% | \$31.60 | \$37.70 | \$44.40 |
| | 51-2099 | Assemblers and Fabricators, All Other | 2% | — | — | — |
| | 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 2% | \$27.40 | \$29.70 | \$31.20 |
| TOTAL | | | 77% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Cleaner Vehicles**Occupation Profile for: Automotive Repair and Maintenance (4 digit)****NAICS Code: 811100**

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 15-0000 | Computer and Mathematical Occupations | < 1% | \$18.20 | \$27.70 | \$33.70 |
| | SUBTOTAL | | < 1% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 0% | \$0.00 | \$0.00 | \$0.00 |
| | 51-0000 | Production Occupations | 6% | \$18.60 | \$24.60 | \$31.50 |
| | 53-0000 | Transportation and Material Moving Occupations | 30% | \$11.20 | \$13.40 | \$17.40 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 42% | \$19.20 | \$26.80 | \$33.90 |
| | 37-0000 | Building and Grounds Cleaning and Maintenance Occupations | < 1% | \$12.40 | \$15.00 | \$20.80 |
| | SUBTOTAL | | 78% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 6% | \$14.00 | \$20.20 | \$29.40 |
| | 43-0000 | Office and Administrative Support Occupations | 10% | \$15.60 | \$20.90 | \$27.40 |
| | SUBTOTAL | | 16% | | | |
| Managerial | 11-0000 | Management Occupations | 3% | \$42.60 | \$56.70 | \$83.60 |
| | 13-0000 | Business and Financial Operations Occupations | 3% | \$27.30 | \$34.80 | \$45.80 |
| | SUBTOTAL | | 6% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 53-7061 | Cleaners of Vehicles and Equipment | 22% | \$10.80 | \$12.00 | \$14.50 |
| | 49-3023 | Automotive Service Technicians and Mechanics | 21% | \$19.00 | \$25.90 | \$31.40 |
| | 49-3021 | Automotive Body and Related Repairers | 10% | \$20.30 | \$27.80 | \$35.20 |
| | 53-6031 | Automotive and Watercraft Service Attendants | 5% | \$11.80 | \$14.00 | \$15.90 |
| | 51-9122 | Painters, Transportation Equipment | 4% | \$20.20 | \$25.80 | \$33.70 |
| | 49-1011 | First-Line Supervisors of Mechanics, Installers, and Repairers | 4% | \$28.50 | \$36.60 | \$46.00 |
| | 49-9098 | Helpers—Installation, Maintenance, and Repair Workers | 2% | \$12.80 | \$15.10 | \$18.10 |
| White Collar | 41-2021 | Counter and Rental Clerks | 3% | \$14.80 | \$21.10 | \$29.10 |
| | 43-9061 | Office Clerks, General | 3% | \$13.00 | \$17.60 | \$22.30 |
| | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 2% | \$19.20 | \$24.60 | \$32.70 |
| TOTAL | | | 77% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



No Green Sector**Occupation Profile for: Truck Transportation (3 digit)****NAICS Code: 484000**

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 53-0000 | Transportation and Material Moving Occupations | 72% | \$15.20 | \$19.70 | \$25.20 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 4% | \$15.90 | \$20.50 | \$26.30 |
| | SUBTOTAL | | 77% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 1% | \$19.20 | \$25.90 | \$37.80 |
| | 43-0000 | Office and Administrative Support Occupations | 16% | \$13.40 | \$16.60 | \$21.40 |
| | SUBTOTAL | | 18% | | | |
| Managerial | 11-0000 | Management Occupations | 4% | \$32.60 | \$43.60 | \$62.70 |
| | 13-0000 | Business and Financial Operations Occupations | 1% | \$25.40 | \$29.60 | \$39.60 |
| | SUBTOTAL | | 5% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 53-3032 | Heavy and Tractor-Trailer Truck Drivers | 56% | \$16.40 | \$20.70 | \$25.80 |
| | 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 8% | \$11.50 | \$13.80 | \$17.40 |
| | 53-3033 | Light Truck or Delivery Services Drivers | 3% | \$12.40 | \$16.40 | \$24.00 |
| | 49-3031 | Bus and Truck Mechanics and Diesel Engine Specialists | 3% | \$17.20 | \$21.40 | \$26.30 |
| | 53-1031 | First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators | 2% | \$19.50 | \$24.70 | \$31.70 |
| White Collar | 43-5032 | Dispatchers, Except Police, Fire, and Ambulance | 4% | \$13.80 | \$17.10 | \$22.60 |
| | 43-9061 | Office Clerks, General | 3% | \$12.10 | \$14.50 | \$18.30 |
| | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 2% | \$12.90 | \$16.60 | \$20.70 |
| | 43-4051 | Customer Service Representatives | 1% | \$13.60 | \$16.60 | \$21.10 |
| | 41-3099 | Sales Representatives, Services, All Other | 1% | \$19.20 | \$26.10 | \$38.00 |
| TOTAL | | | 83% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



No Green Sector

Occupation Profile for: Transit and Ground Passenger Transportation (3 digit)

NAICS Code: 485000

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 53-0000 | Transportation and Material Moving Occupations | 78% | \$14.80 | \$18.50 | \$22.80 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 5% | \$23.20 | \$28.80 | \$35.80 |
| | 37-0000 | Building and Grounds Cleaning and Maintenance Occupations | < 1% | \$13.30 | \$16.10 | \$18.80 |
| | SUBTOTAL | | 83% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | < 1% | \$17.90 | \$29.80 | \$44.20 |
| | 43-0000 | Office and Administrative Support Occupations | 12% | \$16.60 | \$21.40 | \$26.50 |
| | SUBTOTAL | | 13% | | | |
| Managerial | 11-0000 | Management Occupations | 2% | \$41.60 | \$59.10 | \$0.00 |
| | 13-0000 | Business and Financial Operations Occupations | < 1% | \$27.70 | \$34.90 | \$42.20 |
| | SUBTOTAL | | 3% | | | |
| Other Miscellaneous | 33-0000 | Protective Service Occupations | < 1% | \$11.50 | \$12.80 | \$14.50 |
| | SUBTOTAL | | < 1% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 53-3022 | Bus Drivers, School or Special Client | 35% | \$15.30 | \$18.50 | \$22.10 |
| | 53-3021 | Bus Drivers, Transit and Intercity | 21% | \$15.90 | \$19.90 | \$24.10 |
| | 53-3041 | Taxi Drivers and Chauffeurs | 16% | \$12.50 | \$15.70 | \$20.20 |
| | 49-3031 | Bus and Truck Mechanics and Diesel Engine Specialists | 3% | \$24.40 | \$29.00 | \$34.60 |
| | 53-1031 | First-Line Supervisors of Transportation and Material-Moving Machine and Vehicle Operators | 2% | \$19.30 | \$28.30 | \$36.00 |
| | 53-7061 | Cleaners of Vehicles and Equipment | 2% | \$12.80 | \$14.70 | \$17.40 |
| White Collar | 43-5032 | Dispatchers, Except Police, Fire, and Ambulance | 5% | \$17.00 | \$20.80 | \$24.10 |
| | 43-4181 | Reservation and Transportation Ticket Agents and Travel Clerks | 2% | \$14.10 | \$17.40 | \$22.30 |
| | 43-9061 | Office Clerks, General | 1% | \$13.90 | \$17.40 | \$22.00 |
| Other Miscellaneous | 33-9099 | Protective Service Workers, All Other | < 1% | \$11.50 | \$12.70 | \$14.40 |
| TOTAL | | | 87% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Clean Fuel Infrastructure

Occupation Profile for: Electrical Contractors and Other Wiring Installation (5 digit)

NAICS Code: 238210

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 2% | \$37.00 | \$46.10 | \$55.70 |
| | 15-0000 | Computer and Mathematical Occupations | < 1% | \$38.30 | \$50.70 | \$67.40 |
| | 29-0000 | Healthcare Practitioners and Technical Occupations | < 1% | \$31.50 | \$40.70 | \$48.90 |
| | SUBTOTAL | | 3% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 59% | \$28.80 | \$40.30 | \$51.30 |
| | 51-0000 | Production Occupations | < 1% | \$19.50 | \$22.60 | \$24.40 |
| | 53-0000 | Transportation and Material Moving Occupations | < 1% | \$16.50 | \$22.00 | \$28.60 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 16% | \$25.30 | \$33.40 | \$38.50 |
| | 37-0000 | Building and Grounds Cleaning and Maintenance Occupations | < 1% | \$14.60 | \$20.40 | \$26.80 |
| | SUBTOTAL | | 75% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 2% | \$29.10 | \$39.80 | \$63.00 |
| | 43-0000 | Office and Administrative Support Occupations | 10% | \$18.70 | \$25.40 | \$31.20 |
| | SUBTOTAL | | 12% | | | |
| Managerial | 11-0000 | Management Occupations | 6% | \$49.20 | \$72.40 | — |
| | 13-0000 | Business and Financial Operations Occupations | 3% | \$36.20 | \$46.50 | \$58.90 |
| | SUBTOTAL | | 9% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10) | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2111 | Electricians | 45% | \$30.10 | \$41.90 | \$52.20 |
| | 49-2022 | Telecommunications Equipment Installers and Repairers, Except Line Installers | 7% | \$25.70 | \$33.40 | \$38.60 |
| | 47-3013 | Helpers—Electricians | 5% | \$16.70 | \$20.30 | \$23.60 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 4% | \$38.30 | \$49.20 | \$64.50 |
| | 47-2061 | Construction Laborers | 3% | \$19.60 | \$27.00 | \$33.10 |
| | 49-9052 | Telecommunications Line Installers and Repairers | 2% | \$28.70 | \$35.10 | \$38.20 |
| White Collar | 43-9061 | Office Clerks, General | 3% | \$16.80 | \$22.90 | \$28.70 |
| | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 2% | \$16.50 | \$22.80 | \$28.60 |
| Managerial | 11-9021 | Construction Managers | 3% | \$48.20 | \$64.90 | \$80.70 |
| | 11-1021 | General and Operations Managers | 2% | \$47.70 | \$78.60 | — |
| TOTAL | | | 72% | | | |

Note: *Due to missing data, results may not total to 100%

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Transit Infrastructure**Occupation Profile for: Other Heavy and Civil Engineering Construction (4 digit)****NAICS Code: 237900**

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 4% | \$35.10 | \$46.50 | \$61.00 |
| | SUBTOTAL | | 4% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 64% | \$19.60 | \$29.30 | \$39.90 |
| | 51-0000 | Production Occupations | 1% | \$18.00 | \$25.20 | \$29.40 |
| | 53-0000 | Transportation and Material Moving Occupations | 7% | \$20.40 | \$26.60 | \$33.10 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 3% | \$21.20 | \$29.30 | \$38.40 |
| | SUBTOTAL | | 76% | | | |
| White Collar | 43-0000 | Office and Administrative Support Occupations | 8% | \$15.70 | \$22.10 | \$28.10 |
| | SUBTOTAL | | 8% | | | |
| Managerial | 11-0000 | Management Occupations | 8% | \$40.00 | \$55.90 | \$85.90 |
| | 13-0000 | Business and Financial Operations Occupations | 3% | \$25.00 | \$36.40 | \$50.70 |
| | SUBTOTAL | | 11% | | | |
| TOTAL | | | 99% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-2051 | Civil Engineers | 3% | \$38.50 | \$49.90 | \$66.10 |
| Blue Collar | 47-2061 | Construction Laborers | 25% | \$15.80 | \$20.20 | \$28.30 |
| | 47-2073 | Operating Engineers and Other Construction Equipment Operators | 14% | \$26.50 | \$35.50 | \$43.70 |
| | 47-2031 | Carpenters | 8% | \$25.90 | \$35.70 | \$43.70 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 7% | \$29.70 | \$39.30 | \$48.40 |
| | 47-2072 | Pile-Driver Operators | 4% | \$33.00 | \$42.00 | \$46.50 |
| | 53-7031 | Dredge Operators | 2% | \$23.00 | \$28.80 | \$42.90 |
| | 47-2051 | Cement Masons and Concrete Finishers | 1% | \$25.00 | \$31.90 | \$36.60 |
| White Collar | 43-9061 | Office Clerks, General | 2% | \$15.50 | \$21.20 | \$24.40 |
| | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 2% | \$13.50 | \$15.70 | \$22.40 |
| TOTAL | | | 68% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Infill and Transit-Oriented Development
Occupation Profile for: Residential Building Construction (4 digit)
NAICS Code: 236100

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 1% | \$24.70 | \$32.50 | \$44.30 |
| | SUBTOTAL | | 2% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 67% | \$17.20 | \$23.50 | \$30.10 |
| | SUBTOTAL | | 69% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 3% | \$13.40 | \$24.30 | \$33.30 |
| | 43-0000 | Office and Administrative Support Occupations | 11% | \$15.00 | \$20.60 | \$27.00 |
| | SUBTOTAL | | 14% | | | |
| Managerial | 11-0000 | Management Occupations | 11% | \$31.60 | \$46.00 | \$67.90 |
| | 13-0000 | Business and Financial Operations Occupations | 4% | \$23.60 | \$34.20 | \$47.90 |
| | SUBTOTAL | | 15% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2031 | Carpenters | 33% | \$18.90 | \$25.50 | \$30.70 |
| | 47-2061 | Construction Laborers | 15% | \$15.20 | \$18.30 | \$24.30 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 7% | \$26.00 | \$35.50 | \$45.20 |
| | 47-2141 | Painters, Construction and Maintenance | 3% | \$16.90 | \$21.30 | \$25.90 |
| | 47-2081 | Drywall and Ceiling Tile Installers | 2% | \$16.90 | \$21.50 | \$26.70 |
| | 47-2051 | Cement Masons and Concrete Finishers | 2% | \$16.80 | \$22.10 | \$29.00 |
| White Collar | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 3% | \$17.60 | \$24.30 | \$28.90 |
| | 43-9061 | Office Clerks, General | 3% | \$13.20 | \$16.80 | \$21.80 |
| | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 2% | \$13.20 | \$19.60 | \$25.10 |
| | 41-3099 | Sales Representatives, Services, All Other | 2% | \$15.10 | \$26.40 | \$33.90 |
| TOTAL | | | 71% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Infill and Transit-Oriented Development
Occupation Profile for: Nonresidential Building Construction (4 digit)
NAICS Code: 236200

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 4% | \$30.00 | \$38.40 | \$49.90 |
| | SUBTOTAL | | 4% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 55% | \$19.60 | \$28.20 | \$39.00 |
| | 51-0000 | Production Occupations | 1% | \$18.60 | \$27.40 | \$41.10 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 2% | \$17.20 | \$22.50 | \$30.20 |
| | SUBTOTAL | | 59% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 1% | \$19.60 | \$28.20 | \$43.00 |
| | 43-0000 | Office and Administrative Support Occupations | 13% | \$16.50 | \$22.00 | \$28.50 |
| | SUBTOTAL | | 14% | | | |
| Managerial | 11-0000 | Management Occupations | 16% | \$38.60 | \$52.30 | \$71.20 |
| | 13-0000 | Business and Financial Operations Occupations | 7% | \$28.40 | \$38.50 | \$51.20 |
| | SUBTOTAL | | 23% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2031 | Carpenters | 15% | \$21.80 | \$29.40 | \$41.50 |
| | 47-2061 | Construction Laborers | 14% | \$16.50 | \$20.50 | \$28.40 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 12% | \$31.40 | \$39.30 | \$48.50 |
| | 47-2051 | Cement Masons and Concrete Finishers | 3% | \$16.20 | \$25.00 | \$32.90 |
| | 47-2081 | Drywall and Ceiling Tile Installers | 3% | \$20.30 | \$26.00 | \$36.60 |
| | 17-2051 | Civil Engineers | 2% | \$30.80 | \$39.20 | \$50.30 |
| | 47-2152 | Plumbers, Pipefitters, and Steamfitters | 1% | \$24.90 | \$29.80 | \$35.90 |
| White Collar | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 3% | \$14.80 | \$19.40 | \$24.50 |
| | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 3% | \$19.40 | \$24.90 | \$30.80 |
| | 43-9061 | Office Clerks, General | 2% | \$13.90 | \$19.40 | \$24.40 |
| TOTAL | | | 58% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Fossil Fuel Production, Refining, and Distribution
Occupation Profile for: Oil and Gas Extraction (3 digit)
NAICS Code: 211000

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 16% | \$55.40 | \$70.70 | \$92.40 |
| | 15-0000 | Computer and Mathematical Occupations | 4% | \$44.50 | \$56.50 | \$67.00 |
| | 19-0000 | Life, Physical, and Social Science Occupations | 8% | \$42.60 | \$57.60 | \$70.60 |
| | 29-0000 | Healthcare Practitioners and Technical Occupations | 1% | \$39.90 | \$49.90 | \$61.40 |
| | SUBTOTAL | | | 30% | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 20% | \$29.70 | \$38.80 | \$46.70 |
| | 51-0000 | Production Occupations | 14% | \$30.70 | \$42.20 | \$54.00 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 6% | \$33.70 | \$43.50 | \$48.80 |
| | SUBTOTAL | | | 41% | | |
| White Collar | 41-0000 | Sales and Related Occupations | <1% | \$40.50 | \$56.80 | \$89.80 |
| | 43-0000 | Office and Administrative Support Occupations | 5% | \$22.10 | \$28.70 | \$36.00 |
| | SUBTOTAL | | | 6% | | |
| Managerial | 11-0000 | Management Occupations | 8% | \$69.90 | \$95.00 | — |
| | 13-0000 | Business and Financial Operations Occupations | 8% | \$38.90 | \$50.80 | \$67.70 |
| | SUBTOTAL | | | 17% | | |
| TOTAL | | | 93% | | | |



| Occupation Distribution, Detailed Level (Top 10) | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-2171 | Petroleum Engineers | 8% | \$65.10 | \$84.10 | — |
| | 19-4041 | Geological and Petroleum Technicians | 3% | \$30.20 | \$38.20 | \$48.80 |
| | 19-2042 | Geoscientists, Except Hydrologists and Geographers | 3% | \$55.30 | \$64.60 | \$78.80 |
| | 17-2112 | Industrial Engineers | 2% | \$53.70 | \$63.90 | \$79.60 |
| Blue Collar | 51-8093 | Petroleum Pump System Operators, Refinery Operators, and Gaugers | 9% | \$31.00 | \$38.70 | \$45.70 |
| | 47-5012 | Rotary Drill Operators, Oil and Gas | 6% | \$35.30 | \$42.60 | \$47.00 |
| | 49-9041 | Industrial Machinery Mechanics | 2% | \$35.20 | \$43.00 | \$47.60 |
| | 51-1011 | First-Line Supervisors of Production and Operating Workers | 2% | \$56.40 | \$65.90 | \$75.80 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 2% | \$42.90 | \$53.90 | \$69.90 |
| Managerial | 11-9041 | Architectural and Engineering Managers | 3% | \$69.60 | \$91.00 | — |
| TOTAL | | | 39% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Fossil Fuel Production, Refining, and Distribution
Occupation Profile for: Petroleum and Coal Products Manufacturing (3 digit)
NAICS Code: 324000

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 13% | \$52.60 | \$63.20 | \$78.00 |
| | 15-0000 | Computer and Mathematical Occupations | 1% | \$49.90 | \$62.00 | \$73.00 |
| | 19-0000 | Life, Physical, and Social Science Occupations | 4% | \$32.20 | \$46.10 | \$60.70 |
| | 29-0000 | Healthcare Practitioners and Technical Occupations | <1% | \$41.90 | \$51.60 | \$61.60 |
| | SUBTOTAL | | | 20% | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 3% | \$41.90 | \$46.00 | \$48.40 |
| | 51-0000 | Production Occupations | 43% | \$36.20 | \$44.00 | \$48.30 |
| | 53-0000 | Transportation and Material Moving Occupations | 4% | \$22.10 | \$29.70 | \$41.40 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 10% | \$34.40 | \$44.00 | \$51.20 |
| | SUBTOTAL | | | 59% | | |
| White Collar | 41-0000 | Sales and Related Occupations | 2% | \$30.60 | \$45.60 | \$63.70 |
| | 43-0000 | Office and Administrative Support Occupations | 6% | \$22.80 | \$30.90 | \$40.80 |
| | SUBTOTAL | | | 8% | | |
| Managerial | 11-0000 | Management Occupations | 6% | \$66.10 | \$92.20 | — |
| | 13-0000 | Business and Financial Operations Occupations | 7% | \$41.50 | \$53.00 | \$69.20 |
| | SUBTOTAL | | | 12% | | |
| TOTAL | | | 99% | | | |



| Occupation Distribution, Detailed Level (Top 10) | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-2171 | Petroleum Engineers | 7% | \$56.60 | \$68.20 | \$84.30 |
| | 17-2112 | Industrial Engineers | 2% | \$48.80 | \$60.50 | \$75.90 |
| | 19-4031 | Chemical Engineers | 2% | \$25.80 | \$31.90 | \$38.20 |
| Blue Collar | 51-8093 | Petroleum Pump System Operators, Refinery Operators, and Gaugers | 28% | \$39.40 | \$44.80 | \$48.00 |
| | 51-1011 | First-Line Supervisors of Production and Operating Workers | 6% | \$34.40 | \$46.40 | \$57.40 |
| | 49-9041 | Industrial Machinery Mechanics | 5% | \$33.30 | \$41.10 | \$46.10 |
| | 49-1111 | First-Line Supervisors of Mechanics, Installers, and Repairers | 2% | \$50.90 | \$58.60 | \$66.20 |
| | 49-9071 | Maintenance and Repair Workers, General | 2% | \$23.80 | \$34.00 | \$43.90 |
| Managerial | 13-1199 | Business Operations Specialists, All Others | 2% | \$43.00 | \$54.40 | \$72.00 |
| | 11-1021 | General and Operations Managers | 2% | \$67.50 | \$91.20 | — |
| TOTAL | | | 39% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Fossil Fuel Production, Refining, and Distribution
Occupation Profile for: Pipeline Transportation (3 digit)
NAICS Code: 486000

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 18% | \$51.30 | \$63.80 | \$79.40 |
| | SUBTOTAL | | 18% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 5% | \$37.30 | \$45.00 | \$49.80 |
| | 51-0000 | Production Occupations | 22% | \$38.30 | \$45.30 | \$49.40 |
| | 53-0000 | Transportation and Material Moving Occupations | 17% | \$23.40 | \$35.00 | \$43.50 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 16% | \$30.70 | \$38.20 | \$46.70 |
| | SUBTOTAL | | 61% | | | |
| White Collar | 43-0000 | Office and Administrative Support Occupations | 8% | \$23.00 | \$35.60 | \$45.30 |
| | SUBTOTAL | | 8% | | | |
| Managerial | 11-0000 | Management Occupations | 4% | \$50.50 | \$72.40 | — |
| | 13-0000 | Business and Financial Operations Occupations | 5% | \$43.60 | \$56.60 | \$83.90 |
| | SUBTOTAL | | 9% | | | |
| TOTAL | | | 96% | | | |



| Occupation Distribution, Detailed Level (Top 10) | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-2112 | Industrial Engineers | 7% | \$51.80 | \$66.10 | \$78.10 |
| | 17-2171 | Petroleum Engineers | 5% | \$61.70 | \$78.10 | \$99.10 |
| Blue Collar | 49-9041 | Industrial Machinery Mechanics | 11% | \$28.20 | \$36.20 | \$44.20 |
| | 51-8093 | Petroleum Pump System Operators, Refinery Operators, and Gaugers | 9% | \$35.90 | \$42.60 | \$48.00 |
| | 53-7072 | Pump Operators, Except Wellhead Pumpers | 8% | \$33.50 | \$39.00 | \$46.50 |
| | 51-1011 | First-Line Supervisors of Production and Operating Workers | 3% | \$33.40 | \$47.90 | \$64.50 |
| | 47-2111 | Electricians | 3% | \$36.20 | \$46.00 | \$51.80 |
| White Collar | 43-9061 | Office Clerks, General | 3% | \$23.20 | \$33.30 | \$38.40 |
| Managerial | 13-1199 | Business Operations Specialists, All Other | 3% | \$45.20 | \$58.80 | \$91.40 |
| | 11-1021 | General and Operations Managers | 2% | \$58.40 | \$76.40 | — |
| TOTAL | | | 48% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Emissions and Leakage Abatement
Occupation Profile for: Other Specialty Contractors (4 digit)
NAICS Code: 238900

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 67% | \$16.50 | \$22.70 | \$31.70 |
| | 53-0000 | Transportation and Material Moving Occupations | 8% | \$18.40 | \$24.10 | \$30.50 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 3% | \$17.40 | \$23.50 | \$30.60 |
| | 37-0000 | Building and Grounds Cleaning and Maintenance Occupations | 1% | \$13.50 | \$16.00 | \$18.70 |
| | SUBTOTAL | | | 79% | | |
| White Collar | 41-0000 | Sales and Related Occupations | 2% | \$17.40 | \$27.70 | \$38.40 |
| | 43-0000 | Office and Administrative Support Occupations | 9% | \$14.40 | \$19.00 | \$24.80 |
| | SUBTOTAL | | | 11% | | |
| Managerial | 11-0000 | Management Occupations | 5% | \$31.90 | \$43.80 | \$62.30 |
| | 13-0000 | Business and Financial Operations Occupations | 4% | \$25.10 | \$31.80 | \$42.50 |
| | SUBTOTAL | | | 9% | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2061 | Construction Laborers | 27% | \$15.00 | \$19.10 | \$26.30 |
| | 47-2073 | Operating Engineers and Other Construction Equipment Operators | 11% | \$24.80 | \$34.50 | \$43.30 |
| | 47-4031 | Fence Erectors | 5% | \$14.90 | \$18.40 | \$26.20 |
| | 47-2051 | Cement Masons and Concrete Finishers | 4% | \$17.30 | \$22.30 | \$28.30 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 4% | \$25.90 | \$31.40 | \$40.90 |
| | 53-3032 | Heavy and Tractor-Trailer Truck Drivers | 3% | \$19.70 | \$23.10 | \$27.30 |
| | 47-2031 | Carpenters | 3% | \$17.80 | \$24.50 | \$35.40 |
| | 47-2071 | Paving, Surfacing, and Tamping Equipment Operators | 2% | \$19.60 | \$23.50 | \$28.40 |
| White Collar | 43-9061 | Office Clerks, General | 3% | \$12.90 | \$16.40 | \$20.20 |
| | 41-3099 | Sales Representatives, Services, All Other | 2% | \$20.20 | \$28.90 | \$39.40 |
| TOTAL | | | 65% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Electrification

Occupation Profile for: Electrical Contractors and Other Wiring Installation (5 digit)

NAICS Code: 238210

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 2% | \$37.00 | \$46.10 | \$55.70 |
| | 15-0000 | Computer and Mathematical Occupations | < 1% | \$38.30 | \$50.70 | \$67.40 |
| | 29-0000 | Healthcare Practitioners and Technical Occupations | < 1% | \$31.50 | \$40.70 | \$48.90 |
| | SUBTOTAL | | 3% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 59% | \$28.80 | \$40.30 | \$51.30 |
| | 51-0000 | Production Occupations | < 1% | \$19.50 | \$22.60 | \$24.40 |
| | 53-0000 | Transportation and Material Moving Occupations | < 1% | \$16.50 | \$22.00 | \$28.60 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 16% | \$25.30 | \$33.40 | \$38.50 |
| | 37-0000 | Building and Grounds Cleaning and Maintenance Occupations | < 1% | \$14.60 | \$20.40 | \$26.80 |
| | SUBTOTAL | | 75% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 2% | \$29.10 | \$39.80 | \$63.00 |
| | 43-0000 | Office and Administrative Support Occupations | 10% | \$18.70 | \$25.40 | \$31.20 |
| | SUBTOTAL | | 12% | | | |
| Managerial | 11-0000 | Management Occupations | 6% | \$49.20 | \$72.40 | — |
| | 13-0000 | Business and Financial Operations Occupations | 3% | \$36.20 | \$46.50 | \$58.90 |
| | SUBTOTAL | | 9% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10) | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2111 | Electricians | 45% | \$30.10 | \$41.90 | \$52.20 |
| | 49-2022 | Telecommunications Equipment Installers and Repairers, Except Line Installers | 7% | \$25.70 | \$33.40 | \$38.60 |
| | 47-3013 | Helpers—Electricians | 5% | \$16.70 | \$20.30 | \$23.60 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 4% | \$38.30 | \$49.20 | \$64.50 |
| | 47-2061 | Construction Laborers | 3% | \$19.60 | \$27.00 | \$33.10 |
| | 49-9052 | Telecommunications Line Installers and Repairers | 2% | \$28.70 | \$35.10 | \$38.20 |
| White Collar | 43-9061 | Office Clerks, General | 3% | \$16.80 | \$22.90 | \$28.70 |
| | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 2% | \$16.50 | \$22.80 | \$28.60 |
| Managerial | 11-9021 | Construction Managers | 3% | \$48.20 | \$64.90 | \$80.70 |
| | 11-1021 | General and Operations Managers | 2% | \$47.70 | \$78.60 | — |
| TOTAL | | | 72% | | | |

Note: * Due to missing data, results may not total to 100%

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Waste Diversion and Methane Capture
Occupation Profile for: Waste Management and Remediation Services (3 digit)
NAICS Code: 562000

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 17% | \$16.30 | \$19.70 | \$26.90 |
| | 51-0000 | Production Occupations | 4% | \$10.60 | \$16.70 | \$27.10 |
| | 53-0000 | Transportation and Material Moving Occupations | 48% | \$13.40 | \$20.30 | \$24.90 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 6% | \$17.70 | \$23.30 | \$30.30 |
| | SUBTOTAL | | | 76% | | |
| White Collar | 41-0000 | Sales and Related Occupations | 2% | \$20.60 | \$29.00 | \$41.30 |
| | 43-0000 | Office and Administrative Support Occupations | 14% | \$12.70 | \$17.10 | \$22.70 |
| | SUBTOTAL | | | 16% | | |
| Managerial | 11-0000 | Management Occupations | 5% | \$35.10 | \$50.30 | \$74.80 |
| | 13-0000 | Business and Financial Operations Occupations | 2% | \$24.60 | \$32.70 | \$43.70 |
| | SUBTOTAL | | | 7% | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 53-7081 | Refuse and Recyclable Material Collectors | 23% | \$18.50 | \$22.50 | \$26.40 |
| | 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 10% | \$10.40 | \$12.70 | \$15.80 |
| | 47-4041 | Hazardous Materials Removal Workers | 9% | \$16.10 | \$19.10 | \$23.80 |
| | 53-3032 | Heavy and Tractor-Trailer Truck Drivers | 7% | \$17.10 | \$21.30 | \$25.00 |
| | 49-3031 | Bus and Truck Mechanics and Diesel Engine Specialists | 3% | \$20.00 | \$24.10 | \$30.00 |
| | 47-4071 | Septic Tank Servicers and Sewer Pipe Cleaners | 2% | \$15.00 | \$17.30 | \$20.10 |
| | 47-2061 | Construction Laborers | 2% | \$15.00 | \$18.10 | \$23.10 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 2% | \$24.80 | \$29.50 | \$39.50 |
| White Collar | 43-5111 | Weighers, Measurers, Checkers, and Samplers, Recordkeeping | 3% | \$10.00 | \$11.70 | \$16.20 |
| | 43-4051 | Customer Service Representatives | 2% | \$14.20 | \$17.50 | \$21.50 |
| TOTAL | | | 63% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Water Conservation in Drinking Water, Storm Water, Waste Water, Efficient Water Infrastructure

Occupation Profile for: Water, Sewage and Other Systems (4 digit)

NAICS Code: 221300

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 3% | \$28.80 | \$42.90 | \$56.70 |
| | 19-0000 | Life, Physical, and Social Science Occupations | 1% | \$22.50 | \$33.00 | \$44.00 |
| | SUBTOTAL | | 4% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 10% | \$15.70 | \$22.30 | \$32.60 |
| | 51-0000 | Production Occupations | 35% | \$21.40 | \$28.70 | \$35.70 |
| | 53-0000 | Transportation and Material Moving Occupations | 1% | \$15.00 | \$20.70 | \$27.40 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 10% | \$18.70 | \$25.00 | \$33.50 |
| | 45-0000 | Farming, Fishing, and Forestry Occupations | 2% | \$10.00 | \$15.50 | \$20.50 |
| | SUBTOTAL | | 58% | | | |
| White Collar | 43-0000 | Office and Administrative Support Occupations | 24% | \$16.60 | \$21.80 | \$27.60 |
| | SUBTOTAL | | 24% | | | |
| Managerial | 11-0000 | Management Occupations | 9% | \$38.20 | \$48.50 | \$67.90 |
| | 13-0000 | Business and Financial Operations Occupations | 4% | \$29.30 | \$35.40 | \$46.30 |
| | SUBTOTAL | | 13% | | | |
| TOTAL | | | 99% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 51-8031 | Water and Wastewater Treatment Plant and System Operators | 29% | \$21.30 | \$28.40 | \$34.70 |
| | 47-2152 | Plumbers, Pipefitters, and Steamfitters | 3% | \$18.10 | \$26.60 | \$39.30 |
| | 51-1011 | First-Line Supervisors of Production and Operating Workers | 3% | \$27.10 | \$35.10 | \$43.40 |
| | 49-9071 | Maintenance and Repair Workers, General | 3% | \$18.50 | \$28.70 | \$38.60 |
| | 49-9012 | Control and Valve Installers and Repairers, Except Mechanical Door | 3% | \$23.20 | \$26.80 | \$29.80 |
| White Collar | 43-4051 | Customer Service Representatives | 5% | \$15.10 | \$19.90 | \$26.50 |
| | 43-5041 | Meter Readers, Utilities | 4% | \$18.50 | \$22.30 | \$26.30 |
| | 43-9061 | Office Clerks, General | 4% | \$12.30 | \$18.40 | \$29.30 |
| | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 4% | \$16.30 | \$21.30 | \$27.20 |
| | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 3% | \$18.80 | \$21.80 | \$24.50 |
| TOTAL | | | 62% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Water Conservation in Drinking Water, Storm Water, Waste Water, Efficient Water Infrastructure
Occupation Profile for: Utility System Construction (4 digit)
NAICS Code: 237100

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 3% | \$28.80 | \$37.60 | \$51.90 |
| | SUBTOTAL | | 3% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 55% | \$19.10 | \$27.20 | \$36.50 |
| | 51-0000 | Production Occupations | 3% | \$16.20 | \$22.30 | \$31.80 |
| | 53-0000 | Transportation and Material Moving Occupations | 4% | \$17.80 | \$24.00 | \$30.30 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 15% | \$18.80 | \$26.20 | \$36.60 |
| | SUBTOTAL | | 78% | | | |
| White Collar | 43-0000 | Office and Administrative Support Occupations | 8% | \$15.80 | \$20.60 | \$27.30 |
| | SUBTOTAL | | 9% | | | |
| Managerial | 11-0000 | Management Occupations | 6% | \$37.90 | \$51.30 | \$72.00 |
| | 13-0000 | Business and Financial Operations Occupations | 4% | \$28.00 | \$37.00 | \$48.70 |
| | SUBTOTAL | | 10% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-2061 | Construction Laborers | 16% | \$16.50 | \$21.50 | \$29.40 |
| | 47-2073 | Operating Engineers and Other Construction Equipment Operators | 8% | \$27.40 | \$35.80 | \$44.00 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 7% | \$28.00 | \$36.90 | \$46.40 |
| | 47-2151 | Pipelayers | 6% | \$19.80 | \$24.50 | \$29.80 |
| | 47-5071 | Roustabouts, Oil and Gas | 6% | \$19.20 | \$28.50 | \$37.10 |
| | 49-9051 | Electrical Power-Line Installers and Repairers | 5% | \$28.20 | \$40.20 | \$54.20 |
| | 49-9052 | Telecommunications Line Installers and Repairers | 4% | \$16.70 | \$20.70 | \$26.40 |
| | 51-4121 | Welders, Cutters, Solderers, and Brazers | 3% | \$17.90 | \$24.30 | \$33.70 |
| | 47-2152 | Plumbers, Pipefitters, and Steamfitters | 2% | \$19.00 | \$24.50 | \$30.60 |
| White Collar | 43-9061 | Office Clerks, General | 2% | \$14.00 | \$18.00 | \$23.30 |
| TOTAL | | | 58% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Water Conservation in Drinking Water, Storm Water, Waste Water, Efficient Water Infrastructure
Occupation Profile for: Remediation and Other Waste Management Services (4 digit)
NAICS Code: 562900

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Professional | 17-0000 | Architecture and Engineering Occupations | 2% | \$25.50 | \$43.10 | \$63.20 |
| | SUBTOTAL | | 2% | | | |
| Blue Collar | 47-0000 | Construction and Extraction Occupations | 45% | \$16.10 | \$19.30 | \$26.30 |
| | 51-0000 | Production Occupations | 1% | \$10.90 | \$15.00 | \$21.60 |
| | 53-0000 | Transportation and Material Moving Occupations | 21% | \$11.50 | \$14.80 | \$20.20 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 3% | \$14.00 | \$19.30 | \$26.90 |
| | 37-0000 | Building and Grounds Cleaning and Maintenance Occupations | 1% | \$10.50 | \$12.30 | \$14.80 |
| | SUBTOTAL | | 72% | | | |
| White Collar | 41-0000 | Sales and Related Occupations | 3% | \$21.20 | \$29.10 | \$42.00 |
| | 43-0000 | Office and Administrative Support Occupations | 13% | \$14.00 | \$18.10 | \$23.90 |
| | SUBTOTAL | | 16% | | | |
| Managerial | 11-0000 | Management Occupations | 6% | \$35.10 | \$48.10 | \$72.90 |
| | 13-0000 | Business and Financial Operations Occupations | 3% | \$25.70 | \$33.60 | \$44.30 |
| | SUBTOTAL | | 10% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 47-4041 | Hazardous Materials Removal Workers | 23% | \$16.10 | \$19.10 | \$23.90 |
| | 53-7062 | Laborers and Freight, Stock, and Material Movers, Hand | 8% | \$10.60 | \$13.30 | \$18.90 |
| | 47-4071 | Septic Tank Servicers and Sewer Pipe Cleaners | 7% | \$14.90 | \$17.20 | \$19.60 |
| | 47-2061 | Construction Laborers | 6% | \$15.10 | \$18.10 | \$23.00 |
| | 47-1011 | First-Line Supervisors of Construction Trades and Extraction Workers | 5% | \$24.70 | \$29.40 | \$39.30 |
| | 53-3032 | Heavy and Tractor-Trailer Truck Drivers | 4% | \$14.30 | \$18.40 | \$23.20 |
| | 53-7061 | Cleaners of Vehicles and Equipment | 3% | \$10.80 | \$11.80 | \$14.50 |
| White Collar | 43-6014 | Secretaries and Administrative Assistants, Except Legal, Medical, and Executive | 3% | \$15.00 | \$17.50 | \$21.30 |
| | 41-3099 | Sales Representatives, Services, All Other | 2% | \$23.00 | \$29.60 | \$43.60 |
| | 43-9061 | Office Clerks, General | 2% | \$12.00 | \$14.70 | \$19.30 |
| TOTAL | | | 64% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Forestry Services, Fire Prevention and Suppression
Occupation Profile for: Forestry and Logging (3 digit)
NAICS Code: 113000

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 53-0000 | Transportation and Material Moving Occupations | 14% | \$15.30 | \$18.00 | \$21.20 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 4% | \$16.90 | \$20.60 | \$24.30 |
| | 45-0000 | Farming, Fishing, and Forestry Occupations | 72% | \$17.40 | \$20.90 | \$24.80 |
| | SUBTOTAL | | 90% | | | |
| White Collar | 43-0000 | Office and Administrative Support Occupations | 6% | \$11.20 | \$16.40 | \$19.00 |
| | SUBTOTAL | | 6% | | | |
| Managerial | 11-0000 | Management Occupations | 3% | \$18.50 | \$29.50 | \$38.40 |
| | SUBTOTAL | | 3% | | | |
| TOTAL | | | 98% | | | |

| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 45-4022 | Logging Equipment Operators | 50% | \$17.70 | \$20.70 | \$23.90 |
| | 45-4021 | Fallers | 12% | \$19.60 | \$26.30 | \$32.00 |
| | 53-3032 | Heavy and Tractor-Trailer Truck Drivers | 10% | \$17.20 | \$19.30 | \$22.20 |
| | 45-1011 | First-Line Supervisors of Farming, Fishing, and Forestry Workers | 3% | \$22.00 | \$24.90 | \$30.90 |
| | 49-3042 | Mobile Heavy Equipment Mechanics, Except Engines | 2% | \$17.80 | \$21.30 | \$24.70 |
| White Collar | 43-3031 | Bookkeeping, Accounting, and Auditing Clerks | 2% | \$10.00 | \$14.80 | \$17.40 |
| TOTAL | | | 79% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded
 Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Subsector: Lower Carbon Soil Management & Crop Production; Manure Management for Methane Capture
Occupation Profile for: Agriculture, Forestry, Fishing and Hunting (2 digit)
NAICS Code: 110000

| Occupation Distribution, Major Level | | | | | | |
|--------------------------------------|-----------|---|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 51-0000 | Production Occupations | 3% | \$10.70 | \$12.00 | \$14.80 |
| | 53-0000 | Transportation and Material Moving Occupations | 4% | \$10.50 | \$11.90 | \$16.70 |
| | 49-0000 | Installation, Maintenance, and Repair Occupations | 1% | \$13.30 | \$17.60 | \$23.40 |
| | 45-0000 | Farming, Fishing, and Forestry Occupations | 86% | \$10.00 | \$10.60 | \$11.70 |
| | SUBTOTAL | | | 96% | | |
| White Collar | 43-0000 | Office and Administrative Support Occupations | 2% | \$12.40 | \$16.50 | \$21.80 |
| | SUBTOTAL | | 2% | | | |
| Managerial | 11-0000 | Management Occupations | 1% | \$26.00 | \$38.30 | \$57.50 |
| | SUBTOTAL | | 1% | | | |
| TOTAL | | | 100% | | | |



| Occupation Distribution, Detailed Level (Top 10)** | | | | | | |
|--|-----------|--|-------------------------|------------------------|---------|---------|
| Occupation Group | SOCC Code | SOCC Title | % Share of Occupations* | Percentile Hourly Wage | | |
| | | | | 25th | 50th | 75th |
| Blue Collar | 45-2092 | Farmworkers and Laborers, Crop, Nursery, and Greenhouse | 77% | \$10.00 | \$10.50 | \$11.60 |
| | 45-2091 | Agricultural Equipment Operators | 3% | \$11.00 | \$12.80 | \$14.80 |
| | 45-2041 | Graders and Sorters, Agricultural Products | 3% | \$10.00 | \$10.50 | \$11.40 |
| | 45-1011 | First-Line Supervisors of Farming, Fishing, and Forestry Workers | 2% | \$13.50 | \$17.00 | \$25.00 |
| | 51-9111 | Packaging and Filling Machine Operators and Tenders | 2% | \$10.70 | \$11.80 | \$14.00 |
| | 53-7064 | Packers and Packagers, Hand | 1% | \$10.00 | \$10.60 | \$11.70 |
| TOTAL | | | 88% | | | |

Notes: * Due to missing data, results may not total to 100% ** Managerial Occupations excluded

Data Source: May 2016 OES Research Estimates by State and Industry [https://www.bls.gov/oes/current/oes_research_estimates.htm]



Appendix B: Climate and Jobs Consultations

*Prepared by the Consensus & Collaboration Program, Sacramento State University
College of Continuing Education*

Overview

The California Workforce Development Board (State Board) hosted a series of nine climate and jobs conversations related to the Assembly Bill 398 (AB 398) workforce report, which addresses labor market strategies to achieve the State's climate goals while ensuring that the benefits of a low-carbon economy accrue to all Californians. The Consensus & Collaboration Program at Sacramento State University's College of Continuing Education provided process design and facilitation support for the meetings. The meetings were intended to help the State Board plan for economic and workforce development in the low-carbon economy. Participants were asked to discuss how California can simultaneously advance equity, mobility, and job quality for workers; deliver skills and competitiveness for the State's best employers; and address the challenges of climate change throughout the economy.

The objectives of the meetings included:

- To share the State Board's vision for shared prosperity in a low-carbon economy, aligning the State's comprehensive workforce and climate action plans.
- To hear diverse stakeholder perspectives on the jobs and economic impacts of California's Climate Change Scoping Plan (Scoping Plan), focusing on the creation of quality jobs and accessible pathways into them.
- To supplement formal research, inform recommendations, and gather information related to Senate Bill 350 (SB 350) implementation.

Five of the nine meetings brought together stakeholders by constituency group and the remaining four were organized by Scoping Plan sector. Constituency groups included climate-related State agencies, workforce development and education-focused State agencies, community-based and non-governmental organizations, labor, and business. The sector meetings included the waste, energy, and transportation sectors, as well as natural and working lands and water (the natural and working lands sector and the water sector are separate in the Scoping Plan, but were consulted jointly during this process). The State Board initially planned to hold an industry sector meeting, but it was canceled due to limited response; major industries covered by the State's climate policies and programs were involved in the business constituency meeting.



In total, the State Board's consultations engaged 116 participants, with some participants attending multiple meetings. In addition to the nine meetings, the State Board circulated a supplemental questionnaire to participants and others within key stakeholder networks to solicit information on education and training programs, partnerships, or initiatives that address equity and job quality in any sector of California's Climate Change Scoping Plan.

The State Board's Presentations

The State Board provided an overview of the State Board's equity, climate, and jobs vision, as well as background and context for the State Board's work preparing the AB 398 workforce report and tracking the implementation of the SB 350 recommendations.

High Road Vision

The State Board provided an overview of its High Road vision: to create equity by expanding access to skills and economic opportunity for the State's excluded and disadvantaged workers, improve job quality by supporting employers that compete through innovation rather than externalized environmental and societal costs, and address the challenges of climate change by preparing workers and employers for a carbon-constrained economy. The supply side of the labor market, which includes workers and training, is where equity can best be promoted; the demand side, which is the jobs and firms/businesses, is where job quality can be addressed most effectively. The State Board works at the intersection of supply of demand to ensure training is calibrated to jobs available; this is particularly important in setting realistic expectations among disadvantaged workers and communities who have been excluded from, and/or faced barriers to, high-quality employment.

Labor market supply and demand must be calibrated in order to deliver quality jobs and skilled workers to fill them. The State Board's approach is to begin with demand, i.e. jobs, through realistic analysis of existing and future workforce needs, and then build accessible pathways to jobs. The intention is to build upon existing workforce education and training networks and systems, focusing on partnerships and training programs that prepare workers for long-term careers rather than skills that are limited to specific jobs.

AB 398 Workforce Report

AB 398 extends California's Cap and Trade program to 2030 and tasked the State Board with developing a report about the economic and jobs effects of the Climate Change Scoping Plan. The report is a high-level policy document that presents a suite of intentional workforce strategies to deliver equity as the State transitions to a low-carbon economy. It does not provide statistical analysis of workforce changes in each region



of the state; instead, it addresses broader changes required to meet the State's climate change targets. The report is organized by Scoping Plan sector, rather than by traditional economic sector, and addresses job growth and loss, job access, and training in each of the Scoping Plan sectors.

SB 350 Recommendations

SB 350 set energy- and transportation-specific climate targets, and required the California Air Resources Board and California Energy Commission (CEC) to complete low-income barriers reports to address access to renewable energy and clean transportation by low-income and disadvantaged communities. The State Board is tasked with tracking implementation of the jobs and workforce recommendations from the barriers reports. Consultation meeting participants were asked to share information about whether the recommendations are being implemented, as well as how they are being implemented or why they are not being implemented.

Next Steps: Global Climate Action Summit and Beyond

The State Board informed all participants that the AB 398 workforce report, informed by feedback gained from the consultation meetings and training program questionnaire, is due to the State Legislature in January 2019.

Participant Perspectives

Participants were asked to respond to questions about the broad economic and jobs impacts of the Scoping Plan; education and training programs and the equity and/or job quality strategies deployed by those programs; gaps in the supply of trained workers to fill employers' needs; how climate programs can incorporate job quality and equity into their economic and jobs impacts; and progress related to implementation of the jobs and workforce elements of the SB 350 recommendations. Responses reflected a diverse range of perspectives and opinions on the various issues.

Key takeaways are summarized by theme and are not reflective of consensus by all stakeholders, nor do they represent the position of the State Board on workforce recommendations or policy. Where relevant, comments include a reference to the particular meeting wherein the point was raised (noted in parentheses). At all meetings, participants offered examples of relevant programs and partnerships; lists of the programs and partnerships mentioned are available in the Resources, Programs and Partnerships section at the end of the document.



KEY TAKEAWAYS

Defining and Advancing Equity

Equity is a key component of the State Board’s High Road vision. Participant feedback outlined differences in defining which groups should be prioritized in the State Board’s work, the importance of accessibility to both training programs and to jobs themselves, the challenge of retention and expansion in building a diverse workforce, and the importance of wraparound services to improve accessibility and retention.

❖ Defining Priority Groups

Given the State Board’s broad definition of equity in the High Road vision, there is a need to be thoughtful and specific about designating priority groups, accounting for differences between disadvantaged communities which do not all face the same challenges (Community-Based and Non-Governmental Organizations). There is inconsistency among State agencies in the method used to identify target populations, leading to different definitions of “disadvantaged” communities, different targets, and different outcomes. Some of the communities with the greatest need, including small rural communities, lack sufficient data to be designated as disadvantaged communities according to CalEnviroScreen. Using an index that compiles different equity-related factors can be more reflective of complex dynamics (Climate-Related State Agencies Constituency, Community-Based and Non-Governmental Organizations Constituency).

❖ Accessibility

Accessibility to training and jobs is key to ensuring equity in how Californians benefit from the low-carbon economy. Unpaid training programs, even if they are free or low-cost, are not great equity approaches because many people do not have the resources to spend time in training before beginning to work. Earn-and-learn opportunities, grants and stipends for training participants, and wraparound services (discussed further below) are crucial to making career pathways accessible (Natural and Working Lands and Water Sector, Transportation Sector). Additionally, access to transit and affordable housing are vital components that underpin access to worker training and quality jobs (Transportation Sector).

Many of the jobs in the Scoping Plan sectors, especially in the waste, natural and working lands, and water sectors were and/or still are high-quality public sector jobs, and should be targeted to promote equity. However, bureaucratic hiring processes and poor pathways for upward mobility make promoting equity in, and increasing access to public sector careers challenging. The California Department of Human Resources should streamline hiring so that entry-level jobs are more accessible to target populations and



create pathways for upward mobility (Waste Sector, Natural and Working Lands and Water Sector). These challenges are also present at the local level. Some strategies used by the San Francisco Public Utilities commission to address equity include using Community Benefits Agreements when working with contractors, and including job qualifications that specify training programs with a demonstrated track record for advancing equity (Natural and Working Lands and Water Sector).

❖ Retention and Expansion

Equity requires supporting workers so that they can afford to complete training and remain in careers once they are hired. Wraparound services can address barriers that make achieving equity challenging. Workforce development efforts need to account for and coordinate wraparound services that are critical to ensuring that the people who most need training can access and complete it (Climate-Related State Agencies Constituency). Wraparound services can include providing childcare, transportation, mentorship, stipends for participation in training programs, tutoring, purchase of work-related equipment, and more. These services are also critical for retention and expansion once a worker has been hired. Given the importance of coordinated wraparound services, agencies, employers, and training programs should institutionalize the practice of including discretionary funds to support wraparound services.

It is important to address potential work environment issues as they begin to diversify (e.g. hostility) (Workforce Development and Education State Agencies Constituency). Although diversifying the workforce can produce personnel challenges, such as communication issues, they are not insurmountable. Investing in working effectively with a diverse workforce can significantly boost productivity; agencies, businesses, and programs should collaborate with organizations that have experience with a diverse workforce (Business Constituency). It is also important to support diverse workers in advancing to leadership positions in their industries (Business Constituency). The emergence of new technologies that require workers in existing fields to have different competencies (knowledge and skills) presents an opportunity to recruit populations that have historically been excluded from traditional career pathways (e.g., apprenticeship in the building trades), especially women and people of color (Workforce Development and Education State Agencies Constituency).

Partnerships and Collaboration

Partnerships between community-based organizations and training programs can provide a combination of technical training, “soft skills”, and wraparound services. Nonprofit organizations that are well-known and trusted in their communities can be effective partners in recruiting people from disadvantaged communities to participate in apprenticeship programs (Labor Constituency). Agencies and programs that do not have



expertise in equity and outreach should develop partnerships with organizations who have this expertise.

Partnerships between training programs and employers create a direct connection between training and jobs, benefiting both the workers and the employers. It is important for employers to commit funds to training opportunities to support these connections (Labor Constituency).

It is important to develop alliances, for example between labor and environmental coalitions, to proactively identify how disparate needs may have common solutions. Resources can then be aggregated from the various stakeholders in support of mutually beneficial projects (Natural and Working Lands and Water Sector).

Jobs and Careers

❖ Perception of Careers and Opportunities

Participants from various sectors noted that lack of awareness and stigma related to certain careers make it challenging to recruit new workers and meet current demand (Business, Workforce Development and Education State Agencies Constituency, Waste Sector, Natural and Working Lands and Water Sector). Young people in particular are less aware and interested in traditional careers in the building and construction trades (Natural and Working Lands and Water Sector). The misperception of two separate career tracks, one that includes a four-year degree and leads to a high-salaried career and the other that includes only technical training and leads to dead-end jobs, needs to be corrected. There are various career pathways which can intersect in different ways (Workforce Development and Education State Agencies Constituency).

Consider reframing to emphasize that these sectors have pathways to stable, well-compensated careers that do not require extensive schooling. Develop consistent messaging to be communicated from various angles (Workforce Development and Education State Agencies Constituency). In certain fields and sectors (e.g., waste, water) work must be done to make jobs more appealing. For example, dangerous working conditions need to be mitigated. Messaging should emphasize that workers are important and valued actors in climate change mitigation efforts; the State needs skilled workers to do their jobs effectively in order to meet a variety of environmental goals outlined in State climate policy. There are existing quality jobs that many people are unaware of and do not know how to access (e.g. facilities managers; inspection and enforcement related jobs) (Waste Sector, Energy Sector). Data analytics is another area where there is growing need, and it is a transferable skill.



❖ Importance of Pathways and Growth

The State should focus its resources on careers with the most opportunity for growth. Instead of thinking about discrete jobs, workforce development should focus on training for careers that will sustain a person throughout their working life (Energy Sector). In identifying potential areas of job growth, it is necessary to consider how jobs and careers are changing, in addition to new jobs being created or jobs being lost. Statistics about jobs created or projected should differentiate between full-time positions and temporary or contract jobs. State funding should not support the independent contractor system or the creation of temporary jobs.

Many people are not yet in a position to secure a good job, but the intermediate steps that lead there should be valued. The objective should be to get people onto a career path that can eventually lead to a high-quality job (Community-Based and Non-Governmental Organizations Constituency). Focus should be placed on providing continued, incremental training that can help workers continue to grow in their careers and creating pathways for people to move into leadership positions within the organizations they already work in (Workforce Development and Education State Agencies Constituency).

Workforce Development and Training

❖ Skills Delivery

There is a tension between providing broad training that will enhance workers' versatility and economic mobility, and preparing workers for the specific positions that employers need to fill (Business Constituency). Workers need to be prepared to be adaptable, so there is a need for training programs that provide a base of transferable skills. Workers also need a foundation that prepares them for a career rather than a single job (Workforce Development and Education State Agencies Constituency). At the same time, workers need specific skills and recognizable credentials that employers value (Climate-Related State Agencies Constituency). Employers are sometimes willing to hire workers with foundational training in a field and provide additional training that is specialized to the particular position they need to fill (Business Constituency).

Training programs should not be only task based, but should include “soft skills” and leadership skills, which are necessary in all sectors. Consider whether public funding, which is often allocated for more advanced training and cannot be used to teach these broader skills, should support acquisition of “soft skills.” Training in these areas could also be financed by pooling funding through partnerships (Energy Sector). To achieve equity in the workplace, training also needs to cover the skills needed to advance to leadership and management positions (Energy Sector).



Upskilling the incumbent workforce is important, and continuing education and training should be used to help people advance in their careers while meeting employers' evolving needs (Transportation Sector). Since incumbent workers already possess important fundamental skills and need only a small amount of additional training, they can adapt to immediate needs.

❖ **Scale**

Future labor needs are likely going to outpace the rate at which training programs can prepare qualified workers. As labor demand and training needs grow, it is important to make sure that training programs are effectively preparing workers for a shifting economy (Labor Constituency). One way to address the gap between supply and demand is for training programs to focus on general skillsets and for employers to provide specific training. However, for employers who need to fill only a small number of positions with workers who have a tailored skillset, it can be challenging to provide adequate training. In these cases, there is an opportunity to aggregate the need by collaborating with other employers who have similar needs.

❖ **Funding and Policy**

Long-term, sustainable funding is crucial for a successful training program. Funding and investment should come from agencies as well as employers (Community-Based and Non-Governmental Organizations Constituency). As mentioned above, agencies, employers, and training programs should institutionalize the practice of including discretionary funds to support wraparound services (Transportation Sector). Funding also needs to be tied to outcomes. Providing funding to programs that are ineffective at provide skills and connecting people to good jobs undermines the efforts of good training programs (Labor Constituency). The Employment Training Panel has had success at implementing a high-road vision, and a key aspect of their approach is to fund training programs only after participants have successfully completed the program and 90 days in a job placement (Transportation Sector).

Uncertainty in funding, policy, and technology create challenges for both the supply and the demand sides of the workforce system. In the public sector, long-term, stable funding is needed to allow time to monitor, evaluate, and refine programs (Energy Sector). For private sector partners, funding and policy uncertainty make planning and innovation difficult, especially because businesses feel they lack the information needed to make informed investments (Business Constituency). Policy uncertainty also reinforces the tendency to give short-term profit precedence over investing in long-term systems changes (Energy Sector). In addition to demand uncertainty, the fast pace of technological change makes effective workforce development challenging.



Geographically Targeted Investment

Coordinating workforce development and infrastructure projects through place-based investment can increase the impact of investments. Regional apprenticeship models, through which workers are prepared for and connected to work in a region rather than in a single city, should be used to increase access and employment options (Natural and Working Lands and Water Sector). The Strategic Growth Council has found that carrying out multiple, coordinated projects in a given location can make partnerships more attractive to potential partners (Climate-Related State Agencies Constituency). There may be opportunities for workforce development and job quality efforts to be incorporated into anti-displacement strategies at the local level, but this approach needs to be intentional to have an effect (Transportation Sector). Location considerations, such as land use policy, access to transit, and affordable housing, are important for access to training and quality jobs (Transportation Sector).

There are differences between rural and urban areas in terms of the potential to address job quality and equity in economic and workforce development. In rural areas, lack of infrastructure creates challenges for accessing existing opportunities and attracting new investment. Rural areas need geographically targeted efforts to attract and encourage development of new industries, as well as to diversify economies and employment options available locally. The strategies and recommendations that the State Board puts forward in the AB 398 Report should account for differences between rural and urban areas and should focus on reducing existing disparities. Energy procurement through Community Choice Aggregation (CCA) programs could be used intentionally as an opportunity for coastal cities to have a positive impact on job creation in inland areas of the state (Natural and Working Lands and Water Sector). CCA programs are already impacting inland regions by procuring energy produced there, with public agencies procuring energy having the latitude to prioritize co-benefits (e.g., hiring of local and/or disadvantaged workers) from that work. CCAs should be intentional about having a positive impact on job creation in rural parts of the state, using strategies like Community Benefits Agreements to create quality jobs and target communities to work with (Natural and Working Lands and Water Sector).

Sector Dynamics

As climate change policy and climate changes take effect, differential impacts on jobs, skills, and training are expected across the sectors. With regard to impacts to the Natural & Working Lands sector, increasing temperatures and frequency of very hot days will impact working conditions of workers whose jobs require them to be outdoors, such as farmworkers and other agricultural workers, landscape install and maintenance technicians, foresters, etc. There are concerns about challenges to the “high road approach” in this sector, particularly with regard to environmental impacts and equity.



In the Waste and Energy sectors, enforcement will be critical to achieving climate goals. Potential energy efficiency benefits will only be realized if strong enforcement ensures that standards are being met across the board (Energy Sector). In the Waste Sector, inspectors will need to ensure that facilities are compliant with ambitious waste diversion mandates. The State is already struggling to fill positions with properly trained inspectors to enforce climate change-related regulations, and additional inspectors will be needed in the future. Compliance will affect both job quality, for example by ensuring workplace safety, and the State's ability to achieve its climate targets.

State policy that addresses the climate impacts from the Waste sector and mandates significant expansion of diversion efforts will change the nature of work within waste management industries in the public and private sectors. The increase in diversion will likely change the fundamental approach to waste management that has been refined over the past several decades (i.e., a shift from managing organics in landfills to ensuring diversion of organics from landfills in the first place).

Changes in the Energy sector will be far reaching, but the core work and skills required to shift the energy infrastructure primarily remain in construction and advanced manufacturing. With regard to public sector investments in the Transportation sector, State and local agencies often lack workforce and jobs expertise and need guidance to incorporate high road considerations into their investments.

Stakeholder Roles

❖ The State Board's Role

Most agencies lack workforce and jobs expertise and are looking to the State Board for guidance about best practices for incorporating high road considerations into their work. State agencies recognize that there is an important opportunity to allocate their resources in a way that advance equity, for example through procurement practices as well as grant making (Climate-Related State Agencies Constituency). Agencies need guidance about how to use procurement to advance equity through tools such as Project Labor Agreements and Community Workforce Agreements, as well as via grant solicitations, and other forms of public investment.

Specifically, agencies need help identifying what a “good job” is so that they can properly score projects and track funding outcomes for programs with job-related components (Climate-Related State Agencies Constituency, Transportation Sector). Agencies also need information about existing workforce development efforts and support in connecting with the existing workforce development network around the State (Climate-Related State Agencies Constituency). The private sector is also looking to the State Board for guidance about best practices, for example to support diverse workers in advancing to



leadership positions in their industry. At the same time, policy should focus on defining outcomes without becoming prescriptive about how to achieve them.

The State Board needs to make employment and training a consideration in the work of every other State agency. Public health guidelines provide an interesting model of advocating for diverse agencies to incorporate public health considerations in their respective policies (i.e. the Health in all Policies approach) (Transportation Sector).

The State Board should consider how to communicate its High Road vision so that it is understood and taken up at all levels of government and in the private sector. Much of the work that needs to be carried out to meet the State's Scoping Plan targets will be carried out at the local level, so local leaders need to understand how to participate in the implementation of the High Road vision. For example, city managers and zoning administrators will be the decision-makers about most construction projects, so they need to be engaged and understand how to promote equity and job quality.

Various considerations must also be addressed in framing communications about the High Road vision. There are differing views about transitioning to a low-carbon economy, and additional conversations are needed to discuss how labor would like to see the transition move forward (Labor Constituency). The focus should not be exclusively on advancing the high road; it is equally important to close the low road (Labor Constituency). Safety and dignity need to be held up as important aspects of job quality (Waste Sector).

Accountability and Transparency

There is concern about accountability and transparency in the implementation of the State Board's AB 398 Report recommendations. The report has the potential to help advocates push for effective implementation of the High Road vision, but it needs to be specific about *how* to implement the vision in order to be a useful tool (Community-Based and Non-Governmental Organizations Constituency). Accountability needs to be considered up front, before a project or program has been implemented, and built into the process. Desired outcomes and measurements of success need to be defined at the outset in order to have consistency in tracking outcomes and assessing impacts. Pertinent outcomes to measure include the quality of the jobs being supported and what populations are accessing trainings and jobs.

Consider how to ensure that workforce standards are implemented consistently across State agencies, and in the private as well as the public sector, because efficiency benefits will only be realized if standards are met by all actors (Energy Sector). In the Waste Sector, the State has created an ambitious set of mandates, but funding for implementation—both for the facilities and the workers—remains unresolved. Additionally, the roles that the public and private sectors fill in the waste system are



inconsistent across jurisdictions, resulting in different implementation and funding approaches, with different implications for how job quality can be advanced (Waste Sector).

Consider how to maintain rigorous standards while taking into consideration differences in current standards and practices across industries. For example, the agriculture industry presents particular challenges for promoting the High Road vision, in terms of both environmental impacts and job quality and equity (Natural and Working Lands and Water Sector). The Employment Training Panel considers wages and benefits in its funding, and focuses on wage progression in rural areas, where absolute wages are lower (Transportation Sector).

Employers need to be held accountable to the high road promises they make, especially if they receive public funding, but validating claims that grant applicants or contractors make around their hiring practices is a challenge (Climate-Related State Agencies Constituency). Disclosure is a critical step to accountability; employers should not be able to make commitments without following up with data about their practices (Transportation Sector). Funding and reporting requirements should be streamlined so that they are not more cumbersome than the equity targets themselves (Business Constituency).

Resources, Programs, and Partnerships

EXISTING RESOURCES IDENTIFIED

- The San Francisco Public Utilities Commission (SFPUC) has crafted language that can be used in procurement and hiring processes to promote equity, which can be used to advocate for adoption of similar policies around the State (Natural and Working Lands and Water Sector).
- Businesses are interested in getting additional information about the parameters for receiving Employment Training Panel funding (Business Constituency).
- Pacific Gas & Electric is working on updating a study that will identify relevant players in workforce development around the State (Business Constituency).

PROGRAMS AND PARTNERSHIPS

The following programs and partnerships were shared by participants at the in-person meetings and/or in the supplemental questionnaire as examples of existing approaches that promote equity and job quality in a workforce area related to climate change.

- The Insight Garden Program works with vocational gardening and landscaping training with incarcerated and formerly incarcerated individuals.



- California Department of Education provides Vocational English as part of Second Language programs.
- University of California has successfully used apprenticeship programs to retrain workers from one career to another within the University. It also has 119 adult education training programs relevant to a variety of Scoping Plan sectors.
- SLO Partners is a regional workforce development program created by the San Luis Obispo County Office of Education, and has effectively engaged businesses for apprenticeship placements.
- Merritt College Urban Arboriculture Program was created in partnership with San Francisco Bay Area tree care employers. This program addresses two simultaneous needs created by the tree planting grants funded by the State's cap-and-trade program – creating economic benefits in the disadvantaged communities where plantings occur and the employers' increasing workforce needs to care for the trees being planted.
- The Bay Area Water/Wastewater Workforce Development (BAYWORK) apprenticeship program coordinates labor needs across the region, providing opportunities for apprentices to work in different locations at different times.
- The International Brotherhood of Electrical Workers (IBEW) has offered a pre-apprenticeship program related to the high-speed rail project for the past 5-6 years.
- California Harvesters is a farm labor trust that operates as a worker cooperative and offers the Farm Labor Workforce Development Training. The goal is to provide job pathways for farmworkers outside of the agricultural industry while also improving the quality of their farm labor work.
- Rio Hondo College Alternative Fuels/Advanced Transportation Technology Program provides multiple alternative fuel Associate's Degree curriculums developed in collaboration with manufacturers. The partnership includes an agreement that the manufacturers will hire participants directly after they have completed the two-year program.
- Project Lead the Way is a nationwide program that provides STEM education to middle and high school students, with a focus on energy and environment.
- The Utilities Energy Efficiency Training Programs are intended for incumbent workers who need to learn a specific skill. Trainings are free and open to the public and are usually one to three days long. The program also provides train-the-trainer programs and feedback to other programs about improving their own energy efficiency trainings.



- Pacific Gas & Electric (PG&E) is currently working with the local workforce development board to provide a Building Operator Certification program. The workforce development board identifies candidates to participate in the program and PG&E subsidizes tuition costs for under- or unemployed participants who have a baseline of transferable skills. Participants apply the skills they are learning directly in training positions with the utility company.
- DGS has used project labor agreements to prioritize equity goals, partnering with the Sacramento Workforce Board.
- The Strategic Growth Council's Transformative Climate Communities program in Fresno has paired workforce development with infrastructure projects in the same location to increase impact.
- Workforce for Environmental Restoration in Communities works with the Los Angeles Occupational Safety and Health Administration, the Los Angeles Trade-Tech College, and apprenticeship programs to target the communities affected by the contamination from the Exide plant, using a project labor agreement.
- California Department of Resources Recycling and Recovery (CalRecycle) has worked with local public health departments to develop training programs related to floodwater prevention and rescue.
- Employment Training Panel has used Dun & Bradstreet data to identify employers similar to those that have been successful partners in the past.
- California Department of Industrial Relations Division of Apprenticeship Standards has partnered with the Scouts of America Explorers program to include industrial technical careers among the careers profiled through the program.
- UC Berkeley Labor Occupational Health Program, working with Building Trades supporting existing apprenticeship programs as well as over 50 pre-apprenticeship programs around the state.
- The California Labor Federation's Workforce and Economic Development (WED) program is working with seven IBEW programs to incorporate automated demand response into their training, and targets 500 members of disadvantaged communities to participate in the program through a CEC grant.
- The California Labor Federation's WED program has a state highway training partnership that works with local transit agencies around the state, including in the Bay Area, Los Angeles, and the San Joaquin Valley, as they transition to zero-emissions bus fleets.



- The Northern California Teamsters Apprentice Training and Education Trust Fund is working on a project with the West Oakland Job Resource Center to design an apprenticeship pipeline.
- The City of Oakland now requires employers to hire through the West Oakland Job Resource Center (WOJRC) if possible, and to use an Alternative Staffing Organization rather than a traditional temporary placement agency if the WOJRC cannot fill a position. The Northern California Teamsters Apprentice Training and Education Trust Fund is working with this project to design the apprenticeship pipeline to fill these programs.
- The Operating Engineers Local Union 3 works with pre-apprenticeship programs throughout Northern California, including Rising Sun in Oakland.
- The SFPUC works with area high schools to transition graduates into a post-high school education program that places them in jobs that will qualify them for SFPUC positions two years later.
- Local 105 of the International Association of Sheet Metal, Air, Rail, and Transportation Workers is working with Jobs to Move America and the electric bus manufacturer BYD Motors to create training and apprenticeship programs that will funnel into BYD's new operation in Los Angeles. Through a community benefits agreement, BYD committed to hiring 40% of its workforce from populations facing barriers to employment, investing in training, and allowing workers to unionize if they so choose.
- PG&E put out a request for applications for a statewide effort to bring disadvantaged workers into the energy efficiency workforce. PG&E has expertise in training workers in energy efficiency specifically, and is looking to partner with training programs that focus on broader career readiness to provide both sets of skills.
- SMUD partners with the Ford Foundation Career Connected Learning program; works with the Sacramento Tree Foundation to get non-traditional students interested in fields like engineering; and has an energy efficiency career exploration program in which students learn about the energy efficiency field by conducting audits themselves.

Other programs mentioned include:

- The Solid Waste Association of North America (www.swana.org) training and certification program.
- The Facility Management Talent Pipeline, developed by the California Community Colleges and the International Facility Management Association.



- The City of San Francisco's City Apprenticeship Initiative, a centralized apprenticeship program.
- The Utility Pre-Craft Training Program (UPTC), a joint pre-apprenticeship program of the Los Angeles Department of Water and Power and the IBEW Local 18.
- Los Angeles County Federation of Labor's Second Chance Pre-Apprenticeship Bootcamp.
- RePower LA Utility Pre-Craft Training Program.
- Cypress Mandela Training Center in Oakland.
- GRID Alternatives.
- Asian Neighborhood Design's Employment Training Center.
- Rising Sun Training Center.
- Green Technical Education and Employment (Green Tech).
- PG&E Workforce Education and Training on Energy Efficiency.
- SMUD's Energy Efficiency Career Exploration Program (SEEC).
- IBEW - NECA Joint Apprenticeship and Training Committee.
- California Operating Engineers Local 3 Journeymen and Apprentice Training Center (OE3 JATC).
- Carpenters Training Committee for Northern California.



Bibliography

- Abraham, Judson. “Just Transitions for the Miners: Labor Environmentalism in the Ruhr and Appalachian Coalfields.” *New Political Science* 39, no. 2 (April 14, 2017): 218–40. <https://doi.org/10.1080/07393148.2017.1301313>.
- Ahkiam, Lauren. “Cleaning Up Waste and Recycling Management and Securing the Benefits: A Blueprint for Cities.” LAANE: A New Economy For All, July 2015. <http://laane.org/wp-content/uploads/2017/06/Cleaning-Up-Waste-1.pdf>.
- Albeck-Ripka, Livia. “Your Recycling Gets Recycled, Right? Maybe, or Maybe Not.” *The New York Times*, May 29, 2018, sec. Climate. <https://www.nytimes.com/2018/05/29/climate/recycling-landfills-plastic-papers.html>.
- Alliance of Forest Workers and Harvesters. “A Guide to Job Quality and Remaining Competitive in Forest Ecosystem Restoration,” June 2010. <https://firebasestorage.googleapis.com/v0/b/nwforestworkers-f633c.appspot.com/o/PDF%2FHandbook.pdf?alt=media&token=77aacec1-9b77-4c87-bb9b-b9a17eeaccb2>.
- American Council for an Energy Efficient Economy. “Cost-Effectiveness Tests: Overview of State Approaches to Account for Health and Environmental Benefits of Energy Efficiency.” ACEEE Topic Brief, December 2018. <https://aceee.org/sites/default/files/he-ce-tests-121318.pdf>.
- Anderton, Frances, and Avishay Artsy. “Los Angeles Has Become the Detroit of Electric Buses.” *KCRW Design and Architecture*, July 11, 2017. <https://www.kcrw.com/culture/shows/design-and-architecture/los-angeles-has-become-the-detroit-of-electric-buses>.
- Appalachian Regional Commission. “POWER Award Summaries by State As of September 2017,” September 2017. <https://www.arc.gov/images/grantsandfunding/POWER2017/ARCPowerAwardSummariesbyState9-6-2017.pdf>.
- . “POWER Initiative,” 2019. <https://www.arc.gov/funding/POWER.asp>.
- Argyres, Annetta, and Susan Moir. “Building Trades Apprenticeship Training in Massachusetts: An Analysis of Union and Non-Union Programs, 1997-2007.” Labor Resource Center Publications. University of Massachusetts, Boston, Labor Resource Center, October 2008. http://scholarworks.umb.edu/lrc_pubs/2/?utm_source=scholarworks.umb.edu%2Flrc_pubs%2F2&utm_medium=PDF&utm_campaign=PDFCoverPages.
- Associated Press. “Program Trains Young Garbage Collectors amid U.S. Shortage,” November 24, 2016. <https://www.cbsnews.com/news/program-trains-young-garbage-collectors-amid-u-s-shortage/>.



- Austin, Chris. “California Water Plan Update 2018: Envisioning Statewide Water Sustainability.” *Maven’s Notebook* (blog), November 29, 2017. <https://mavensnotebook.com/2017/11/29/california-water-plan-update-2018-envisioning-statewide-water-sustainability/>.
- Autor, David. “The Polarization of Job Opportunities in the U.S. Labor Market: Implications for Employment and Earnings.” Center for American Progress and The Hamilton Project, April 2010. <https://economics.mit.edu/files/5554>.
- Avis, Ellen, and Carol Zabin. “Training for the Future, Workforce Development for a 21st Century Utility Los Angeles’s Utility Pre-Craft Trainee Program.” UC Berkeley Donald Vial Center on Employment in the Green Economy, 2013. http://laborcenter.berkeley.edu/pdf/2013/training_future13.pdf.
- Ayala, Alberto. “California’s Advanced Clean Cars Program: A Coordinated Set of GHG, Criteria, and ZEV Regulations.” presented at the California-Mexico Mission, Mexico City, July 9, 2014. <https://www.theicct.org/sites/default/files/%5B9%20July%5D%20Panel%20%20-%20Alberto%20Ayala%2C%20ARB.pdf>.
- Ayre, James. “Report: 1/4 Of World’s Oil Refineries Face Closure By 2035 If Greenhouse Gas Emissions Targets Are Met.” CleanTechnica, November 4, 2017. <https://cleantechnica.com/2017/11/04/report-14-worlds-oil-refineries-face-closure-2035-greenhouse-gas-emissions-targets-met/>.
- Bailey, Diane, Zach Goldman, and Maria Minjares. “Driving on Fumes: Truck Drivers Face Elevated Health Risks from Diesel Pollution.” NRDC Issue Paper. The Natural Resources Defense Council, December 2007. <https://www.nrdc.org/sites/default/files/driving.pdf>.
- Barenfeld, Scott, Samuel Ho, Mika Sugawara, Jackie Wong, and Wendy Yu. “Analyzing and Expanding the Green Janitor Education Program.” SeedLA, 2017. <http://www.buildingskills.org/wp-content/uploads/2013/11/SEEDLAFinalpdf.pdf>.
- Barone, Richard, and Emily Roach. “Why Goods Movement Matters: Strategies for Moving Goods in Metropolitan Areas.” Regional Plan Association, 2016. <http://library.rpa.org/pdf/Why-Goods-Movement-Matters-ENG.pdf>.
- Bauer, Mary, and Meredith Stewart. “Close to Slavery: Guestworker Programs in the United States.” Southern Poverty Law Center, February 19, 2013. <https://www.splcenter.org/20130218/close-slavery-guestworker-programs-united-states>.
- Bay Area Rapid Transit. “BART Major Projects Project Stabilization Agreement (PSA) Summary of Workforce Goals and Steps Towards Establishing Good Faith Efforts for Contractors,” n.d. <https://www.bart.gov/sites/default/files/docs/Summary%20of%20Workforce%20Goals%20and%20GFE%20Steps%20for%20Contractors.pdf>.



- Beall, James. SB-1 Transportation funding, Chapter 5, Statutes of 2017 § (2017). https://leginfo.legislature.ca.gov/faces/billStatusClient.xhtml?bill_id=201720180SB1.
- Belzer, Michael. *Sweatshops on Wheels: Winners and Losers in Trucking Deregulation*. Oxford University Press, 2000.
- Bernhardt, Annette. “Labor Standards and the Reorganization of Work: Gaps in Data and Research.” IRLE Working Paper. UC Berkeley Institute for Research on Labor and Employment, January 2014. <https://escholarship.org/uc/item/3hc6t3d5>.
- . “Low-Wage Work in California: 2014 Chartbook.” UC Berkeley Center for Labor Research and Education, April 30, 2015. <http://laborcenter.berkeley.edu/lowwageca/>.
- Bernhardt, Annette, and Sarah Thomason. “What Do We Know About Gig Work in California? An Analysis of Independent Contracting.” UC Berkeley Center for Labor Research and Education, June 2017. <http://laborcenter.berkeley.edu/what-do-we-know-about-gig-work-in-california/>.
- Berth, Rhandi, Laura Dresser, and Emanuel Ubert. “Moving Apprenticeship into Manufacturing’s Future: Industrial Manufacturing Technician.” Wisconsin Regional Training Partnership and COWS, February 2017. https://www.cows.org/_data/documents/1826.pdf.
- Bigelow, Frank. AB-2842 Wood products, Public Resources Code § (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2842.
- Bilginsoy, Cihan. “The Hazards of Training: Attrition and Retention in Construction Industry Apprenticeship Programs.” *Industrial and Labor Relations Review* 57, no. 1 (October 2003): 54–67. <https://doi.org/10.2307/3590981>.
- Billingsley, Megan A., Ian M. Hoffman, Elizabeth Stuart, Steven R. Schiller, Charles A. Goldman, and Kristina LaCommare. “The Program Administrator Cost of Saved Energy for Utility Customer-Funded Energy Efficiency Programs.” LBNL-6595E. Lawrence Berkeley National Laboratory, March 2014. <https://emp.lbl.gov/sites/all/files/lbnl-6595e.pdf>.
- Bivens, Josh. “A Comprehensive Analysis of the Employment Impacts of the EPA’s Proposed Clean Power Plan.” Briefing Paper. Economic Policy Institute, 2015. <http://www.epi.org/publication/employment-analysis-epa-clean-power-plan/>.
- Blackmesapeeps. *Navajo Green Job*. Youtube, 2009. <https://www.youtube.com/watch?v=tAJHuRxblmE>.
- Blakeslee, Sam. AB-1613 Energy: Waste Heat and Carbon Emissions Reduction Act, Chapter 713, Statutes of 2007 § (2007). http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200720080AB1613.



- Bolinger, Mark, and Joachim Seel. “Utility-Scale Solar 2015: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States.” Lawrence Berkeley National Laboratory, August 2016. http://eta-publications.lbl.gov/sites/default/files/lbnl-1006037_report.pdf.
- Bonta, Rob. AB-262 Public contracts: bid specifications: Buy Clean California Act, Chapter 816, Statutes of 2017 § (2017). https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB262.
- Borenstein, Severin, and Lucas Davis. “The Distributional Effects of U.S. Clean Energy Tax Credits.” *NBER Tax Policy and the Economy* 30, no. 1 (June 2016): 191–234.
- Bradbury, Alexandra. “How Do We ‘Change Everything’ without Pitting Workers against the Planet?” *Labor Notes* (blog), September 8, 2015. <https://labornotes.org/blogs/2015/09/how-do-we-change-everything-without-pitting-workers-against-planet>.
- Bradford, Ben. “Extreme California Wildfires Emit More Greenhouse Gases—But Scientists Don’t Know Exactly How Much.” *Capitol Public Radio*, August 7, 2018. <http://www.caprado.org/120977>.
- Brecher, Jeremy. “Climate, Jobs, and Justice: A Plan for a Just Transition to a Climate-Safe Economy.” *Labor Network for Sustainability* (blog). Accessed December 4, 2018. <http://www.labor4sustainability.org/articles/climate-jobs-and-justice-a-plan-for-a-just-transition-to-a-climate-safe-economy/>.
- . “Jobs Beyond Coal: A Manual for Communities, Workers, and Environmentalists.” Labor Network for Sustainability, 2012. http://report.labor4sustainability.org/coal_2012.pdf.
- Brink, Stephen A. “Vice President for Public Resources, California Forestry Association,” January 11, 2019.
- Brinkman, Norman, Michael Wang, Trudy Weber, and Thomas Darlington. “Well-to-Wheels Analysis of Advanced Fuel/Vehicle Systems — A North American Study of Energy Use, Greenhouse Gas Emissions, and Criteria Pollutant Emissions,” May 2005. https://www.energy.gov/sites/prod/files/2014/04/f14/well_to_wheels_analysis_0.pdf.
- Brown, Anne Elizabeth. “Ridehail Revolution: Ridehail Travel and Equity in Los Angeles.” UCLA, 2018. <https://escholarship.org/uc/item/4r22m57k>.
- Buckley, Laura, Linda Rudolph, and Neil Maizlish. “Public Health Research Roadmap on Emerging Electricity Systems.” California Energy Commission, November 2017. <https://www.energy.ca.gov/2017publications/CEC-500-2017-035/CEC-500-2017-035.pdf>.



- Building Skills Partnership. “About Us.” Accessed November 13, 2018. <http://www.buildingskills.org/about/>.
- Burke, Autumn. AB 2722, Burke. Transformative Climate Communities Program, Chapter 371, Statutes of 2016 § (2016). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB2722.
- Burks, Stephen V., Jeffrey Carpenter, Lorenz Götte, Kristen Monaco, Kay Porter, and Aldo Rustichini. “Using Behavioral Economic Field Experiments at a Large Motor Carrier: The Context and Design of the Truckers and Turnover Project.” IZA Discussion Papers. Institute for the Study of Labor (IZA), May 2007. <https://doi.org/10.3386/w12976>.
- Burks, Stephen V., and Kristen Monaco. “Is the U.S. Labor Market for Truck Drivers Broken? An Empirical Analysis Using Nationally Representative Data.” IZA Discussion Papers. Institute for the Study of Labor (IZA), 2018. <https://ideas.repec.org/p/iza/izadps/dp11813.html>.
- Burns, Patrick, and Daniel Flaming. “Water Use Efficiency and Jobs.” Economic Roundtable, 2011. https://economicrt.org/wp-content/uploads/2011/12/Water_Use_Efficiency_and_Jobs_2011.pdf.
- Burtraw, Dallas, Karen Palme, and Danny Kahn. “Allocation of CO2 Emissions Allowances in the Regional Greenhouse Gas Cap-and-Trade Program.” Resources for the Future, May 2005. <https://ageconsearch.umn.edu/bitstream/10650/1/dp050025.pdf>.
- Busch, Chris. “How Do Ambitious Climate Pledges Impact Economic Growth? For Insight, Compare Texas And California.” *Forbes*, September 10, 2018. <https://www.forbes.com/sites/energyinnovation/2018/09/10/how-do-ambitious-climate-pledges-impact-economic-growth-for-insight-compare-texas-and-california/>.
- Business Wire. “LADWP Provides Water-Saving Toilets and Installation Service Free of Charge; Program Also Supports Jobs in Diverse Communities,” September 25, 2003. <https://www.businesswire.com/news/home/20030925005452/en/LADWP-Water-Saving-Toilets-Installation-Service-Free-Charge>.
- Cal Fire. “CAL FIRE Firefighter Training,” October 2009. http://calfire.ca.gov/communications/downloads/fact_sheets/Firefightertraining.pdf.
- . “Fire Protection Careers - Firefighter Hiring.” Accessed April 19, 2018. http://calfire.ca.gov/about/about_careers_fireprotection_seasonal.
- . “Forest Climate Action Team (FCAT).” Accessed April 19, 2018. Available via Internet archive at <https://web.archive.org/web/20180328173604/https://www.fire.ca.gov/fcat>.



- Cal Fire Local 2881. “Representing the Professional Firefighters of Cal Fire.” Accessed October 22, 2018. <http://www.calfirelocal2881.org/>.
- Caldwell, Jim. “The Facility Management Talent Pipeline: California Statewide Plan.” California Community Colleges - Energy, Construction, & Utilities Sector, February 16, 2016. <https://foundation.ifma.org/docs/default-source/gwi-resources/california-statewide-plan-for-the-facility-management-talent-pipeline-02-2017.pdf?sfvrsn=2>.
- Caldwell, Jim. Sector Navigator for Energy, Utilities and Construction, Chancellor’s Office, California Community Colleges. Personal communication with author, November 17, 2017.
- California Air Resources Board. “2017 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development,” August 2017. https://ww2.arb.ca.gov/sites/default/files/2018-12/ab8_report_2017.pdf.
- . “2018 Progress Report: California’s Sustainable Communities and Climate Protection Act,” November 2018. https://ww2.arb.ca.gov/sites/default/files/2018-11/Final2018Report_SB150_112618_02_Report.pdf.
- . “Allowance Allocation.” Accessed December 6, 2018. <https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/allowance-allocation>.
- . “Alternative Fuel Volumes and Credit Generation,” December 31, 2019. <https://ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm>.
- . “Assembly Bill 32 Overview: California Global Warming Solutions Act,” August 5, 2014. <https://www.arb.ca.gov/cc/ab32/ab32.htm>.
- . “Attachment A: First Notice of Public Availability of 15-Day Amendment Text; Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation,” December 21, 2016. <https://www.arb.ca.gov/regact/2016/capandtrade16/attacha.pdf>.
- . “Attachment C: Staff Report: Initial Statement of Reasons; Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation,” September 4, 2018. <https://www.arb.ca.gov/regact/2018/capandtrade18/ct18sria.pdf>.
- . “California Air Resources Board’s Guidance to Volkswagen on First 30 Month Electric Vehicle Infrastructure Investment Plan of the 2.0 Liter Diesel Engine Partial Consent Decree Settlement,” February 2017. https://www.arb.ca.gov/msprog/vw_info/vsi/vw-zevinvest/documents/carb_guidance_021017.pdf.
- . “California Climate Investments.” Accessed November 19, 2018. <https://ww2.arb.ca.gov/our-work/programs/california-climate-investments/about>.



- . “California Climate Investments: Appropriations from the Greenhouse Gas Reduction Fund as of August 31, 2018, Sustainable Communities and Clean Transportation,” August 31, 2018. Available via Internet archive at https://web.archive.org/web/20181202233236/https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/summary_appropriation_table_8_31_18.pdf.
- . “California Greenhouse Gas Emissions for 2000 to 2016: Trends of Emissions and Other Indicators,” 2018. https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2016/ghg_inventory_trends_00-16.pdf.
- . “California Greenhouse Gas Emissions for 2000 to 2017: Trends of Emissions and Other Indicators,” 2019. https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2017/ghg_inventory_trends_00-17.pdf.
- . “California Greenhouse Gas Inventory - Forests and Other Lands.” Accessed April 19, 2018. Available via Internet archive at <https://web.archive.org/web/20171218210713/https://www.arb.ca.gov/cc/inventory/sectors/forest/forest.htm..>
- . “California Greenhouse Gas Inventory for 2000-2016—by Category as Defined in the 2008 Scoping Plan,” June 22, 2018. https://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_sum_2000-16.pdf.
- . “California’s 2017 Climate Change Scoping Plan,” November 2017. https://ww3.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf.
- . “California’s 2017 Climate Change Scoping Plan Appendix E Economic Analysis,” November 2017. https://ww3.arb.ca.gov/cc/scopingplan/2030sp_app_econ_final.pdf.
- . “California’s 2017 Climate Change Scoping Plan Appendix H Major Climate Statutes and Regulations,” November 2017. https://ww3.arb.ca.gov/cc/scopingplan/2030sp_apph_climatestatutesref_final.pdf.
- . “Cap-and-Trade Auction Proceeds: Funding Guidelines for Agencies That Administer California Climate Investments,” December 2015. <https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/arb-funding-guidelines-for-ca-climate-investments.pdf>.
- . “Cap-and-Trade Program: Vintage 2017 Allowance Allocation,” August 9, 2017. <https://www.arb.ca.gov/cc/capandtrade/allowanceallocation/v2017allocation.pdf>.
- . “Cap-and-Trade Regulation and Mandatory GHG Reporting Regulation 2018 Amendments.” presented at the CARB Board Meeting, December 13, 2018. <https://www.arb.ca.gov/board/books/2018/121318/18-10-6pres.pdf>.



- . “CCI Quantification, Benefits, and Reporting Materials.” Accessed May 23, 2019. <https://ww2.arb.ca.gov/resources/documents/cci-quantification-benefits-and-reporting-materials>.
- . “Facts About The Advanced Clean Cars Program,” November 9, 2011. https://www.arb.ca.gov/msprog/zevprog/factsheets/advanced_clean_cars_eng.pdf.
- . “FARMER Program.” Accessed October 9, 2018. <https://ww2.arb.ca.gov/our-work/programs/farmer-program>.
- . “Greenhouse Gas Emissions Inventory - Query Results: Greenhouse Gas Emissions Inventory Summary [2000 - 2016],” June 22, 2018. https://www.arb.ca.gov/app/ghg/2000_2016/ghg_sector_data.php.
- . “Greenhouse Gas Reduction Fund Appropriations by Fiscal Year (As of August 31, 2018),” August 31, 2018. Available via Internet archive at https://web.archive.org/web/20190228191421/https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/detail_appropriation_8_31_18.pdf/.
- . “High Global Warming Potential Gases,” June 22, 2018. <https://www.arb.ca.gov/cc/inventory/background/hgwp.htm>.
- . “Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project,” October 10, 2017. <https://www.arb.ca.gov/msprog/aqip/hvip.htm>.
- . “Landfilling of Waste,” September 17, 2013. <https://ww3.arb.ca.gov/cc/waste/landfillingofwaste.pdf>.
- . “Low Carbon Fuel Standard.” Accessed November 21, 2018. <https://www.arb.ca.gov/fuels/lcfs/background/basics-notes.pdf>.
- . “Low Carbon Transportation Investments and Air Quality Improvement Program.” Accessed November 21, 2018. <https://www.arb.ca.gov/msprog/aqip/aqip.htm>.
- . “Low-Income Barriers Study, Part B: Overcoming Barriers to Clean Transportation Access for Low-Income Residents.” California Air Resources Board, February 21, 2018. https://www.arb.ca.gov/msprog/transoptions/sb350_final_guidance_document_022118.pdf.
- . “Mandatory GHG Reporting - Reported Emissions.” Accessed January 1, 2019. <https://ww2.arb.ca.gov/mrr-data>.
- . “Oil and Gas Methane Regulation.” Accessed January 2, 2019. <https://ww2.arb.ca.gov/resources/fact-sheets/oil-and-gas-methane-regulation>.
- . “Oil and Gas Regulation,” July 18, 2017. <https://www.arb.ca.gov/regact/2016/oilandgas2016/oilandgas2016.htm>.



- . “Overview of ARB Emissions Trading Program,” February 9, 2015. https://www.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf.
- . “Overview of the Waste Management Sector Plan: Assembly Bill (AB) 341,” June 18, 2013. https://www.arb.ca.gov/cc/waste/ws_overview.pdf.
- . “Proposed California Phase 2 Greenhouse Gas Standards (CA Phase 2 GHG) and Potential Amendments to the Tractor-Trailer GHG Regulation.” Sacramento, California, August 31, 2017. https://www.arb.ca.gov/msprog/onroad/caphase2ghg/20170831_workshop_presentation.pdf.
- . “Proposed Fiscal Year 2018-19 Funding Plan for Clean Transportation Incentives for Low Carbon Transportation Investments and the Air Quality Improvement Program,” September 21, 2018. https://www.arb.ca.gov/msprog/aqip/fundplan/proposed_1819_funding_plan.pdf.
- . “Proposed Regulation to Implement the California Cap-and-Trade Program: Appendix K - Leakage Analysis,” October 28, 2010. <https://www.arb.ca.gov/regact/2010/capandtrade10/capv4appk.pdf>.
- . “Proposed Short-Lived Climate Pollutant Reduction Strategy,” April 11, 2016. <https://www.arb.ca.gov/cc/shortlived/meetings/04112016/proposedstrategy.pdf>.
- . “Public Data on Allocation,” December 5, 2017. <https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/cap-and-trade-program-data>.
- . “Report: Cap-and-Trade Spending Doubles to \$1.4 Billion in 2018.” Press Release, March 25, 2019. <https://ww2.arb.ca.gov/news/report-cap-and-trade-spending-doubles-14-billion-2018>.
- . “Short-Lived Climate Pollutant Reduction Strategy,” March 2017. https://www.arb.ca.gov/cc/shortlived/meetings/03142017/final_slcp_report.pdf.
- . “Sustainable Communities,” 2017. <https://ww2.arb.ca.gov/our-work/topics/sustainable-communities>.
- . “Update on Innovative Clean Transit (ICT) Discussion Document,” March 27, 2018. <https://arb.ca.gov/msprog/ict/meeting/mt180327/180327ictconcept.pdf>.
- California Air Resources Board, and California Department of Finance. “2018 Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds,” March 2018. https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/2018_cci_annual_report.pdf.
- . “2019 Annual Report to the Legislature on California Climate Investments Using Cap-and-Trade Auction Proceeds,” March 2019. https://ww3.arb.ca.gov/cc/capandtrade/auctionproceeds/2019_cci_annual_report.pdf.



- California Air Resources Board, California Environmental Protection Agency, California Department of Food and Agriculture, and California Natural Resources Agency. “California 2030 Natural and Working Lands Climate Change Implementation Plan: Concept Paper,” May 2018. <https://ww3.arb.ca.gov/cc/natandworkinglands/nwl-implementation-plan-concept-paper.pdf>.
- California Board of Registered Nursing. “Welcome to the Board of Registered Nursing.” Accessed October 5, 2018. <https://www.rn.ca.gov/index.shtml>.
- California Budget & Policy Center. “2009 Mapping California’s Workforce Development System: A Guide to Workforce Development Programs in California,” May 2009. <https://calbudgetcenter.org/resources/2009-mapping-californias-workforce-development-system-a-guide-to-workforce-development-programs-in-california/>.
- California Climate & Agriculture Network. “Methane from Dairies,” November 12, 2015. <http://calclimateag.org/methanedairies/>. (Available now via <https://web.archive.org/web/20180901023624/http://calclimateag.org/methanedairies/>.)
- California Coastal Conservancy. “Climate Ready Program.” Accessed October 22, 2018. <https://scc.ca.gov/climate-change/climate-ready-program/>.
- California Code. Project Labor Agreements, Chapter 2.8 Public Contract Code - PCC § 2500-2503 (2012). https://leginfo.legislature.ca.gov/faces/codes_displayText.xhtml?lawCode=PCC&division=2.&title=&part=1.&chapter=2.8.&article=.
- California Community Colleges. “Inmate Education Pilot Program.” Accessed October 30, 2018. <http://extranet.cccco.edu/Divisions/AcademicAffairs/InmateEducation-PilotProgram.aspx>.
- . “Latest ATL News!” ATL – Advanced Transportation and Logistics. Accessed October 12, 2018. <http://www.atreeducation.org/category/news/>.
- . “Strong Workforce Program.” Accessed November 15, 2018. <http://doingwhatmatters.cccco.edu/strongworkforce.aspx>.
- . “Welcome to ATL.” ATL – Advanced Transportation and Logistics. Accessed November 15, 2018. <http://www.atreeducation.org/>.
- . “Welcome to the California Community Colleges Chancellor’s Office.” Accessed October 10, 2018. <http://www.cccco.edu/>.
- California Community Colleges Chancellor’s Office. “California Community Colleges Guided Pathways.” Accessed June 16, 2019. <http://cccgp.cccco.edu/>.
- . “Management Information Systems Data Mart.” Accessed October 10, 2018. https://datamart.cccco.edu/Students/Enrollment_Status.aspx.



- . “Strong Workforce Program.” California Community Colleges, November 15, 2018. <https://www.cccco.edu/About-Us/Chancellors-Office/Divisions/Workforce-and-Economic-Development/Strong-Workforce-Program>.
- California Department of Community Services and Development. “Energy Services Providers; Community Services Providers.” Accessed June 24, 2019. Available via Internet archive at [https://web.archive.org/web/20190601015418/https://www.csd.ca.gov/Services/FindServicesinYourArea/SanDiego\(CUI\).aspx](https://web.archive.org/web/20190601015418/https://www.csd.ca.gov/Services/FindServicesinYourArea/SanDiego(CUI).aspx).
- . “Low-Income Weatherization Program Guidelines: Fiscal Year 2015-16 Appropriation Procurements: Single-Family Energy Efficiency; Single-Family Solar Photovoltaics,” November 30, 2017. http://www.csd.ca.gov/Portals/0/Documents/LIWP/LIWP-SF_ProgramGuidelines2015-16_FINAL_Amended_113017.pdf.
- . “Weatherization Assistance Program for Low-Income Persons: Amended Draft 2017 State Plan and Application to the U.S. Department of Energy,” May 15, 2018. Available via Internet archive at <https://web.archive.org/web/20190601020538/http://www.csd.ca.gov/Portals/0/Documents/Public%20Notices/2017%20DOE%20WAP%20State%20Plan.pdf>.
- California Department of Community Services and Development, and Low Income Weatherization Program Regional Administrators RFP. “Building Workforce Partnerships,” November 15, 2016. Available via Internet archive at <https://web.archive.org/web/20161216194800/http://www.csd.ca.gov/Portals/0/Documents/LIWP/Bidders%20Library/Presentations/CSD%20-%20Workforce%20Partnerships%20161115%20FINAL.pdf>.
- California Department of Consumer Affairs, Board for Professional Engineers, Land Surveyors, and Geologists. “Board for Professional Engineers, Land Surveyors, and Geologists.” Department of Consumer Affairs. Accessed October 5, 2018. <https://www.bpelsg.ca.gov/>.
- California Department of Corrections and Rehabilitation. “2013 CDCR Outcome Evaluation Report.” California Department of Corrections and Rehabilitation, January 2014. <https://sites.cdcr.ca.gov/research/wp-content/uploads/sites/9/2018/04/2013-Outcome-Evaluation-Report.pdf>.
- California Department of Finance. “Governor’s Budget Summary 2018-19 (Proposed),” January 10, 2018. <http://www.ebudget.ca.gov/2018-19/pdf/BudgetSummary/FullBudgetSummary.pdf>.
- . “Governor’s Budget Summary 2018-19 (Proposed): Climate Change,” January 10, 2018. <http://www.ebudget.ca.gov/2018-19/pdf/BudgetSummary/ClimateChange.pdf>.



- . “Gross State Product.” Accessed December 7, 2018. http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/.
- . “Population Projections (Baseline 2016).” Accessed September 24, 2018. <http://www.dof.ca.gov/Forecasting/Demographics/projections/>.
- California Department of Fish and Wildlife. “Wetlands Restoration for Greenhouse Gas Reduction Program.” Accessed October 9, 2018. <https://www.wildlife.ca.gov/Conservation/Watersheds/Greenhouse-Gas-Reduction>.
- California Department of Food and Agriculture. “2017 Dairy Digester Research and Development Program: Projects Selected for Award of Funds,” September 14, 2018. https://www.cdfa.ca.gov/oefi/ddrdp/docs/2017_DDRDP_ProjectsAwarded.pdf.
- . “Alternative Manure Management Program (AMMP).” Accessed October 24, 2018. <https://www.cdfa.ca.gov/oefi/AMMP/>.
- . “State Water Efficiency and Enhancement Program.” Accessed October 9, 2018. <https://www.cdfa.ca.gov/oefi/sweep/>.
- California Department of Human Resources. “Labor Relations Unit 8 - Firefighters.” Accessed October 22, 2018. <http://www.calhr.ca.gov/labor-relations/Pages/Unit-08-Firefighters.aspx>.
- California Department of Human Resources Office of Financial Management and Economic Research. “2014 California Firefighter Total Compensation Survey,” May 30, 2014. <https://www.calhr.ca.gov/Documents/2014-California-Firefighter-Total-Compensation-Survey.pdf>.
- California Department of Industrial Relations. “California Prevailing Wage Laws,” February 1, 2016. <https://www.dir.ca.gov/public-works/CaliforniaPrevailing-WageLaws.pdf>.
- . “Cal/OSHA Issues Citations for Fatal Waste Collection Truck Accident (News Release No. 2018-77),” September 20, 2018. <https://www.dir.ca.gov/DIRNews/2018/2018-77.pdf>.
- . “Labor Commissioner Posts List of Port Trucking Companies with Unsatisfied Judgments for Labor Violations (News Release No. 2019-01),” January 2, 2019. <https://www.dir.ca.gov/DIRNews/2019/2019-01.html>.
- . “Landmark Workplace Safety and Health Regulation Approved to Reduce Risk of Major Incidents at Oil Refineries in California,” May 18, 2017. <https://www.dir.ca.gov/DIRNews/2017/2017-37.pdf>.



- . “News Release: DIR Recognizes New Apprenticeship Program at the Santa Clara Valley Transportation Authority during National Apprenticeship Week,” November 14, 2016. Available via Internet archive at <https://web.archive.org/web/20161115113026/https://www.dir.ca.gov/DIRNews/2016/2016-105.pdf>.
- . “Prevailing Wage Requirements,” October 2016. <https://www.dir.ca.gov/public-works/prevailing-wage.html>.
- . Process Safety Management for Petroleum Refineries, California Code of Regulations, Title 8, General Industry Safety Orders § 5189.1 (2017). https://www.dir.ca.gov/title8/5189_1.html.
- . “Public Works Apprentice Wage Sheets,” October 2016. <https://www.dir.ca.gov/OPRL/pwappwage/PWAppWageStart.asp>.
- . “U.S. District Court Upholds Labor Commissioner Awards of Almost \$1 Million for Misclassification of Port and Rail Truck Drivers (News Release No. 2017-39),” May 23, 2017. <https://www.dir.ca.gov/DIRNews/2017/2017-39.pdf>.
- California Department of Industrial Relations, Division of Apprenticeship Standards. “Apprenticeship Program Information: Water Treatment Plant Operator.” Accessed November 9, 2018. https://www.dir.ca.gov/databases/das/results_aigdetail.asp?varOcclid=550.
- . “Best Practices: Preparation for Apprenticeship Training.” Accessed November 13, 2018. <https://www.dir.ca.gov/das/BP-Pre-Apprenticeship.pdf>.
- . “Division of Apprenticeship Standards (DAS) - Minimum Industry Training Criteria (MITC).” Accessed December 31, 2018. <https://www.dir.ca.gov/das/mitc.htm>.
- . “Find an Apprenticeship Program,” September 23, 2018. <https://www.dir.ca.gov/databases/das/aigstart.asp?Flag1=NR>.
- . “Public Works Apprenticeship Requirements,” April 2017. <https://www.dir.ca.gov/das/publicworks.html>.
- California Department of Industrial Relations, Industrial Welfare Commission. “History of California Minimum Wage.” Accessed December 5, 2018. <https://www.dir.ca.gov/iwc/MinimumWageHistory.htm>.
- California Department of Industrial Relations, Labor Commissioner’s Office. “Electrician Certification Program,” 2017. <https://www.dir.ca.gov/dlse/ecu/ElectricalTrade.html>.
- . “Independent Contractor versus Employee.” Accessed October 5, 2018. https://www.dir.ca.gov/dlse/faq_independentcontractor.htm.



- California Department of Industrial Relations, Office of Policy, Research and Legislation. “Index 2018-2 General Prevailing Wage Journeyman Determinations.” Accessed January 2, 2019. <https://www.dir.ca.gov/OPRL/2018-2/PWD/index.htm#Journeyman>.
- California Department of Motor Vehicles. “Statistics for Publication,” December 2017. <https://www.dmv.ca.gov/portal/wcm/connect/5aa16cd3-39a5-402f-9453-0d353706cc9a/official.pdf?MOD=AJPERES>.
- California Department of Resources Recycling and Recovery (CalRecycle). “AB 341 Report to the Legislature,” August 28, 2015. <https://www2.calrecycle.ca.gov/Publications/Details/1538>.
- . “Businesses Going Green With Commercial Recycling,” September 27, 2013. <https://www2.calrecycle.ca.gov/Publications/Details/1413>.
- . “California Anaerobic Digestion Projects (a Partial List, May 2017),” May 2017. <https://www.calrecycle.ca.gov/docs/cr/Organics/conversion/ADProjects.pdf>; available via <https://pdfslide.net/documents/california-anaerobic-digestion-projects-a-partial-list-california-anaerobic.html>.
- . “California’s Climate Strategy: Waste Sector Goals,” April 18, 2019. <https://www2.calrecycle.ca.gov/Publications/Details/1650>.
- . “CalRecycle Awards \$25 Million for Organics Recycling Projects--Communities Get Environmental and Economic Boost from California Climate Investments,” July 3, 2018. <https://www.calrecycle.ca.gov/newsroom/2018/07july/16>.
- . “History of California Solid Waste Law, 1985-1989,” July 27, 2018. <https://www.calrecycle.ca.gov/laws/legislation/calhist/1985to1989>.
- . “Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility.” Accessed November 1, 2018. <https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Destination/DisposalByFacility>.
- . “Mandatory Commercial Recycling,” October 23, 2018. <https://www.calrecycle.ca.gov/Recycle/Commercial/>.
- . “Organics Grant Program.” [CA.gov](https://www.ca.gov), July 26, 2018. <https://www.calrecycle.ca.gov/climate/grantsloans/organics>.
- . “Per Capita Disposal and Goal Measurement (2007 and Later).” Accessed September 19, 2018. <https://www.calrecycle.ca.gov/lgcentral/basics/percapitadsp/>.
- . “Product Stewardship and Extended Producer Responsibility (EPR),” October 23, 2018. <https://www.calrecycle.ca.gov/epr>.



———. “Proposed Regulation for Short-Lived Climate Pollutants: Organic Waste Methane Emissions; Standardized Regulatory Impact Assessment (SRIA),” n.d. <https://www.calrecycle.ca.gov/docs/cr/laws/rulemaking/slcp/impactassessment.pdf>.

———. “Short-Lived Climate Pollutants (SLCP): Organic Waste Reductions; Proposed Regulation Text,” January 18, 2019. <https://www.calrecycle.ca.gov/docs/cr/laws/rulemaking/slcp/proposedregulations.pdf>.

———. “State of Disposal and Recycling in California for Calendar Year 2016,” August 2017. <https://www2.calrecycle.ca.gov/Publications/Download/1398>.

California Department of Tax and Fee Administration. “Sales & Use Tax Exemptions.” Accessed October 9, 2018. <https://www.cdtfa.ca.gov/taxes-and-fees/sales-and-use-tax-exemptions.htm#Farm-Equipment-and-Machinery>.

———. “Sales and Use Taxes: Exemptions and Exclusions; California Revenue and Taxation Code Part 1, Division 2,” March 2018. <https://www.cdtfa.ca.gov/formspubs/pub61.pdf>.

California Department of Transportation. “ATP Purpose and Goals,” March 2015. <https://dot.ca.gov/-/media/dot-media/programs/local-assistance/documents/atp/2018/visio-atp-purpose-and-goals-flowchart-3-3-15.pdf>.

———. “California Public Road Data 2016,” March 2018. http://www.dot.ca.gov/hq/tsip/hpms/hpmslibrary/prd/prd_pdf_format/prd2016.pdf.

———. “SB 1 Overview.” Rebuilding California SB1. Accessed November 14, 2018. <http://rebuildingca.ca.gov/overview.html>.

California Department of Transportation, California Air Resources Board, California Energy Commission, and California Governor’s Office of Business and Economic Development. “California Sustainable Freight Action Plan,” July 29, 2016. http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/Documents/CSFAP_Main%20Document_FINAL_07272016.pdf.

California Department of Transportation, California Air Resources Board, California Energy Commission, and Governor’s Office of Business and Economic Development. “About the California Sustainable Freight Action Plan.” California Sustainable Freight Action Plan. Accessed January 4, 2019. <http://www.dot.ca.gov/csfap/>.

California Department of Water Resources. “Clean Energy for the State Water Project,” May 12, 2016. <https://water.ca.gov/LegacyFiles/climatechange/docs/2016/CleanEnergyforSWPFinal.5.19.16.pdf>.



- . “Groundwater Sustainability Plans.” Accessed September 24, 2018. <https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management/Groundwater-Sustainability-Plans>.
- . “Model Water Efficient Landscape Ordinance.” California Code of Regulations, 2015. <https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency/Model-Water-Efficient-Landscape-Ordinance>.
- . “Power.” Accessed September 26, 2018. <https://water.ca.gov/Programs/State-Water-Project/SWP-Power>.
- . “Producing and Consuming Power.” California Department of Water Resources. Accessed September 24, 2018. <https://water.ca.gov/What-We-Do/Power>.
- . “Sustainable Groundwater Planning Grant Program.” Accessed June 11, 2018. <https://water.ca.gov/Work-With-Us/Grants-And-Loans/Sustainable-Groundwater>.
- . “Water Energy Grant Program.” Accessed September 24, 2018. <https://water.ca.gov/Work-With-Us/Grants-And-Loans/Water-Energy-Grant-Programs>.
- . “Water Plan Update 2018 Draft Reviewer’s Guide,” January 9, 2018. Available via Internet archive at <https://web.archive.org/web/20190324091547/https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/California-Water-Plan/Water-Plan-Updates/Files/Update-2018/Water-Plan-Update-2018-Working-Draft.pdf>.
- California Department of Water Resources, State Water Resources Control Board, California Public Utilities Commission, California Department of Food and Agriculture, and California Energy Commission. “Making Water Conservation a California Way of Life: Implementing Executive Order B-37-16,” April 2017. https://water.ca.gov/LegacyFiles/wateruseefficiency/conservation/docs/20170407_EO_B-37-16_Final_Report.pdf.
- California Department of Water Resources Sustainable Groundwater Management Program. Groundwater Sustainability Plan Emergency Regulations (2016). https://water.ca.gov/LegacyFiles/groundwater/sgm/pdfs/GSP_Emergency_Regulations.pdf.
- California Employment Development Department. “Employment Determination Guide (DE 38),” n.d. https://www.edd.ca.gov/pdf_pub_ctr/de38.pdf.
- . “Final Report for the California Clean Energy Workforce Training Program,” April 13, 2012. https://listserver.energy.ca.gov/efficiency/existing_buildings/documents/ARRA-Programs/final_reports/CA_Clean_Energy_Wrkfc_Training_Program-Final_Report_2012-04-13.pdf.



- . “Labor Market Information for the State of California (Statewide Summary).” Accessed December 4, 2018. <https://www.labormarketinfo.edd.ca.gov/geography/california-statewide.html>.
- . “Quarterly Census of Employment and Wages (QCEW) - Industry Detail,” 2016. https://www.labormarketinfo.edd.ca.gov/qcew/CEW-Detail_NAICS.asp?MajorIndustryCode=1021&GeoCode=06000000&Year=2016&OwnCode=50&Qtr=00.
- . “Training Program Summary.” Accessed January 7, 2019. <http://www.labormarketinfo.edd.ca.gov/cgi/databrowsing/traProgramSummary.asp?menuChoice=ocexplorer&CipCode=470614++++&geogArea=0601000000>.
- California Energy Commission. “2012 Total Electricity System Power.” Accessed January 14, 2019. https://www.energy.ca.gov/almanac/electricity_data/system_power/2012_total_system_power.html.
- . “2016 Existing Buildings Energy Efficiency Action Plan Update December 2016,” December 14, 2016. https://ww2.energy.ca.gov/efficiency/existing_buildings/16-EBP-01/.
- . “Acceptance Test Technician Certification Providers.” Accessed November 13, 2018. <https://www.energy.ca.gov/title24/attcp/providers.html>.
- . “California Retail Fuel Outlet Annual Reporting (CEC-A15) Results.” Accessed October 16, 2018. <https://www.energy.ca.gov/data-reports/energy-almanac/transportation-energy/california-retail-fuel-outlet-annual-reporting>.
- . “Clean Energy & Pollution Reduction Act: SB 350 Overview.” Accessed February 26, 2018. <http://www.energy.ca.gov/sb350/>.
- . “Doubling Energy Efficiency Savings.” Accessed July 17, 2019. https://ww2.energy.ca.gov/sb350/doubling_efficiency_savings/.
- . “Energy Commission Adopts Standards Requiring Solar Systems for New Homes, First in Nation,” May 9, 2018. <https://www.energy.ca.gov/news/2018-05/energy-commission-adopts-standards-requiring-solar-systems-new-homes-first>.
- . “Food Production Investment Program (18-MISC-01).” Accessed October 29, 2018. Available via Internet archive at <https://web.archive.org/web/20180831230516/https://www.energy.ca.gov/research/fpip/index.html>. <https://www.energy.ca.gov/research/fpip/index.html>.
- . “New California Program Provides \$57 Million to Help Food Processors Cut Energy, Greenhouse Gas Emissions,” July 13, 2018. https://www.energy.ca.gov/releases/2018_releases/2018-07-13_fpip_grants.html.



- . “The California Clean Energy Jobs Act (Proposition 39 K-12 Program).” Accessed December 5, 2018. <http://www.energy.ca.gov/efficiency/proposition39/>.
- . “Tracking Progress.” Accessed November 12, 2018. https://www.energy.ca.gov/renewables/tracking_progress/.
- California Environmental Protection Agency. “California Climate Investments to Benefit Disadvantaged Communities.” Accessed November 19, 2018. <https://calepa.ca.gov/EnvJustice/GHGInvest/>.
- California Fire Safe Council. “Mobilizing Californians to Protect Their Homes, Communities and Environments from Wildfire.” Accessed October 19, 2018. <http://www.cafiresafecouncil.org/>.
- California Firefighter Joint Apprenticeship Committee. “Demographics From Application to Cohort,” June 2018.
- California Governor’s Office of Business and Economic Development. “Transportation Impacts (SB 743).” Accessed November 21, 2018. <http://opr.ca.gov/ceqa/updates/sb-743/>.
- California Governor’s Office of Planning and Research. “Senate Bill 375 CEQA Provision Flow Charts,” February 2, 2011. <http://www.opr.ca.gov/docs/SB375-Intro-Charts.pdf>.
- . “Technical Advisory on Evaluating Transportation Impacts in CEQA,” April 2018. http://www.opr.ca.gov/docs/20180416-743_Technical_Advisory_4.16.18.pdf.
- California Governor’s Office of Planning and Research, California Natural Resources Agency, and California Energy Commission. “California’s Fourth Climate Change Assessment.” Accessed June 12, 2019. <http://www.climateassessment.ca.gov/>.
- California Health and Human Services Agency, and California Emergency Medical Services Authority. “State of California Emergency Medical Services Law,” January 1, 2016. <https://emsa.ca.gov/wp-content/uploads/sites/47/2017/07/2016-Statute-Book.pdf>.
- California High-Speed Rail Authority. “Community Benefits Agreement,” August 13, 2013. https://www.hsr.ca.gov/Programs/Construction/community_benefits_agreement.html.
- . “Community Benefits Agreement: Putting Californians to Work,” May 2015. https://www.hsr.ca.gov/docs/newsroom/fact%20sheets/CBA_Factsheet_FINAL_0050415.pdf.



- California Integrated Waste Management Board. “Diversion Is Good for the Economy: Highlights from Two Independent Studies on the Economic Impacts of Diversion in California,” March 2003. <https://www2.calrecycle.ca.gov/Publications/Download/557>.
- California Labor & Workforce Development Agency. “Labor and Workforce Development Agency Announces Record Number of Apprentices,” May 15, 2018. <https://www.dir.ca.gov/DIRNews/2018/Record-Number-of-Apprentices.pdf>.
- California Natural Resources Agency. “Recommendations to Expand Wood Products Markets in California.” on behalf of Wood Products Working Group, October 2017. <https://resources.ca.gov/CNRALegacyFiles/wp-content/uploads/2014/07/Wood-Products-Recommendations.pdf>.
- California Natural Resources Agency, and Cal Fire. “Expenditure Record for Urban & Community Forestry Program, Fiscal Year 2017/2018,” January 9, 2018. https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/calfire-urbanforestry-atte-er.pdf?_ga=2.52808107.2080290525.1524169459-800290699.1505934573.
- California Natural Resources Agency, California Department of Food and Agriculture, and California Environmental Protection Agency. “California Water Action Plan: 2016 Update,” 2016. http://resources.ca.gov/docs/california_water_action_plan/Final_California_Water_Action_Plan.pdf.
- California Natural Resources Agency, California Environmental Protection Agency, and California Department of Food and Agriculture. “California Water Action Plan Implementation Report: 2016 Summary of Accomplishments,” January 9, 2017. http://resources.ca.gov/docs/california_water_action_plan/CA_WAP_Impl_Rpt_2016.pdf.
- California Office of Environmental Health Hazard Assessment (OEHHA). “CalEnviroScreen.” Text. OEHHA, November 27, 2014. <https://oehha.ca.gov/calenviroscreen>.
- California Public Utilities Commission. “California Solar Initiative.” Accessed January 2, 2019. <http://www.cpuc.ca.gov/General.aspx?id=6043>.
- . “CHP Program Settlement Agreement Term Sheet,” October 8, 2010. <http://docs.cpuc.ca.gov/PUBLISHED/GRAPHICS/124875.PDF>.
- . “CPUC Low Income Energy Programs California Alternate Rates for Energy Fact Sheet,” April 20, 2017. <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=6442453786>.
- . “Decision Addressing Energy Efficiency Business Plans,” May 31, 2018. <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M215/K706/215706139.PDF>.



- . “Decision Addressing Workforce Requirements and Third-Party Contract Terms and Conditions (18-10-008),” October 22, 2018. https://www.pge.com/pge_global/common/pdfs/for-our-business-partners/energy-efficiency-solicitations/Decision_Addressing_Workforce_Requirements_and_Third_Party_Contract_Terms_and_Conditions.pdf.
 - . “Decision Approving 2013-2014 Energy Efficiency Programs and Budgets,” November 8, 2012. <http://docs.cpuc.ca.gov/publisheddocs/published/g000/m034/k299/34299795.pdf>.
 - . “Decision Approving Retirement of Diablo Canyon Nuclear Power Plant,” January 16, 2018. <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M205/K423/205423920.PDF>.
 - . “Decision on Large Investor-Owned Utilities’ 2012-2014 Energy Savings Assistance (ESA) (Formerly Referred to as Low Income Energy Efficiency or LIEE) and California Alternate Rates for Energy (CARE) Applications,” August 23, 2012. http://docs.cpuc.ca.gov/word_pdf/AGENDA_DECISION/172767.pdf.
 - . “Decision on the Transportation Electrification Priority Review Projects,” January 11, 2018. <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M204/K655/204655240.PDF>.
 - . “Energy Storage.” Accessed October 4, 2018. <http://www.cpuc.ca.gov/General.aspx?id=3462>.
 - . “Fact Sheet Industrial Programs 2013-2014,” March 2013. <http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5418>.
 - . “Income Qualified Assistance Programs.” Accessed December 5, 2018. <http://www.cpuc.ca.gov/iqap/>.
 - . “Multifamily Affordable Solar Housing Program Handbook, First Edition.” Accessed August 1, 2018. http://www.gosolarcalifornia.ca.gov/documents/MASH_Handbook.pdf.
 - . “Qualifying Facilities and CHP Program Settlement.” Accessed October 24, 2018. <http://www.cpuc.ca.gov/General.aspx?id=5168>.
 - . “Water/Energy Nexus.” Accessed September 24, 2018. http://www.cpuc.ca.gov/nexus_calculator/.
- California Public Utilities Commission, Energy Division. “Resolution E-4770,” March 17, 2016. <http://docs.cpuc.ca.gov/publisheddocs/published/g000/m159/k652/159652363.pdf>.



- California Senate Governmental Organization Committee. "The Utilization of Current and Emerging Technologies to Monitor Wildfire Activity in California." Sacramento, California, March 6, 2019. https://sgov.senate.ca.gov/sites/sgov.senate.ca.gov/files/tech_info_hearing_background_3.4.19.pdf.
- California State Association of Counties. "Cap and Trade Expenditures: CalRecycle Funding," May 2, 2018. http://www.counties.org/sites/main/files/file-attachments/2018_support_of_calrecycle_ggrf_funding_may_2_version.pdf.
- California State Board of Pharmacy. "Welcome to the California State Board of Pharmacy." Accessed October 5, 2018. <https://www.pharmacy.ca.gov/>.
- California State Water Resource Control Board. "Water Loss Control," September 18, 2018. https://www.waterboards.ca.gov/water_issues/programs/conservation_portal/water_loss_control.html.
- California Strategic Growth Council. "Affordable Housing and Sustainable Communities Program: FY 2016-2017 Program Guidelines," July 17, 2017. http://sgc.ca.gov/programs/ahsc/docs/20171024-AHSC_16-17_Guidelines.pdf.
- . "Sustainable Agricultural Lands Conservation." Accessed October 9, 2018. <http://sgc.ca.gov/programs/salc/>.
- . "Transformative Climate Communities (TCC)." California Strategic Growth Council. Accessed August 28, 2018. <http://sgc.ca.gov/programs/tcc/>.
- California Transit Works! "CTW California Transit Works!" Accessed October 5, 2018. <http://californiatransitworks.org/>.
- . "Measurable Results." Accessed November 21, 2018. <http://www.catransitworks.org/metrics.html>.
- California Transportation Commission. "Senate Bill (SB) 1 Road Repair and Accountability Act of 2017: Active Transportation Program (ATP)." Accessed April 17, 2019. <http://www.catc.ca.gov/programs/atp/>.
- California Water Efficiency Partnership. "Fact Sheet on Long-Term Conservation Legislation," June 22, 2018. http://www.allianceforwaterefficiency.org/uploadedFiles/Resource_Center/Library/United_States/California/CaWEP-FAQ-Fact-Sheet-on-Long-Term-Conservation-Legislation.pdf.
- California Wildlife Conservation Board. "Climate Adaptation Program." Accessed October 9, 2018. <https://wcb.ca.gov/Programs/Climate-Adaptation>.
- California Workforce Development Board. "Construction Pre-Apprenticeship Pipeline for Ex-Offenders Awards," June 8, 2017. https://cwdb.ca.gov/wp-content/uploads/sites/43/2017/03/Ex-Offender_Web_Announcement-6-8-17.pdf.



- . “High Road Framework,” June 2018. https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/09/High-Road-ECJ-Brief_UPDATED-BRANDING.pdf.
- . “High Road Partnerships for Construction Careers.” Accessed October 12, 2018. <https://cwdb.ca.gov/initiatives/hrcc/>.
- . “High Road Training Partnerships.” Accessed September 11, 2019. <https://cwdb.ca.gov/initiatives/high-road-training-partnerships/>.
- . “Model High Road Training Partnership Awards,” December 21, 2017. <https://cwdb.ca.gov/wp-content/uploads/sites/43/2018/01/HRTPAmentedAwardAnnouncement122117.pdf>.
- . “Overview of PROP 39 Pre-Apprenticeship Training Pilots,” 2016. https://cwdb.ca.gov/wp-content/uploads/sites/43/2016/08/Prop39TrainingReport020917Final_Digital_85x11.pdf.
- . “Overview of Prop 39 Pre-Apprenticeship Training Pilots,” September 30, 2017. https://cwdb.ca.gov/wp-content/uploads/sites/43/2017/03/Prop39TrainingReport020917Final_Digital_85x11.pdf.
- . “SB 1 Workforce Guidelines,” January 2019. <https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/02/SB1-Workforce-Guidelines-1.18.2019.pdf>.
- . “Skills Attainment for Upward Mobility; Aligned Services for Shared Prosperity: California’s Unified Strategic Workforce Development Plan Under the Workforce Innovation and Opportunity Act (WIOA) for Program Years 2016-2019,” December 2018. https://cwdb.ca.gov/wp-content/uploads/sites/43/2019/01/Unified-State-Plan-modifications.Final_.12.27.18.1.pdf.
- California’s Citizens Oversight Board. “Proposition 39 Clean Energy Jobs Act Report to the Legislature,” March 2018. https://www.energy.ca.gov/efficiency/proposition39/citizens_oversight_board/documents/3rd_annual_report/CCOB_3rd_Annual_Report_2018_With_Appendices.pdf.
- Calpin, Patrick, and Esteban Plaza-Jennings. “A Look Back at EPA’s Cost and Other Impact Projections for MY 2004-2010 Heavy-Duty Truck Emissions Standards.” National Automobile Dealers Association and American Truck Dealers, February 13, 2012. <https://www.nada.org/WorkArea/DownloadAsset.aspx?id=21474839308>.
- “CalRecycle Targets Wage Violators.” *Recycling Today*, March 16, 2015. <http://www.recyclingtoday.com/article/calrecycle-targets-wage-violators/>.
- CALSTART. “California’s Clean Transportation Technology Industry: Time to Shift into High Gear,” August 2016. <https://calstart.org/report-highlights-growth-opportunity-for-ca-clean-trans-tech-industry/>.



- CalTraining Inc. “California ETP Training Grants.” Accessed November 15, 2018. http://www.caltraining.com/california_etp_training_grants.htm.
- CalVans. “History.” CalVans. Accessed November 21, 2018. <https://calvans.org/history>.
- California Climate Investments. “Cap-and-Trade Dollars at Work.” Accessed October 17, 2018. <http://www.caclimateinvestments.ca.gov/>.
- Career Ladders Project. “California Community Colleges Linked Learning Initiative (CCLLI).” Accessed November 19, 2018. <http://dev.careerladdersproject.org/initiatives-programs/california-community-college-linked-learning-initiative-cclli-2/>.
- Carnevale, Anthony P., Tamara Jayasundera, and Andrew R. Hanson. “Career and Technical Education: Five Ways That Pay Along the Way to the BA.” Georgetown University Center on Education and the Workforce, September 2012. <https://eric.ed.gov/?id=ED535321>.
- Cascadia Consulting Group. “2014 Generator-Based Characterization of Commercial Sector Disposal and Diversion in California.” California Department of Resources Recycling and Recovery (CalRecycle), September 10, 2015. <https://www2.calrecycle.ca.gov/Publications/Download/1177>.
- Cassidy, Megan. “Plum Gig or Slave Labor? California Inmates Fight Wildfires for \$1 an Hour - SFChronicle.Com.” *San Francisco Chronicle*, August 11, 2018. <https://www.sfchronicle.com/bayarea/article/Plum-gig-or-slave-labor-California-inmates-fight-13148532.php>.
- Center for Climate and Energy Solutions. “California Cap and Trade.” Accessed November 19, 2018. <https://www.c2es.org/content/california-cap-and-trade/>.
- Center for Construction Research and Training. *The Construction Chart Book: The U.S. Construction Industry and Its Workers*. Fifth Edition. Silver Spring, MD: The Center for Construction Research and Training, 2013. <https://www.cpwr.com/sites/default/files/publications/5th-Edition-Chart-Book-Final.pdf>.
- Center for Media and Democracy. “Mohave Generating Station.” SourceWatch, August 10, 2012. https://www.sourcewatch.org/index.php/Mohave_Generating_Station.
- Cha, J. Mijin. “A Just Transition: Why Transitioning Workers into a New Clean Energy Economy Should Be at the Center of Climate Change Policies.” *Fordham Environmental Law Review* 29, no. 2 (2017): 196–220.
- Chesbro, Wesley. AB-341 Solid waste: diversion, Chapter 476, Statutes of 2011 § (2011). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB341.



- . AB-1826 Solid waste: organic waste, Chapter 727, Statutes of 2014 § (2014). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1826.
- Chiu, David. AB-73: Planning and zoning: housing sustainability districts, Chapter 371, Statutes of 2017 § (2017). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB73.
- Cislo, Connor, and Nao Sano. “Electric Cars Could Be a Job Killer for Japan’s No. 1 Industry.” *Bloomberg Businessweek*, August 13, 2018. <https://www.bloomberg.com/news/articles/2018-08-13/electric-cars-could-be-a-job-killer-for-japan-s-no-1-industry>.
- City of Carson, CA. Chapter 16: Garbage, Trash, and Weeds, Article 2: Solid Waste Collection Regulations, Section 16-41: Employee Retention/Preferential Hiring/Wage Maintenance. Accessed December 7, 2018. <https://www.codepublishing.com/CA/Carson/?Carson09/Carson09010509.html&?f>.
- City of Maywood, CA. Chapter 13 - Waste Disposal Worker Retention Ordinance. Accessed November 5, 2018. https://library.municode.com/ca/maywood/codes/code_of_ordinances?nodeId=T4_C13.
- City of San Jose, CA. “Commercial Solid Waste and Recyclable Materials Collection Franchises Agreement Between the City of San Jose and Allied Waste Services of North America, LLC, DBA Allied Waste Services of Santa Clara County,” n.d. http://www3.sanjoseca.gov/clerk/Agenda/20110621/20110621_0701bcon.pdf.
- City of Santa Ana, CA. Chapter 16 - Garbage, Trash and Weeds. Accessed December 7, 2018. https://library.municode.com/ca/santa_ana/codes/code_of_ordinances?nodeId=PTIITHCO_CH16GATRWE_ARTIISOWACORE.
- Clean Coalition. “East Bay Community Energy: Feed-in Tariff Design Recommendations.” Prepared for East Bay Community Energy, August 2017. https://ebce.org/wp-content/uploads/Task-3-EBCE-FIT-Design-Recommendations_DRAFT.pdf.
- Cloer, Lee. “Closed Military Bases - What Are They Doing Now?” Duotech, January 26, 2018. <https://duotechservices.com/closed-military-bases-where-are-they-now>.
- Coalition for Energy Efficiency. “Final Comments on the SCE, PG&E, SDG&E and SoCalGas Business Plan Proposals.” California Public Utilities Commission, September 25, 2017. <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M196/K814/196814922.PDF>.
- . “Final Comments on the SCE, PG&E, SDG&E and SoCalGas Business Plan Proposals Attachment 2.” California Public Utilities Commission, September 25, 2017. <http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M196/K769/196769699.PDF>.



- Collier, Robert. "High Road for Deep Water." UC Berkeley Center for Labor Research and Education, November 2017. <http://laborcenter.berkeley.edu/pdf/2017/High-Road-for-Deep-Water.pdf>.
- Colosi, Stephanie. "The Future of (Water) Work." Jewish Vocational Service, July 16, 2018. <https://www.jvs.org/search/baywork/>.
- Committee on Budget. AB-134 Budget Act of 2017, Chapter 254, Statutes of 2017 § (2017). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB134.
- . AB-1613 Budget Act of 2016., Pub. L. No. Chapter 370, Statutes of 2016 (2016). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB1613.
- Committee on Budget and Fiscal Review. SB-73 Energy: Proposition 39 implementation, Chapter 29, Statutes of 2013 § (2013). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB73.
- . SB-99 Active Transportation Program, Chapter 359, Statutes of 2013 § (2013). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB99.
- . SB-101 Budget Act of 2015, Pub. L. No. Chapter 321, Statutes of 2015 (2015). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB101.
- . SB-859 Public resources: greenhouse gas emissions and biomass, Chapter 368, Statutes of 2016 § (2016). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB859.
- Correa, Maritza, Benjamin Demonbreum, Sean Hackett, Nefeli Ioannou, Camila Tussie, and David Yosuico. "Renewable Natural Gas: Insights and Recommendations for California." TomKat Center for Sustainable Energy, Stanford University, April 2018. <https://stanford.app.box.com/s/6lfnipidxeoeuc4ix4rww1xz7w0m8tdq>.
- Costa, Daniel. "The H-2B Temporary Foreign Worker Program: For Labor Shortages or Cheap, Temporary Labor?" Economic Policy Institute, January 19, 2016. <https://www.epi.org/publication/h2b-temporary-foreign-worker-program-for-labor-shortages-or-cheap-temporary-labor/#epi-toc-13>.
- Costello, Bob. "Truck Driver Shortage Analysis." American Trucking Associations, October 2017. <http://progressive1.acs.playstream.com/truckline/progressive/ATAs%20Driver%20Shortage%20Report%202017.pdf>.



- Cowan, Tadlock. "Military Base Closures: Socioeconomic Impacts." CRS Report for Congress. Congressional Research Service, February 7, 2012. <https://fas.org/sgp/crs/natsec/RS22147.pdf>.
- COWS. "Equity in Apprenticeship," August 17, 2018. <https://www.cows.org/equity-in-apprenticeship>.
- CR&R Environmental Services. "Anaerobic Digestion." Accessed September 21, 2018. <http://crrwasteservices.com/sustainability/anaerobic-digestion/>.
- Curry, Melanie. "California Active Transportation Program Funding Unchanged for Next Two Years." *StreetsBlogLA* (blog), January 26, 2015. <https://la.streetsblog.org/2015/01/26/active-transportation-program-funding-unchanged-for-next-two-year-cycle/>.
- Davidson, Paul. "Trucker Shortage Is Raising Prices, Delaying Deliveries." *USA TODAY*, April 29, 2018. <https://www.usatoday.com/story/money/2018/04/26/truck-driver-shortage-raises-prices/535870002/>.
- Davis, Stacey. "California's AB 617: A New Frontier in Air Quality Management... If Funded." Center for Clean Air Policy, August 2, 2017. <http://ccap.org/californias-ab-617-a-new-frontier-in-air-quality-management-if-funded/>.
- Decker, Nathaniel, Carol Galante, Karen Chapple, Amy Martin, Ethan N. Elkind, and Marilee Hanson. "Right Type, Right Place: Assessing the Environmental and Economic Impact of Infill Residential Development Through 2030." Next 10, n.d. <http://next10.org/sites/default/files/right-type-right-place.pdf>.
- DeShazo, J.R., Julien Gattaciecce, and Kelly Trumbull. "The Promises and Challenges of Community Choice Aggregation in California." UCLA Luskin Center for Innovation, July 2017. https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/The_Promises_and_Challenges_of_Community_Choice_Aggregation_in_CA.pdf.
- DeShazo, J.R., Jason Karpman, Weilong (David) Kong, and Colleen Callahan. "Employment Benefits from California Climate Investments and Co-Investments." UCLA Luskin Center for Innovation, August 14, 2018. https://innovation.luskin.ucla.edu/wp-content/uploads/2019/03/Employment_Benefits_from_CA_Climate_Investments_and_Co-investments.pdf.
- Deutsche Welle. "The Rise and Fall of Germany's Coal Mining Industry." *DW* (blog), January 31, 2007. <https://www.dw.com/en/the-rise-and-fall-of-germanys-coal-mining-industry/a-2331545>.
- DiChristopher, Tom. "Sizing up the Trade Adjustment Assistance Program." *CNBC*, June 26, 2015. <https://www.cnbc.com/2015/06/26/is-aid-to-trade-displaced-workers-worth-the-cost.html>.



- Dickenson, Roger. AB-1739 Groundwater management, Chapter 347, Statutes of 2014 § (2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1739.
- Dodd, Bill. SB-901 Wildfires, Chapter 626, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB901.
- Dolfin, Sarah, and Peter Z. Schochet. "The Benefits and Costs of the Trade Adjustment Assistance (TAA) Program Under the 2002 Amendments." Mathematica Policy Research, December 2012. https://wdr.doleta.gov/research/FullText_Documents/ETAOP_2013_09.pdf.
- Dresser, Laura, Hannah Halbert, and Stephen Herzenberg. "High Road WIOA: Building Higher Job Quality into Workforce Development." Economic Analysis Research Network (EARN), COWS, Policy Matters Ohio, Keystone Research Center, December 2015. https://www.keystoneresearch.org/sites/default/files/KRC_WIOA.pdf.
- Dresser, Laura, and Sarah White. "Equity. Climate. Jobs." California Workforce Development Board, June 2018.
- East Bay Rental Housing Association. "Oakland Property Owners File Landmark Suit Against City Over \$1.5 Billion Garbage Deal," June 29, 2016. <https://www.ebrha.com/blog/oakland-property-owners-file-landmark-suit-against-city-over-1-5-billion-garbage-deal/>.
- Eggman, Susan. AB-693 Multifamily Affordable Housing Solar Roofs Program., Chapter 582, Statutes of 2015 § (2015). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB693.
- EJAG. "SCAQMD AB 617 Implementation," January 26, 2018. <http://www.aqmd.gov/docs/default-source/ab-617-ab-134/ab-617-overview-to-ejag.pdf?sfvrsn=9>.
- Electrical Industry Training Committee. "Commercial/Industrial Electrical Industry Construction Training Criteria." California Apprenticeship Council, October 2010. <https://www.dir.ca.gov/das/MITC/MITC/Electrical/Electrical.pdf>.
- Electro Scan Inc. "New Law for Reporting Water Loss (SB 555): Electro Scan Applauds New California Law for Reporting Water Losses; Senate Bill 555 to Require Water Suppliers to Meet New Performance Standards," October 12, 2015. <https://www.electroscan.com/new-law-for-reporting-water-loss-sb-555/>.
- Energy Construction & Utilities, California Community Colleges, Workforce & Economic Development. "ECU Sector: Engage. Enroll. Employ." Accessed November 15, 2018. <https://web.archive.org/web/20190209020719/https://www.ecusectordwm.com/>.



- . “Key Initiatives.” ECU Sector: Engage. Enroll. Employ. Accessed October 12, 2018. <https://web.archive.org/web/20170823074408/http://www.ecusectordwm.com/key-initiatives.html>.
- Energy Market Innovations, Inc., Western Cooling Efficiency Center (WCEC), and Better Buildings, Inc. (BBI). “California HVAC Contractor & Technician Behavior Study: Final Report.” CALMAC Study, September 14, 2012. http://www.calmac.org/publications/CA_HVAC_Behavior_Study_FinalReport_2012Sept14_FINAL.pdf.
- Energy Vision. “The Largest Anaerobic Digester in the United States Sets the Green Pace in Perris, California,” n.d. https://energy-vision.org/pdf/CR&R_Project_Profile.pdf.
- Escrivá-Escrivá, Guillermo. “Basic Actions to Improve Energy Efficiency in Commercial Buildings in Operation.” *Energy and Buildings* 43, no. 11 (November 1, 2011): 3106–11. <https://doi.org/10.1016/j.enbuild.2011.08.006>.
- Esfahani, Asal, Mary Claire Evans, Kerry Fleisher, and Sara Kamins. “California Solar Initiative – Annual Program Assessment.” California Public Utilities Commission, June 2018. http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy_-_Electricity_and_Natural_Gas/Energy_Programs/2018%20CSI%20APA_FINAL.PDF.
- European Trade Union Institute. “Social Partners and the Collaborative Approach Are Key to the Green Transition of the Ruhr Region.” *Etui* (blog), February 9, 2016. <https://www.etui.org/News/Social-partners-and-the-collaborative-approach-are-key-to-the-green-transition-of-the-Ruhr-region>.
- Farnsworth, David, Christina Palmero, and Christopher Sherry. “Potential Emissions Leakage and the Regional Greenhouse Gas Initiative (RGGI): Evaluating Market Dynamics, Monitoring Options, and Possible Mitigation Mechanisms.” Regional Greenhouse Gas Initiative, March 14, 2007. https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Staff-Working-Group/il_report_final_3_14_07.pdf.
- Feldman, Kiera. “Trashed: Inside the Deadly World of Private Garbage Collection.” *ProPublica*, April 1, 2018. <https://www.propublica.org/article/trashed-inside-the-deadly-world-of-private-garbage-collection>.
- Figueroa, Maria, Jeff Grabelsky, and J. Ryan Lamare. “Community Workforce Agreements: A Tool to Grow the Union Market and to Expand Access to Lifetime Careers in the Unionized Building Trades.” *Labor Studies Journal* 38, no. 1 (March 2013): 7–31. <https://doi.org/10.1177/0160449X13490408>.
- Fine, Howard. “Labor-Backed Housing Initiative Measure JJJ Passes.” *Los Angeles Business Journal*, November 9, 2016. <http://labusinessjournal.com/news/2016/nov/09/los-angeles-voters-approve-measure-jjj/>.



- Fine, Janice, and Jennifer Gordon. "Strengthening Labor Standards Enforcement through Partnerships with Workers' Organizations." *Politics & Society* 38, no. 4 (December 2010): 552–85. <https://doi.org/10.1177/0032329210381240>.
- Fitzgerald, Joan. *Moving Up in the New Economy: Career Ladders for U.S. Workers*. A Century Foundation Book. Ithaca, NY: Cornell University Press, 2006.
- Flora, Heath. AB-579 Apprenticeship: Fire Protection: Firefighter Preapprenticeship Program., Pub. L. No. 579, Chapter 344, Statutes of 2017 (2017). https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB579.
- Forest Climate Action Team. "California Forest Carbon Plan: Managing Our Forest Landscapes in a Changing Climate." Cal Fire, California Natural Resources Agencies, California Environmental Protection Agency, May 2018. <http://resources.ca.gov/wp-content/uploads/2018/05/California-Forest-Carbon-Plan-Final-Draft-for-Public-Release-May-2018.pdf>.
- Forest Service Workers, Pub. L. No. S. Hrg. 109-427, § Subcommittee on Public Lands and Forests of the Committee on Energy and Natural Resources (2006). <https://www.gpo.gov/fdsys/pkg/CHRG-109shrg28144/html/CHRG-109shrg28144.htm>.
- Forman, Glen. Deputy Director, Division of Apprenticeship Standards, California Department of Industrial Relations. Personal communication with author, August 28, 2017.
- Foshay, Elena, Jill Kubit, and Lara Skinner. "Making the Transition: Helping Workers and Communities Retool for the Clean Energy Economy." Apollo Alliance & Cornell University, ILR School Global Labor Institute, 2009. http://www.climatechange.ca.gov/eaac/comments/2009-12-11_California_Labor_Federation_attachment_2.pdf.
- Foster, Ann C. "Differences in Union and Nonunion Earnings in Blue-Collar and Service Occupations." U.S. Department of Labor, Bureau of Labor Statistics, June 25, 2003. <https://www.bls.gov/opub/mlr/cwc/differences-in-union-and-nonunion-earnings-in-blue-collar-and-service-occupations.pdf>.
- Foundation for California Community Colleges. "Vision for Success: Strengthening the California Community Colleges to Meet California's Needs," July 17, 2017. <http://californiacommunitycolleges.cccco.edu/portals/0/reports/vision-for-success.pdf>.
- Franco, Guido. "Greenhouse Gas Emission Reductions - Tracking Progress." California Energy Commission, December 2017. https://ww2.energy.ca.gov/renewables/tracking_progress/documents/%20%20_%20%20duplicate:old%20files%20here/Greenhouse_Gas_Emissions_Reductions.pdf.



- Frederick, Michelle, and Caitlin Juarez. “Consolidation and Regionalization Efforts.” State Water Resources Control Board, Division of Drinking Water, 2017. https://calafco.org/sites/default/files/resources/2017_Staff_Workshop/Water%20Consolidations_SWRCB%20presentation.pdf.
- French Economic, Social and Environmental Council. “No Jobs on a Dead Planet—Trade Union Summit on Climate Change.” International Trade Union Confederation, July 27, 2015. <https://www.ituc-csi.org/no-jobs-on-a-dead-planet-trade>.
- Friedman, Laura. AB-1668 Water management planning, Chapter 15, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB1668.
- Friends of Urban Forest. “Green Teens,” 2016. <https://www.fuf.net/programs-services/community-engagement-education/green-teens/>.
- Fulton, Lew, Jacob Mason, and Dominique Meroux. “Three Revolutions in Urban Transportation.” UC Davis Institute of Transportation Studies and Institute for Transportation & Development Policy, May 2017. https://steps.ucdavis.edu/wp-content/uploads/2017/05/STEPS_ITDP-3R-Report-5-10-2017-2.pdf.
- Gale, Jr., H. Frederick, Linda Foreman, and Thomas Capehart. “Tobacco and the Economy: Farms, Jobs, and Communities.” Agricultural Economic Report. Economic Research Service/USDA, September 2000. <http://ageconsearch.umn.edu/record/34007/files/ae000789.pdf>.
- Garcia, Cristina. AB-617 Nonvehicular air pollution: criteria air pollutants and toxic air contaminants, Chapter 136, Statutes of 2017 § (2017). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB617.
- Garcia, Eduardo. AB-398 California Global Warming Solutions Act of 2006: market-based compliance mechanisms: fire prevention fees: sales and use tax manufacturing exemption, Chapter 135, Statutes of 2017 § (2017). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB398.
- Garry, Michael. “California Adopts U.S. SNAP Regs on HFCs.” *Hydrocarbons 21*, March 27, 2018. http://hydrocarbons21.com/articles/8194/california_adopts_u_s_snap_regs_on_hfcs.
- Garthwaite, Josie. “Smarter Driver Behavior Improves Fuel Economy for Trucks.” *National Geographic News*, September 24, 2011. <https://news.nationalgeographic.com/news/energy/2011/09/110923-fuel-economy-for-trucks/>.
- Gates, Sean P. Doe I, et al. v. Pure Forest, LLC et al., No. Case 2:14-cv-00879-LKK-CMK (United States District Court Eastern District of California April 8, 2014).



- Gatto, Mike. AB-1900 Renewable energy resources: biomethane, Chapter 602, Statutes of 2012 § (2012). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201120120AB1900.
- . AB-2282 Building standards: recycled water systems, Chapter 606, Statutes of 2014 § (2014). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2282.
- . AB-2868 Energy storage, Chapter 681, Statutes of 2016 § (2016). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB2868.
- Gearon, Jihan, and Wahleah Johns. “Peabody’s Declaration of Bankruptcy Is ‘No Surprise’: Navajo Tribal Members Demand Just Transition to a Sustainable Economy.” Indigenous Environmental Network, April 14, 2016. <http://www.ienearth.org/peabodys-declaration-of-bankruptcy-is-no-surprise/>.
- Giloth (ed.), Robert P. *Workforce Intermediaries for the Twenty-First Century*. Temple University Press, 2004. <https://www.jstor.org/stable/j.ctt14bszvp>.
- Giloth, Robert P. “Workforce Intermediaries: Partnerships for the Future.” *Economic Development Quarterly* 17, no. 3 (August 1, 2003): 215–19. <https://doi.org/10.1177/0891242403255222>.
- Gittleman, Maury, and Morris M. Kleiner. “Wage Effects of Unionization and Occupational Licensing Coverage in the United States.” *Industrial and Labor Relations Review*, January 2016. <https://journals.sagepub.com/doi/pdf/10.1177/0019793915601632>.
- Go Solar California. “California Solar Statistics.” Accessed November 26, 2018. https://www.californiasolarstatistics.ca.gov/reports/cost_vs_system_size/.
- . “Solar Incentive Programs by Utility.” Accessed April 4, 2019. <https://www.gosolarcalifornia.org/utilities/munis.php>.
- . “What Is The New Solar Homes Partnership?” Accessed January 2, 2019. <https://gosolarcalifornia.org/about/nshp.php>.
- Goldberg, Amelie, Robert P. Taylor, and Bruce Hedman. “Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector.” State and Local Energy Efficiency Action Network, March 18, 2014. https://www4.eere.energy.gov/seeaction/system/files/documents/industrial_energy_efficiency.pdf.
- Goldman, Charles A., Jane S. Peters, Nathaniel Albers, Elizabeth Stuart, and Merrian C. Fuller. “Energy Efficiency Services Sector: Workforce Education and Training Needs.” Lawrence Berkeley National Laboratory, March 2010. <https://emp.lbl.gov/publications/energy-efficiency-services-sector-0>.



- Gomez, Jimmy. AB-1550 Greenhouse gases: investment plan: disadvantaged communities, Chapter 369, Statutes of 2016 § (2016). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB1550.
- Gona, Ashita. “Tobacco to Tomatoes: The Reinvention of North Carolina’s Agriculture.” *Environmental Storytelling: Reporting by Students at UNC-Chapel Hill* (blog), December 9, 2014. <http://jomc565.web.unc.edu/2014/12/09/tobacco-to-tomatoes-the-reinvention-of-north-carolinas-agriculture/>.
- Gonzalez Fletcher, Lorena. AB-1530 Urban forestry, Chapter 720, Statutes of 2017 § (2017). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB1530.
- Gordon, Rich. AB-901 Solid waste: reporting requirements: enforcement, Chapter 746, Statutes of 2015 § (2015). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB901.
- Gorman, Steve. “Southern California Ports Clean Up Polluting Trucks.” *Reuters*, October 1, 2008. <https://www.reuters.com/article/us-ports/southern-california-ports-clean-up-polluting-trucks-idUSTRE4906D320081001>.
- Gray, Wayne, Joshua Linn, and Richard Morgenstern. “Employment and Output Leakage under California’s Cap-and-Trade Program.” Discussion Paper. Resources for the Future, May 2016. <https://www.rff.org/documents/1716/RFF-DP-16-17.pdf>.
- Grayson, Tim. AB-3187 Biomethane: gas corporations: rates: interconnection, Chapter 598, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB3187.
- Greenhouse, Steven. “Connecting Public Transit to Great Manufacturing Jobs.” *The American Prospect*, April 9, 2018. <http://prospect.org/article/connecting-public-transit-great-manufacturing-jobs>.
- Griseta, Myke. “Workforce Metrics Dashboard Report 2018: AB 2148 Legislative Report.” California Workforce Development Board, 2018. <https://cwdb.ca.gov/wp-content/uploads/sites/43/2018/05/2148-Report-FINAL.pdf>.
- Hall, Alessandro. “Under New Pollution Regulations, Milk Producers Seek Profit in Dairy Air.” Stanford University, The Bill Lane Center for the American West. ... & *the West* (blog), April 24, 2018. <https://west.stanford.edu/news/blogs/and-the-west-blog/2018/california-methane-dairy-farms>.
- Hall, Dee J., and Riley Vetterkind. “Undocumented Workers Are The Backbone Of Dairies. Will Trump Change That?” Listen to America. HuffPost, Wisconsin Center for Investigative Journalist, June 4, 2018. https://www.huffingtonpost.com/entry/wisconsin-dairy-industry-undocumented-workers_us_59c3cfb7e4b06f93538cfd3f.



- Hancock, Loni. SB-54 Hazardous materials management: stationary sources: skilled and trained workforce, Chapter 795, Statutes of 2013 § (2013). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB54.
- Hathaway, Ian, and Mark Muro. "Tracking the Gig Economy: New Numbers," October 13, 2016. <https://www.brookings.edu/research/tracking-the-gig-economy-new-numbers/>.
- Herring, Hal. "The Changing Politics of Woods Work." *High Country News*, October 30, 2017. <https://www.hcn.org/issues/49.18/timber-how-the-outsourcing-of-forestry-jobs-seeps-into-our-public-lands-debates>.
- Hertzberg, Robert. SB-606 Water management planning, Chapter 14, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB606.
- Heschong Mahone Group, Inc. "Large Office ('Ziggurat' Building) Site Report: High Efficiency Office: Low Ambient/Task Lighting Pilot Project." Submitted to Pacific Gas and Electric Company, October 23, 2009. <https://www.etc-ca.com/sites/default/files/OLD/images/pge0819.pdf>.
- Hinkley, Sara, Annette Bernhardt, and Sarah Thomason. "Race to the Bottom: How Low Road Subcontracting Affects Working Conditions in California's Property Services Industry." UC Berkeley Center for Labor Research and Education, March 8, 2016. <http://laborcenter.berkeley.edu/race-to-the-bottom/>.
- Hoffman, Ian M., Gregory Rybka, Greg Leventis, Charles A. Goldman, Lisa Schwartz, Megan Billingsley, and Steven Schiller. "The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level." Lawrence Berkeley National Laboratory, April 2015. <https://emp.lbl.gov/sites/all/files/total-cost-of-saved-energy.pdf>.
- Hoffman, Mitchell, and Stephen V. Burks. "Training Contracts, Worker Overconfidence, and the Provision of Firm-Sponsored General Training." SSRN Scholarly Paper. Rochester, NY: Social Science Research Network, May 31, 2013. <https://papers.ssrn.com/abstract=2220043>.
- Holley, Peter. "'People Are Freaking out.' Will Electric Vehicles Doom Your Neighborhood Auto Mechanic?" *The Washington Post*, December 11, 2017. https://www.washingtonpost.com/news/innovations/wp/2017/12/11/people-are-freaking-out-why-electric-vehicles-might-doom-your-neighborhood-auto-mechanic/?noredirect=on&utm_term=.c6ba47156ab6.



- House, Lon W. “Water Supply-Related Electricity Demand in California.” Prepared for Public Interest Energy Research, California Energy Foundation. Water and Energy Consulting and the Demand Response Research Center, November 2007. <https://drcc.lbl.gov/publications/water-supply-related-electricity>.
- Hueso, Ben. SB-693: Public contracts: skilled and trained workforce, Education Code, Health and Safety Code, Public Contract Code § (2016). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB693.
- . SB-1440 Energy: biomethane: biomethane procurement, Chapter 739, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1440.
- Huffman, Jared. AB-1470 Solar energy: Solar Water Heating and Efficiency Act of 2007, Chapter 536, Statutes of 2007 § (2007). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080AB1470.
- Hultquist, Andy, and Tricia L. Petras. “An Examination of the Local Economic Impacts of Military Base Closures.” *Economic Development Quarterly* 26, no. 2 (2012): 151–61. <https://doi.org/10.1177/0891242412442374>.
- IBEW Local 569. “IBEW and NECA to Strengthen Imperial County Green Energy Economy with New Electrical Training Center,” May 6, 2010. <http://www.ibew569.org/news/ibew-and-neca-strengthen-imperial-county-green-energy-economy-new-electrical-training-center?articleid=79&zoneid=3>.
- . “Local Hire Successes: Imperial Clean Energy Projects,” June 4, 2013.
- IBEW Local 595. “San Leandro JATC Electrical Apprenticeship.” Accessed August 2, 2017. http://www.ibew595.org/index.cfm?zone=/unionactive/view_article.cfm&HomeID=254085&page=Apprenticeships.
- “Initiative Measure No. 1631,” March 13, 2018. https://www.sos.wa.gov/_assets/elections/initiatives/finaltext_1482.pdf.
- Irwin, Jacqui. AB-1045 Organic waste: composting, Chapter 596, Statutes of 2015 § (2015). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160AB1045.
- Itron Consulting. “2017 SGIP Advanced Energy Storage Impact Evaluation.” California Public Utilities Commission, September 7, 2018. http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/Customer_Gen_and_Storage/2017_SGIP_AES_Impact_Evaluation.pdf.
- “IZA Discussion Papers.” Institute for the Study of Labor (IZA), n.d. <https://ideas.repec.org/s/iza/izadps.html>.



- Jackson, Charlie, and Allison Perrett. "The End of Tobacco and the Rise of Local Food in Western North Carolina." Local Food Research Center, Appalachian Sustainable Agriculture Project, March 2018. http://asapconnections.org/wp-content/uploads/Final_The-End-of-Tobacco.pdf.
- Jackson, Cori. "California's Advanced Lighting Controls Training Program: Building a Skilled Workforce in the Energy Efficiency Market." *ACEEE Summer Study on Energy Efficiency in Buildings*, 2012. <http://cltc.ucdavis.edu/sites/default/files/files/publication/20120800-aceee-calctp-jackson-1.pdf>.
- Jackson, Luther. "Award of Contract to the Santa Clara Valley Transportation Authority to Implement a California Energy Commission Initiative Supporting Transit Apprenticeship Development." Report to Council. Legislative Public Meetings. City of Sunnyvale, California, November 7, 2017. <https://sunnyvaleca.legistar.com/LegislationDetail.aspx?ID=3096522&GUID=-3F12A967-2B43-45CD-8BC5-5ABADB209951&Options=&Search=&FullText=1>.
- Jacobs, Ken, Zohar Perla, Ian Perry, and Dave Graham-Squire. "Producing Poverty: The Public Cost of Low-Wage Production Jobs in Manufacturing." UC Berkeley Center for Labor Research and Education, May 2016. <http://laborcenter.berkeley.edu/pdf/2016/Producing-Poverty.pdf>.
- Jacobs, Ken, Ian Perry, and Jenifer MacGillvary. "The High Public Cost of Low Wages." UC Berkeley Center for Labor Research and Education, April 2015. <http://laborcenter.berkeley.edu/the-high-public-cost-of-low-wages/>.
- Jafry, Tahseen, ed. *Routledge Handbook of Climate Justice*. First. Routledge International Handbooks. Routledge, 2019. <https://www.routledge.com/Routledge-Handbook-of-Climate-Justice/Jafry/p/book/9781138689350>.
- Janatpour, Mark. "Division of Labor Standards Enforcement, California Department of Industrial Relations," January 22, 2019.
- Jewish Vocational Service, Baywork, and The Centers of Excellence. "Water and Wastewater Career Pathways: Connecting People to Water Industry Jobs in the Bay Area," 2016. <https://www.jvs.org/wp-content/uploads/2018/07/BAYWORK-JVS-Water-Report-2017.pdf>.
- Jobs to Move America. "Labor and Community Groups Sign Landmark Agreement with Electric Bus Manufacturer BYD in Los Angeles," July 17, 2017. <https://en.byd.com/news-posts/press-release-labor-and-community-groups-sign-landmark-agreement-with-electric-bus-manufacturer-byd-in-los-angeles/>.
- . "U.S. Employment Plan," 2016. <https://jobstomoveamerica.org/wp-content/uploads/2015/10/JMA-Fact-Sheet-Branded-U.S.-Employment-2016.pdf>.



- . “U.S. Employment Plan Fact Sheet,” October 2015. <https://metro council.org/getdoc/6a488e92-1879-4811-8cf8-9fc32ed636a5/BusinessItem.aspx>.
- . “Victories.” Accessed November 21, 2018. <https://jobstomoveamerica.org/about/california-jobs-move-america/victories/>.
- JOC. “Federal Court Bars LA Employee-Driver Mandate.” *JOC.com*, August 26, 2013. https://www.joc.com/port-news/us-ports/port-los-angeles/federal-court-bars-la-employee-driver-mandate_20130826.html.
- Jones, Betony. “Creating Opportunities for Good Jobs in Distributed Solar.” *Raising the Bar: UC Berkeley Labor Center Blog* (blog), August 27, 2015. <http://laborcenter.berkeley.edu/creating-opportunities-for-good-jobs-in-distributed-solar/>.
- Jones, Betony, Molly Chlebnikow, Katherine (Nikki) Luke, and Alexis Goggins. “Employment Impacts and Just Transition Considerations Related to the Electrification of California Buildings,” forthcoming.
- Jones, Betony, Kevin Duncan, Ethan N. Elkind, and Marilee Hanson. “The Net Economic Impacts of California’s Major Climate Programs in the Inland Empire: Analysis of 2010-2016 and Beyond.” *Next 10*, August 2017. <https://www.law.berkeley.edu/wp-content/uploads/2017/08/InlandEmpireNetImpacts.pdf>.
- Jones, Betony, Ethan Elkind, Kevin Duncan, and Marilee Hanson. “The Economic Impacts of California’s Major Climate Programs on the San Joaquin Valley.” *Next 10*, 2017. <http://laborcenter.berkeley.edu/the-economic-impacts-of-californias-major-climate-programs-on-the-san-joaquin-valley/>.
- Jones, Betony, and Abigail Martin. “Statewide Program to Improve Industrial Energy Efficiency in Clean Power Plan Implementation: A Proposal for States.” Unpublished. UC Berkeley Center for Labor Research and Education, 2016.
- Jones, Betony, Peter Philips, and Carol Zabin. “Job Impacts of California’s Existing and Proposed Renewables Portfolio Standard.” UC Berkeley Donald Vial Center on Employment in the Green Economy, August 28, 2015. <http://laborcenter.berkeley.edu/pdf/2015/job-impacts-ca-rps.pdf>.
- . “The Link Between Good Jobs and a Low Carbon Future.” UC Berkeley Donald Vial Center on Employment in the Green Economy, July 2016. <http://laborcenter.berkeley.edu/the-link-between-good-jobs-and-a-low-carbon-future/>.
- Jones, Betony, and Carol Zabin. “Are Solar Energy Jobs Good Jobs?” *Raising the Bar: UC Berkeley Labor Center Blog* (blog), July 2, 2015. <http://laborcenter.berkeley.edu/are-solar-energy-jobs-good-jobs/>.



- Jones, Melissa, Michael Jaske, Michael Kenney, Brian Samuelson, Cynthia Rogers, Elena Giyenko, and Manjit Ahuja. "Senate Bill 350: Doubling Energy Efficiency Savings by 2030." California Energy Commission, 2017. http://docketpublic.energy.ca.gov/PublicDocuments/17-IEPR-06/TN221631_20171026T102305_Senate_Bill_350_Doubling_Energy_Efficiency_Savings_by_2030.pdf.
- Kadrigamar, Skanda. "New NYC Regulations on Uber and Lyft a Victory for Union Organizing." *Waging Nonviolence*, August 11, 2018. <https://wagingnonviolence.org/2018/08/nyc-regulations-uber-lyft-victory-union-organizing/>.
- Kane, Joseph, and Adie Tomer. "Renewing the Water Workforce: Improving Water Infrastructure and Creating a Pipeline to Opportunity." The Metropolitan Policy Program at Brookings, June 2018. <https://www.brookings.edu/research/water-workforce/>.
- Katz, Lawrence F., and Alan B. Krueger. "The Rise and Nature of Alternative Work Arrangements in the United States, 1995-2015." NBER Working Paper. National Bureau of Economic Research, September 2016. <https://doi.org/10.3386/w22667>.
- Khouri, Andrew. "Three Port Truck Companies Exploited Drivers, L.A. City Attorney Says in Lawsuits." *Los Angeles Times*, January 8, 2018. <https://www.latimes.com/business/la-fi-port-trucker-lawsuits-20180108-story.html>.
- Kings Basin Water Authority. "DWR Announce Solicitation for 2016 Water-Energy Grant Program," September 7, 2016. <http://www.kingsbasinauthority.org/dwr-announce-solicitation-for-2016-water-energy-grant-program/>.
- Kissam, Edward. "Differential Undercount of Mexican Immigrant Families in the U.S. Census." *Statistical Journal of the IAOS* 33 (2017): 797–816. <https://doi.org/10.3233/SJI-170388>.
- Klein, Gary, Martha Krebs, Valerie Hall, Terry O'Brien, and B. B. Blevins. "California's Water-Energy Relationship." Final Staff Report. California Energy Commission, November 2005. <http://large.stanford.edu/courses/2012/ph240/sperrin1/docs/CEC-700-2005-011-SF.PDF>.
- Kletzer, Lori G. *Job Loss from Imports: Measuring the Costs*. Institute for International Economics, 2001.
- . "Why the U.S. Needs Wage Insurance." *Harvard Business Review*, January 25, 2016. <https://hbr.org/2016/01/why-the-u-s-needs-wage-insurance>.
- Knudson, Tom, and Hector Amezcua. "The Pineros: Men of the Pines." *Sacramento Bee*, November 13, 2005. <http://www.sethlondon.com/portfolio/sacbee/pineros/index.html>.



- Kuipers, Dean. “Los Angeles’ Groundbreaking ‘RecyclA’ Program Dumps the Dump.” *Capital & Main*, June 28, 2017. <https://capitalandmain.com/los-angeles-ground-breaking-recycla-program-dumps-the-dump-0628>.
- LA Sanitation Solid Resources Commercial Franchise Division, and Solid Resources Commercial Franchise Division. “Personal Services Contract between the City of Los Angeles and Arakelian Enterprises, Inc. DBA Athens Services for Exclusive Franchise to Provide Collection, Transfer, Processing, and Disposal Services for Solid Resources to Commercial Establishments and Applicable Multifamily Establishments in the West Los Angeles, North Central and Harbor Zones.” City of Los Angeles Department of Public Works, September 15, 2016. <https://www.lacitysan.org/cs/groups/public/documents/document/y250/mde0/~edisp/cnt014118.pdf>.
- LAANE: A New Economy for All. “Repower LA.” Accessed September 26, 2018. <https://laane.org/blog/campaigns/energy-and-water/>.
- LAANE: A New Economy For All. “Waste & Recycling: Don’t Waste Long Beach.” Accessed January 1, 2019. <https://laane.org/blog/campaigns/waste-recycling/>.
- Labor Network for Sustainability, and Strategic Practice Grassroots Policy Project. “‘Just Transition’ – Just What Is It? An Analysis of Language, Strategies, and Projects,” July 6, 2016. <http://www.labor4sustainability.org/uncategorized/just-transition-just-what-is-it/>.
- Laird, John. AB-2466 Local government renewable energy self-generation program, Chapter 540, Statutes of 2008 § (2008). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080AB2466.
- Lara, Ricardo. SB-605 Short-lived climate pollutants, Chapter 523, Statutes of 2014 § 39730 (2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB605.
- . SB-1204 California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program, Chapter 524, Statutes of 2014 § (2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1204.
- . SB-1383 Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills, Chapter 395, Statutes of 2016 § (2016). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383.
- . SB-1402 Labor contracting: customer liability, Chapter 702, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1402.



- Le, Uyen. "Project Labor Agreements: Pathways to Business Ownership and Workforce Development in Los Angeles." UCLA Labor Center California Construction Academy, November 2011. <http://docplayer.net/1112166-Project-labor-agreements-pathways-to-business-ownership-and-workforce-development-in-los-angeles.html>.
- Legislative Analyst's Office. "2017-18 Cap-and-Trade Expenditure Plan," August 24, 2017. <http://www.lao.ca.gov/handouts/resources/2017/Senate-Cap-and-Trade-Expenditure-Plan-082417.pdf>.
- Leigh, Nancey Green, and Edward J. Blakely. *Planning Local Economic Development: Theory and Practice*. Sixth Edition. SAGE Publications, 2016. <https://us.sagepub.com/en-us/nam/planning-local-economic-development/book244769>.
- Lenius, Pat. "Los Angeles Offers Free Delivery of Low-Flow Toilets to Homes." *Supply House Times*, September 12, 1999. <https://www.supplyht.com/articles/86340-los-angeles-offers-free-delivery-of-low-flow-toilets-to-homes>.
- Leno, Mark. SB-1371 Natural gas: leakage abatement, Chapter 525, Statutes of 2014 § (2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1371.
- Leon, Kevin de. SB-100 California Renewables Portfolio Standard Program: emissions of greenhouse gases, Chapter 312, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB100.
- . SB-350 Clean Energy and Pollution Reduction Act of 2015, Chapter 547, Statutes of 2015 § (2015). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB350.
- . SB-535 California Global Warming Solutions Act of 2006: Greenhouse Gas Reduction Fund, Chapter 830, Statutes of 2012 § (2012). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB535.
- Lepore, Brian J. "Military Base Realignment and Closures: Updated Costs and Savings Estimates from BRAC 2005." Letter to chairs and ranking members of relevant committees of the U.S. Senate and the U.S. House of Representatives. U.S. Government Accountability Office, June 29, 2012. <https://www.gao.gov/assets/600/592076.pdf>.
- . "Military Bases: Opportunities Exist to Improve Future Base Realignment and Closure Rounds." Report to Congressional Committees. U.S. Government Accountability Office, March 2013. <https://www.gao.gov/assets/660/652805.pdf>.



- Levenson, Howard. "Allocation, Eligibility, Scoring Criteria, and Evaluation Process for the Organics Grant Program (Greenhouse Gas Reduction Fund, Fiscal Year 2017-18)," January 16, 2018. <https://www2.calrecycle.ca.gov/PublicNotices/Documents/8718>.
- Lipman, Zoe, and Luke Tonachel. "Supplying Ingenuity II: U.S. Suppliers of Key Clean, Fuel-Efficient Vehicle Technologies." The Natural Resources Defense Council, BlueGreen Alliance, May 2017. <https://www.nrdc.org/sites/default/files/supplying-ingenuity-clean-vehicle-technologies-report.pdf>.
- Long, George I. "Differences between Union and Nonunion Compensation, 2001–2011." *Monthly Labor Review, U.S. Department of Labor, Bureau of Labor Statistics* 136, no. 4 (April 2013): 16–23.
- Lopez, Steve. "We Know L.A.'s New Recycling Program Is a Fiasco, but How'd It Get so Screwed Up?" *Los Angeles Times*, January 10, 2018. <https://www.latimes.com/local/california/la-me-lopez-recycla-20180110-story.html>.
- Los Angeles City Planning. "City Planning Releases Measure JJJ and Transit Oriented Communities Housing Progress Report," August 9, 2018. <https://www.lacity.org/blog/city-planning-releases-measure-jjj-and-transit-oriented-communities-housing-progress-report>.
- Los Angeles County Metropolitan Transportation Authority. "LA Metro MicroTransit Pilot Project (MTP) Draft Scope Questions for Consideration," August 29, 2017. <https://media.metro.net/uploads/Portal/MicroTransit.pdf>.
- . "Metro's Project Labor Agreement and Construction Careers Policy," March 2018. https://media.metro.net/about_us/pla/images/policy_constructioncareers_2018-03.pdf.
- . "Project Labor Agreement & Construction Careers Policy." LA Metro. Accessed November 21, 2018. <https://www.metro.net/about/placcp/>.
- . "Women Build Metro Los Angeles (WBMLA): Overview." LA Metro. Accessed January 7, 2019. <https://www.metro.net/about/wbmla/overview/>.
- Los Angeles County Metropolitan Transportation Authority, and The Los Angeles/Orange Counties Buildings and Construction Trades Council Affiliated with The Building and Construction Trade Department (AFL/CIO) And Signatory Craft Council and Local Unions. "Project Labor Agreement," 2012. http://media.metro.net/about_us/pla/images/project_labor_agreement_2012.pdf.
- Los Angeles County Supervisor Sheila Kuehl. "Women Build Metro LA: Apprenticeship Readiness Fair in Van Nuys," April 18, 2018. <https://supervisorkuehl.com/women-build-metro/>.



- Los Angeles Department of Water and Power. “Competitive Offer Power Purchase Agreement Between City of Los Angeles Acting by and Through the Department of Water and Power and Hecate Energy Fit ‘A’ LLC,” June 3, 2014. http://clkrep.lacity.org/onlinedocs/2014/14-0736_misc_06-05-14.pdf.
- . “Equity Metrics Data Initiative.” Accessed September 26, 2018. https://www.ladwp.com/ladwp/faces/wcnav_externalId/au-fr-corporateperformance-emdi;jsessionid=Fp8qbrnBDd22rGZL19TZTTBIJMvc9mvF4n-7v0w3pSXpvJ3bvXPfY!210892335?_afWindowId=null&_afLoop=9966663789852&_a%29%29=&_afWindowMode=0&_adf.ctrl-state=18b-c96x2hu_4#%40%3F_afWindowId%3Dnull%26_afLoop%3D9966663789852%26_a%2529%2529%3D%26_afWindowMode%3D0%26_adf.ctrl-state%3D3877zxy63_4.
- . “LADWP Approves New Community Solar Power Program for Renters,” September 26, 2018. <http://www.ladwpnews.com/ladwp-approves-new-community-solar-power-program-for-renters/>.
- Lowenthal, Bonnie. AB-2675 State agency: public contracts, Chapter 617, Statutes of 2014 § (2014). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB2675.
- Lujan, Art, Lyle A. Balistreri, and Loree K. Soggs. “Community Workforce Agreements: Pathway to Career Opportunities.” Jobs for the Future, March 2013. <https://www.jff.org/resources/community-workforce-agreements-pathway-career-opportunities/>.
- Luke, Nikki, Carol Zabin, Dalia Velasco, and Robert Collier. “Diversity in California’s Clean Energy Workforce: Access to Jobs for Disadvantaged Workers in Renewable Energy Construction.” UC Berkeley Center for Labor Research and Education, Green Economy Program, August 2017. <http://laborcenter.berkeley.edu/pdf/2017/Diversity-in-Californias-Clean-Energy-Workforce.pdf>.
- Luria, Daniel, and Joel Rogers. *Metro Futures: Economic Solutions for the Cities and Their Suburbs*. Boston, MA: Beacon Press, 1999. https://www.cows.org/_data/files/1999_Metro_Futures_complete_book.pdf.
- Maguire, Sheila, Joshua Freely, Carol Clymer, Maureen Conway, and Deena Schwartz. “Tuning in to Local Labor Markets: Findings from the Sectoral Employment Impact Study.” Public/Private Ventures, July 2010. <http://ppv.issuelab.org/resources/5101/5101.pdf>.
- Mahalia, Nooshin. “Prevailing Wages and Government Contracting Costs: A Review of the Research.” Briefing Paper, July 3, 2008. <https://www.epi.org/publication/bp215/>.



- Manley, David. "Oil Companies Face Stranded Assets, But Producer Countries Have It Worse." *Natural Resource Governance Institute* (blog), January 27, 2017. <https://resourcegovernance.org/blog/oil-companies-face-stranded-assets-producer-countries-have-it-worse>.
- Manville, Michael, Brian D. Taylor, and Evelyn Blumenberg. "Falling Transit Ridership: California and Southern California." prepared for the Southern California Association of Governments, January 2018. https://www.scag.ca.gov/Documents/ITS_SCAG_Transit_Ridership.pdf.
- Martelle, Scott. "Kick Coal, Save Jobs Right Now." *Sierra Magazine*, 2012. <http://vault.sierraclub.org/sierra/201201/kick-coal-save-jobs.aspx>.
- Martin, Shawn. "Improving Outcomes for California Conservation Corpsmembers." Legislative Analyst's Office, February 9, 2018. http://www.lao.ca.gov/Publications/Report/3742#Multiple_Program_Goals_and_Lack_of_Outcome_Data_Make_Program_Assessment_Difficult_.
- Mason, Jennifer, and Mireya Solís. "Globalization on the Cheap: Why the U.S. Lost Its Way on Trade." Brookings, August 28, 2017. <https://www.brookings.edu/blog/order-from-chaos/2017/08/28/globalization-on-the-cheap-why-the-u-s-lost-its-way-on-trade/>.
- Masunaga, Samantha. "L.A. and Long Beach Port Truckers and Warehouse Workers Begin Strike." *Los Angeles Times*, October 1, 2018, sec. Business. <https://www.latimes.com/business/la-fi-port-truckers-strike-20181001-story.html>.
- Mattera, Philip, and Greg LeRoy. "The Jobs Are Back in Town: Urban Smart Growth and Constructin Employment." Good Jobs First, November 2003. <http://www.goodjobsfirst.org/sites/default/files/docs/pdf/backintown.pdf>.
- Maume, David J., and George Wilson. "Determinants of Declining Wage Mobility in the New Economy." *Work and Occupations* 42, no. 1 (February 1, 2015): 35–72. <https://doi.org/10.1177/0730888414552707>.
- McCarty, Kevin. AB-876 Compostable organics, Chapter 593, Statutes of 2015 § (2015). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB876.
- Medical Board of California. "The Mission of the Medical Board of California." Accessed October 5, 2018. <http://www.mbc.ca.gov/>.
- Melville, John, Renae Steichen, Janine Kaiser, and Francie Genz. "CA's Advanced Transportation Industry Clusters of Opportunity: Driving Market Expansion, Technology Innovation and Job Growth." Collaborative Economics, Inc., September 2013. http://www.coecon.com/assets/ca_advancedtransport-clusters_2013.pdf.



- Messenger, Michael. "Strategic Plan to Reduce the Energy Impact of Air Conditioners." California Energy Commission, June 2008. <http://www.energy.ca.gov/2008publications/CEC-400-2008-010/CEC-400-2008-010.PDF>.
- Metropolitan Transportation Commission. "MTC Overview of SB 1 (Beall and Frazier)," May 3, 2017. https://mtc.ca.gov/sites/default/files/MTC_SB_1_Bill_Summary_5-3-17.pdf.
- Michel, Matt. "NATE Impact Study." Service Roundtable, September 2016. <https://www.serviceroundtable.com/freebies/viewfreebie.asp?PCID=1469>.
- Milkman, Ruth, Ana Luz Gonzalez, and Victor Narro. "Wage Theft and Workplace Violations in Los Angeles: The Failure of Employment and Labor Law for Low-Wage Workers." UCLA Institute for Research on Labor and Employment, 2010. <https://escholarship.org/uc/item/5jt7n9gx>.
- Mishel, Lawrence. "Uber and the Labor Market: Uber Drivers' Compensation, Wages, and the Scale of Uber and the Gig Economy." Economic Policy Institute, May 15, 2018. <https://www.epi.org/publication/uber-and-the-labor-market-uber-drivers-compensation-wages-and-the-scale-of-uber-and-the-gig-economy/>.
- . "Yes, Manufacturing Still Provides a Pay Advantage, but Staffing Firm Outsourcing Is Eroding It." Economic Policy Institute, March 12, 2018. <https://www.epi.org/files/pdf/141193.pdf>.
- Mitchell, David, Thomas Chesnutt, and David Pekelney. "Transforming Water: Water Efficiency as Infrastructure Investment." Position Paper. Alliance for Water Efficiency, December 2017. <http://www.allianceforwaterefficiency.org/Transforming-Water.aspx>.
- Mitchell, Ellen. "Pentagon Chief Pushes for New Round of Base Closures." *The Hill*, October 18, 2017. <https://thehill.com/policy/defense/356054-pentagon-chief-pushes-for-new-round-of-base-closures>.
- Moehrle, Thomas. "Compensation of Residential and Nonresidential Construction Workers." *Monthly Labor Review*, April 2010, 15.
- Monning, Bill. SB-1090 Diablo Canyon nuclear powerplant, Chapter 561, Statutes of 2018 Public Utilities Code § 712.7 (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1090.
- Morello, Anne, Raja Issa, and Bryan Franz. "Exploratory Study of Recruitment and Retention of Women in the Construction Industry." *Journal of Professional Issues in Engineering Education and Practice* 144 (April 1, 2018). <https://ascelibrary.org/doi/10.1061/%28ASCE%29EI.1943-5541.0000359>.



- Morrow, William, John Marano, Jayant Sathaye, Ali Hasanbeigi, and Tengfang Xu. “Assessment of Energy Efficiency Improvement in the United States Petroleum Refining Industry.” Lawrence Berkeley National Laboratory, June 2013.
- Mosburg, Sue. “Implementing SB 555: Validated Water Loss Audits and Reporting.” presented at the California Water Association 2016 Annual Conference, November 3, 2016. <http://www.calwaterassn.com/wp-content/uploads/2016/11/Implementing-SB-555.pdf>.
- Moseley, Cassandra. “Chapter 9: Job Quality for Forest Workers.” In *Forest Community Connections: Implications for Research, Management, and Governance*, by Ellen Donoghue and Victoria Sturtevant, 162–81. Washington, DC: Resources for the Future, 2008.
- Murphy, Brett. “Asleep at the Wheel: Companies Risk Lives by Putting Sleep-Deprived Port Truckers on the Road.” *USA TODAY*, December 28, 2017. <https://www.usatoday.com/pages/interactives/news/rigged-asleep-at-the-wheel/>.
- . “Rigged. Forced into Debt. Worked Past Exhaustion. Left with Nothing.” *USA TODAY*, June 16, 2017. <https://www.usatoday.com/pages/interactives/news/rigged-forced-into-debt-worked-past-exhaustion-left-with-nothing/>.
- Murray, Kevin. SB-1 Electricity: solar energy: net metering, Chapter 132, Statutes of 2006 § (2006). https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=200520060SB1.
- National Academies of Sciences, Engineering, and Medicine. *Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services*. Washington, DC: The National Academies Press, 2016. <https://doi.org/10.17226/21875>.
- National Employment Law Project. “California Governor Brown Signs Fair Chance Act, Extending ‘Ban the Box’ to Private Employers,” October 15, 2017. <https://www.nelp.org/news-releases/california-governor-brown-signs-fair-chance-act-extending-ban-the-box-to-private-employers/>.
- National Employment Law Project, and In The Public Interest. “Reentry and Employment for the Formerly Incarcerated and the Role of American Trades Unions,” April 6, 2016. <https://www.nelp.org/publication/reentry-and-employment-for-the-formerly-incarcerated-and-the-role-of-american-trades-unions/>.
- National Fire Protection Association. “List of NFPA Codes and Standards.” Accessed January 7, 2019. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards>.



- Natural Resources Conservation Service California. “Forestry,” November 3, 2017. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/ca/technical/landuse/forestry/>.
- Natural Resources Defense Council. “Gov. Brown Signs Historic Diablo Canyon Nuclear Plant Bill,” September 20, 2018. <https://www.nrdc.org/media/2018/180920>.
- Nero, Mark Edward. “SB 54 Creates a New, Safe Day at Refineries.” International Brotherhood of Boilermakers, March 1, 2016. <https://boilermakers.org/news/headlines/SB-54-creates-a-new-safe-day-at-refineries>.
- Nevada Division of Environmental Protection. “Reid Gardner Power Station.” Accessed July 8, 2019. <https://ndep.nv.gov/environmental-cleanup/site-cleanup-program/active-cleanup-sites/reid-gardner-power-station>.
- Nichols, Matt. Policy Director, Infrastructure and Transportation, Office of Mayor Libby Schaaf. Personal communication with author, December 1, 2018.
- Nilsen, Sigurd R. “Trade Adjustment Assistance: Program Provides an Array of Benefits and Services to Trade-Affected Workers.” Testimony before the Committee on Ways and Means, House of Representatives. U.S. Government Accountability Office, June 14, 2007. <https://www.gao.gov/new.items/d07994t.pdf>.
- North American Sustainable Refrigeration Council. “SMUD Launches Natural Refrigerant Incentive Program,” June 12, 2017. <http://nasrc.org/articles1/2017/6/12/smud-launches-natural-refrigerant-incentive-program>.
- Northwest Forest Worker Center. “Occupational Safety and Health.” Accessed October 22, 2018. <https://nwforestworkers.org/programs/occupational-safety-and-health>.
- Nothoff, Robert. Director of Waste and Recycling, Los Angeles Alliance for a New Economy, June 19, 2018.
- Núñez, Fabian. AB-32 Air pollution: greenhouse gases: California Global Warming Solutions Act of 2006, Chapter 488, Statutes of 2006 § (2006). https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=200520060AB32.
- Occupational Safety and Health Standard Board. “Process Safety Management for Petroleum Refineries: Initial Statement of Reasons.” California Department of Industrial Relations, September 15, 2016. <https://www.dir.ca.gov/OSHSB/documents/Process-Safety-Management-for-Petroleum-Refineriess-ISOR.pdf>.
- Office of Governor Edmund G. Brown Jr. “Clean Energy Jobs Plan,” 2010. https://www.gov.ca.gov/wp-content/uploads/2017/09/Clean_Energy_Plan.pdf.



- . “Governor Brown Issues Executive Order to Protect Communities from Wildfire, Climate Impacts,” May 10, 2018. <https://www.ca.gov/archive/gov39/2018/05/10/governor-brown-issues-executive-order-to-protect-communities-from-wildfire-climate-impacts/index.html>.
- . “Tree Mortality State of Emergency,” October 30, 2015. https://www.ca.gov/archive/gov39/wp-content/uploads/2017/09/10.30.15_Tree_Mortality_State_of_Emergency.pdf.
- “Oil and Gas Final Regulation Order: Title 17, Division 3, Chapter 1, Subchapter 10 Climate Change, Article 4.” California Code of Regulations, n.d. https://www.arb.ca.gov/cc/oil-gas/oil-gas_final_regulation.pdf.
- Orenberg, Jacob. “2018-2019 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program.” Commission Report. California Energy Commission, Fuels and Transportation Division, May 2018. <https://efiling.energy.ca.gov/getdocument.aspx?tn=223420>.
- Osterman, Paul. “In Search of the High Road: Meaning and Evidence.” *ILR Review* 71, no. 1 (January 1, 2018): 3–34. <https://doi.org/10.1177/0019793917738757>.
- Pacific CHP Technical Assistance Partnership. “The State of CHP: California.” U.S. Department of Energy, November 2017. <https://www.energy.gov/sites/prod/files/2017/11/f39/StateOfCHP-California.pdf>.
- Pacific Gas and Electric Company. “Energy Efficiency Business Plan 2018-2025.” Accessed July 31, 2018. https://docs.wixstatic.com/ugd/0c9650_cbeb1d9e14cf4575845e8d5cd6bce57f.pdf.
- . “PG&E, SLO County, SLO Coastal Unified School District, Local Cities Reach Accord on Diablo Canyon Community Support Funding,” November 28, 2016. https://www.pge.com/en_US/safety/how-the-system-works/diablo-canyon-power-plant/news-and-articles/pge-slo-county-slo-coastal-unified-school-district-local-cities-reach-accord-on%20diablo-canyon-community-support-funding.page.
- Pacific Gas and Electric Company, Friends of the Earth, Natural Resources Defense Council, Environmental California, International Brotherhood of Electrical Workers Local 1245, Coalition of California Utility Employees, and Alliance for Nuclear Responsibility. “Joint Proposal to Retire Diablo Canyon Nuclear Power Plant at Expiration of the Current Operating Licenses and Replace It with a Portfolio of GHG Free Resources.” PG&E, June 20, 2016. <https://www.pge.com/includes/docs/pdfs/safety/dcpp/JointProposal.pdf>.
- Parsons Brinckerhoff. “California High-Speed Rail Project: Economic Impact Analysis Report.” California High-Speed Rail Authority, April 2012. http://www.hsr.ca.gov/docs/about/business_plans/BPlan_2012EIR.pdf.



- Partnership for Working Families. “Los Angeles Waste Workers Survey,” unpublished 2015.
- . “Policy & Tools: Community Benefits Agreements and Policies In Effect.” Accessed May 9, 2016. <http://www.forworkingfamilies.org/page/policy-tools-community-benefits-agreements-and-policies-effect>.
- Pavley, Fran. SB-32 California Global Warming Solutions Act of 2006: emissions limit., Chapter 249, Statutes of 2016 § (2016). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB32.
- . SB-1168 Groundwater management, Chapter 346, Statutes of 2014 § (2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1168.
- . SB-1319 Groundwater, Chapter 348, Statutes of 2014 § (2014). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1319.
- Pavley, Fran, and Roger Dickenson. Sustainable Groundwater Management Act [And Related Statutory Provisions from SB1168 (Pavley), AB1739 (Dickinson), and SB1319 (Pavley) as Chaptered] (2016). <https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Groundwater-Management/Sustainable-Groundwater-Management/Files/2014-Sustainable-Groundwater-Management-Legislation-with-2015-amends-1-15-2016.pdf?la=en&hash=AD-B3455047A2863D029146E9A820AC7DE16B5CB1>.
- Percannella, Aurora. “Under a New Law, Retailers Share Liability for Misclassified Truck Drivers at California Ports.” *Los Angeles Times*, September 25, 2018. <https://www.latimes.com/business/la-fi-truck-drivers-20180925-story.html>.
- Perry, Ian. “California Is Working: The Effects of California’s Public Policy on Jobs and the Economy Since 2011.” UC Berkeley Center for Labor Research and Education, November 14, 2017. <http://laborcenter.berkeley.edu/california-is-working/>.
- . “Low-Wage Work in California Data Explorer.” UC Berkeley Center for Labor Research and Education, August 16, 2018. <http://laborcenter.berkeley.edu/low-wage-work-in-california-data-explorer/>.
- Peterson, Erica. “In Germany, A City Moves Away From Coal.” *WFPL News*, December 7, 2015. <http://energyfuture.wfpl.org/in-germany-a-city-moves-away-from-coal/>.
- Pew Research Center. “America’s Shrinking Middle Class: A Close Look at Changes Within Metropolitan Areas,” May 11, 2016. <http://www.pewsocialtrends.org/2016/05/11/americas-shrinking-middle-class-a-close-look-at-changes-within-metropolitan-areas/>.



- Philips, Peter. “Environmental and Economic Benefits of Building Solar in California: Quality Careers—Cleaner Lives.” UC Berkeley Donald Vial Center on Employment in the Green Economy, November 10, 2014. <http://laborcenter.berkeley.edu/environmental-and-economic-benefits-of-building-solar-in-california-quality-careers-cleaner-lives/>.
- Pollin, Robert, and Brian Callaci. “A Just Transition for U.S. Fossil Fuel Industry Workers.” *The American Prospect*, July 6, 2016. <http://prospect.org/article/just-transition-us-fossil-fuel-industry-workers>.
- Porter, Eduardo. “Harvard Is Vaulting Workers Into the Middle Class With High Pay. Can Anyone Else Follow Its Lead?” *The New York Times*, September 8, 2018, sec. Economy. <https://www.nytimes.com/2018/09/08/business/economy/harvard-living-wage.html>.
- PPIC Water Policy Center. “Energy and Water.” Public Policy Institute of California, October 2016. http://www.ppic.org/content/pubs/report/R_1016AER.pdf.
- Primen, and The Response Center. “California Residential California Residential Remodeling/ Renovation Remodeling/ Renovation Market Study Market Study,” July 2001. <http://www.calmac.org/startDownload.asp?Name=CA+RemodelES.pdf&Size=2685KB>.
- Profita, Cassandra, and Jes Burns. “Recycling Chaos In U.S. As China Bans ‘Foreign Waste.’” *NPR Moring Edition*, December 9, 2017. <https://www.npr.org/2017/12/09/568797388/recycling-chaos-in-u-s-as-china-bans-foreign-waste>.
- “Project Labor Agreement, AC Transit, Bus Rapid Transit Project.” Alameda Contra Costa Transit District, n.d. <http://www.actransit.org/wp-content/uploads/purchasing/Attachment%20B%20-%20Project%20Labor%20Agreement.pdf>.
- Putre, Laura. “Manufacturing’s Temporary Worker Boom.” *IndustryWeek*, May 11, 2015. <https://www.industryweek.com/workforce/manufacturings-temporary-worker-boom>.
- Rabin, Jeffrey L., Colleen Callahan, and J.R. DeShazo. “Planning California Climate Investments in Disadvantaged Communities: A Guide to Greenhouse Gas Reduction Fund Program Designs, Expenditures, and Benefits.” UCLA Luskin Center for Innovation, August 2015. <http://innovation.luskin.ucla.edu/sites/default/files/Final%20081915.pdf>.
- Ramo, Alan, and Deborah Behles. “Transitioning a Community Away from Fossil-Fuel Generation to a Green Economy: An Approach Using State Utility Commission Authority.” *Minnesota Journal of Law, Science & Technology* 15, no. 1 (2014): 505–27.



- Recycling Today. “CalRecycle Targets Wage Violators,” March 16, 2015. <https://www.recyclingtoday.com/article/calrecycle-targets-wage-violators/>.
- Reed, Debbie, Albert Yung-Hsu Liu, Rebecca Kleinman, Annalisa Mastri, Davin Reed, Samina Sattar, and Jessica Ziegler. “An Effectiveness Assessment and Cost-Benefit Analysis of Registered Apprenticeship in 10 States.” Mathematica Policy Research, July 25, 2012. http://wdr.doleta.gov/research/fulltext_documents/etaop_2012_10.pdf.
- Reich, Michael, Ken Jacobs, and Miranda Dietz. *When Mandates Work: Raising Labor Standards at the Local Level*. Berkeley and Los Angeles, California: University of California Press, 2014. <http://irle.berkeley.edu/when-mandates-work/>.
- Riley, David, and Bernie Kotlier. “Energy Storage and Microgrid Training and Certification (ESAM-TAC).” presented at the NECA 2017, Seattle, October 8, 2017. https://www.necanet.org/docs/default-source/17presentations/e-35_energy-storage-and-microgrid-training-and-certification_riley_kotlier_0900-0950_100817.pdf?sfvrsn=2.
- Rogers, Joel, Laura Dresser, Robyn Richards, and Danielle Salus. “High Performance Partnerships: Winning Solutions for Employers and Workers.” State of Wisconsin Department of Workforce Development, 1999. <https://www.cows.org/high-performance-partnerships-winning-solutions-for-employers-and-workers>.
- Roland-Holst, David, Saika Belal, Ernesto Guerra, and William Eisenstein. “Methods to Assess Co-Benefits of California Climate Investments.” UC Berkeley Center for Resource Efficient Communities, November 2, 2017. https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/ucb_lit_rev_on_jobs.pdf.
- Rosengren, Cole. “Crackdown on Wage Violations Continues in California Recycling Industry.” *Waste Dive*, May 20, 2016. <https://www.wastedive.com/news/crackdown-on-wage-violations-continues-in-california-recycling-industry/419538/>.
- . “LA Sanitation: Lawsuit Will Not Delay RecyclLA Franchise System.” *WasteDive*, June 15, 2017. <https://www.wastedive.com/news/la-sanitation-lawsuit-will-not-delay-recycla-franchise-system/445024/>.
- . “Waste Management’s Bell on the Tough Job of MRF Sorters and Life After China.” *Waste Dive*, March 14, 2018. <https://www.wastedive.com/news/waste-management-brent-bell-head-recycling-life-after-china-mrf-sorters/518844/>.
- Ross, Stacey Hendler. “VTA’s Training Expertise Shared Nationwide.” Santa Clara Valley Transportation Authority, December 14, 2017. Available via Internet archive at <https://web.archive.org/web/20180221082610/http://www.vta.org/News-and-Media/Connect-with-VTA/VTAs-Training-Expertise-Shared-Nationwide>.



- . “We’re Growing Our Own.” Santa Clara Valley Transportation Authority, November 15, 2016. <http://transportation744.rssing.com/browser.php?indx=15157814&item=31376>.
- Rubio, Michael J. SB-1122 Energy: renewable bioenergy projects, Chapter 612, Statutes of 2012 § (2012). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201120120SB1122.
- Ruckelshaus, Catherine, and Sarah Leberstein. “Manufacturing Low Pay: Declining Wages in the Jobs That Built America’s Middle Class.” National Employment Law Project, 2014. <http://stage.nelp.org/content/uploads/2015/03/Manufacturing-Low-Pay-Declining-Wages-Jobs-Built-Middle-Class.pdf>.
- San Diego Gas & Electric Company. “Advanced Lighting Control System Assessment, Final Report,” December 15, 2010. <https://www.etcc-ca.com/reports/advanced-lighting-control-system-assessment>.
- . “Application of San Diego Gas & Electric Company (U 902-M) to Adopt Energy Efficiency Rolling Portfolio Business Plan,” January 17, 2017. https://www.sdge.com/sites/default/files/SDGE%2520EE%2520BP%2520Application%2520FINAL%2520with%2520BP_2.PDF.
- . “Office of the Future 25% Solution Assessment, Stage One, Final Report,” December 15, 2010. <https://www.etcc-ca.com/reports/office-future-25-solution>.
- San Francisco County Transportation Authority. “TNCs Today: A Profile of San Francisco Transportation Network Company Activity,” June 2017. <https://www.sfcta.org/emerging-mobility/tncs-today>.
- San Francisco Office of Labor Standards Enforcement. “Prevailing Wage: Construction.” City and County of San Francisco. Accessed April 2, 2018. <http://sfgov.org/olse/prevailing-wage>.
- San Francisco Public Utilities Commission. “Internships, Apprenticeships and Youth Employment.” Accessed February 12, 2018. <http://sfwater.org/index.aspx?page=888>.
- . “Project Labor Agreement.” Accessed September 24, 2018. <https://sfwater.org/index.aspx?page=113>.
- . “SFPUC Community Benefits Program Social Impact Partnerships,” May 10, 2018. <https://sfwater.org/Modules/ShowDocument.aspx?documentid=11622>.
- Sarathy, Brinda. *Pineros: Latino Labour and the Changing Face of Forestry in the Pacific Northwest*. Vancouver, BC: UBC Press, 2012.



- Schaller, Bruce. “Unsustainable? The Growth of App-Based Ride Services and Traffic, Travel and the Future of New York City.” Schaller Consulting, February 27, 2017. <http://schallerconsult.com/rideservices/unsustainable.pdf>.
- Schultz, Garth. Principal Owner of R3 Consulting Group Inc. Interview with author, June 28, 2018.
- Schwartz, Samuel I., and Karen Kelly. *No One at the Wheel: Driverless Cars and the Road of the Future*. New York, NY: PublicAffairs, 2018.
- Schwarz, Andrew. “Climate Action Plan Phase 1: Greenhouse Gas Emissions Reduction Plan.” California Department of Water Resources, May 2012. <https://water.ca.gov/LegacyFiles/climatechange/docs/Final-DWR-ClimateActionPlan.pdf>.
- Schwieterman, Joseph, Mallort Livingston, and Stijn Van Der Slot. “Partners in Transit: A Review of Partnerships between Transportation Network Companies and Public Agencies in the United States.” Policy Series. Chaddick Institute for Metropolitan Development at Depaul University, August 1, 2018. https://las.depaul.edu/centers-and-institutes/chaddick-institute-for-metropolitan-development/research-and-publications/Documents/Partners%20in%20Transit_Live1.pdf.
- Scott, Megan Emiko, and Carol Zabin. “Training for the Future II: Los Angeles’s Utility Pre-Craft Trainee Program: Progress to Date.” UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2016. <http://laborcenter.berkeley.edu/training-for-the-future-ii/>.
- Sergejev, Amika. “A Skilled Cal Fire Firefighter as an Inmate, She’s Barred from Career Now That She’s Free.” *The Mercury News*, November 21, 2017. <https://www.mercurynews.com/2017/11/21/opinion-a-skilled-cal-fire-firefighter-as-an-inmate-shes-barred-from-career-now-that-shes-free/>.
- SFMTA. “SFMTA MOUs, CBAs and Labor Organizations / Unions.” Accessed November 21, 2018. <https://www.sfmta.com/about-us/labor-relations/sfmta-mous-cbas>.
- Sher, Byron. AB-939 Solid waste management, source reduction, recycling, composting, and market development, Chapter 1095, Statutes of 1989 § (1989). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=198919900AB939.
- . SB-1078 Renewable energy: California Renewables Portfolio Standard Program, Chapter 516, Statutes of 2002 § (2002). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200120020SB1078.
- Shin, Laura. “Navajo Nation Approves First Tribal ‘Green Jobs’ Legislation.” InsideClimate News, July 22, 2009. <http://insideclimatenews.org/news/20090722/navajo-nation-approves-first-tribal-green-jobs-legislation>.



- Siemaszko, Corky. “In the Shadow of Uber’s Rise, Taxi Driver Suicides Leave Cabbies Shaken.” *NBC News*, June 7, 2018. <https://www.nbcnews.com/news/us-news/shadow-uber-s-rise-taxi-driver-suicides-leave-cabbies-shaken-n879281>.
- Silva, Mike. Project Engineer with CR&R, July 24, 2018.
- Simitian, Joe. SB-107 Renewable energy: Public Interest Energy Research, Demonstration, and Development Program, Chapter 464, Statutes of 2006 § (2006). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200520060SB107.
- . SBX1-2 Energy: renewable energy resources, Chapter 1, Statutes of 2011 § (2011). http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_0001-0050/sbx1_2_bill_20110412_chaptered.html.
- Skinner, Nancy. AB-758 Energy: energy audit, Chapter 470, Statutes of 2009 § (2009). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200920100AB758.
- . SB-1014 California Clean Miles Standard and Incentive Program: zero-emission vehicles, Chapter 369, Statutes of 2018 § (2018). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB1014.
- Smith, Rebecca, David Bensman, and Paul Alexander Marvy. “The Big Rig: Poverty, Pollution, and the Misclassification of Truck Drivers at America’s Ports.” National Employment Law Project and Change to Win, December 2010. <https://s27147.pcdn.co/wp-content/uploads/2015/03/PovertyPollutionandMisclassification.pdf>.
- Smith, Rebecca, Paul Alexander Marvy, and Jon Zerolnick. “The Big Rig Overhaul: Restoring Middle-Class Jobs at America’s Ports Through Labor Law Enforcement.” National Employment Law Project, Change to Win Strategic Organizing Center, Los Angeles Alliance for New Economy, February 2014. <http://www.laane.org/wp-content/uploads/2014/02/BigRigOverhaul2014.pdf>.
- Smithline, Scott. “Reviews of Jurisdiction Mandatory Commercial Recycling and Commercial Organics Recycling Programs.” California Department of Resources Recycling and Recovery (CalRecycle), January 10, 2017. <https://www2.calrecycle.ca.gov/Docs/Web/113202>.
- SMUD. “SMUD Pilot Natural Refrigerant Incentive Program,” May 2017. <https://www.smud.org/-/media/Documents/Business-Solutions-and-Rebates/Refrigerant-Pilot-Program-Summary.ashx>.
- Solomon, Amy L. “In Search of a Job: Criminal Records as Barriers to Employment.” *National Institute of Justice Journal*, no. 270 (June 15, 2012). <https://www.nij.gov/443/journals/270/pages/criminal-records.aspx>.



- South Coast Air Quality Management District. “Board Meeting Minutes, Agenda No. 29 (Report of the Technology Committee Meeting Held September 21, 2018),” October 5, 2018. <http://www.aqmd.gov/docs/default-source/Agendas/Governing-Board/2018/2018-oct5-029.pdf?sfvrsn=2>.
- Southern California Edison Company. “Southern California Edison Company’s Energy Efficiency Rolling Portfolio Business Plan for 2018-2025,” January 17, 2017. https://docs.wixstatic.com/ugd/0c9650_a0b40f88a30c4f0ab7b02d35f2360591.pdf.
- Southern California Edison Design & Engineering Services. “Office of the Future - Landmark Square Building,” October 14, 2010. <https://www.etcc-ca.com/reports/office-future-landmark-square-building>.
- Southern California Gas Company. “Appendix B.1: Section A, Program Implementation Plans (Redline Versions) Statewide Programs,” May 29, 2013. [https://www.socalgas.com/regulatory/documents/A-12-07-003/SCG%20Appendix%20B.1%20Section%20A%20Statewide%20Program%20Implementation%20Plans%20\(Redline\).pdf](https://www.socalgas.com/regulatory/documents/A-12-07-003/SCG%20Appendix%20B.1%20Section%20A%20Statewide%20Program%20Implementation%20Plans%20(Redline).pdf).
- . “Authorized Contractors.” SoCalGas. Accessed June 24, 2019. <https://www3.socalgas.com/save-money-and-energy/assistance-programs/authorized-contractors>.
- Sperling, Daniel. Professor and American founding director of the UC Davis Institute for Transportation Studies. Personal communication with author, December 19, 2017.
- Spiegel Online. “End of an Industrial Era: Germany to Close Its Coal Mines.” *Spiegel Blog* (blog), January 30, 2007. <http://www.spiegel.de/international/end-of-an-industrial-era-germany-to-close-its-coal-mines-a-463172.html>.
- St. John, Jeff. “California Passes Bill Requiring Diablo Canyon Plant to Be Replaced With Carbon-Free Resources.” Greentech Media, August 24, 2018. <https://www.greentechmedia.com/articles/read/california-bill-requiring-diablo-canyon-carbon-free>.
- State Bar of California. “The State Bar of California.” Accessed October 5, 2018. <http://www.calbar.ca.gov/>.
- State Board of Forestry and Fire Protection, and California Department of Forestry and Fire Protection (Cal Fire). “2018 Strategic Fire Plan for California,” August 22, 2018. Available via Internet archive at <https://web.archive.org/web/20190511010810/http://cdfdata.fire.ca.gov/pub/fireplan/fpupload/fpppdf1614.pdf>.



- Steinberg, Darrell. SB-375 Transportation planning: travel demand models: sustainable communities strategy: environmental review, Chapter 728, Statutes of 2008 § (2008). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080SB375.
- . SB-743 Environmental quality: transit oriented infill projects, judicial review streamlining for environmental leadership development projects, and entertainment and sports center in the City of Sacramento, Chapter 386, Statutes of 2013 § (2013). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB743.
- . SBX7-7 Water conservation, Chapter 4, Statutes of 2009 § (2009). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=200920107SB7.
- Steyn, Lisa. “Montauk Energy Strikes Biogas Deal with US Dairy Farm.” *Business Day*, August 2, 2018. <https://www.businesslive.co.za/bd/companies/energy/2018-08-02-montauk-energy-strikes-biogas-deal-with-us-dairy-farm/>.
- Strecker, Jesse, Karin Vosgueritchian, Zack Deutsch-Gross, and Gaelan Bickford-Gewarter. “Protecting California Workers in Cap and Trade.” Unpublished. UC Berkeley Goldman School of Public and UC Berkeley Labor Center, 2018.
- Strickland, Wes. “The Organization of Water Utilities in California.” *Private Water Law* (blog), September 25, 2013. <https://privatewaterlaw.com/2013/09/25/the-organization-of-water-utilities-in-california/>.
- Stroud, Dean, Peter Fairbrother, Claire Evans, and Joanne Blake. “Skill Development in the Transition to a ‘Green Economy’: A ‘Varieties of Capitalism’ Analysis.” *The Economic and Labour Relations Review* 25, no. 1 (January 13, 2014): 10–27.
- Sturgeon, Lianne. “The Impact of Transportation Network Companies on Public Transit: A Case Study at the San Francisco International Airport.” Scripps Senior Theses, January 1, 2019. https://scholarship.claremont.edu/scripps_theses/1318.
- Sum, Juliann, Debra Lee, and Cora Gherga. “State OSHA Annual Report (SOAR), FY 2016.” California Occupational Safety and Health Program, December 2016. [https://www.dir.ca.gov/dosh/reports/State-OSHA-Annual-Report-\(SOAR\)-FY-2016.pdf](https://www.dir.ca.gov/dosh/reports/State-OSHA-Annual-Report-(SOAR)-FY-2016.pdf).
- Teamsters. “Solid Waste and Recycling Division.” Accessed January 1, 2019. <https://teamster.org/divisions/solid-waste-and-recycling>.
- Tellus Institute. “From Waste to Jobs: What Achieving 75 Percent Recycling Means for California.” Natural Resources Defense Council, March 2014. <https://www.nrdc.org/sites/default/files/green-jobs-ca-recycling-report.pdf>.



- Tengco, JB. West Coast Director for the BlueGreen Alliance. Interview with author, June 8, 2018. Notes available from author (mcha@oxy.edu).
- “The Build Better LA Initiative.” City of Los Angeles, 2016. http://clkrep.lacity.org/onlinedocs/2016/16-0684_misc_06-15-2016.pdf.
- “The Price of Tobacco: The Basics.” *The New York Times*, March 22, 1993. <https://www.nytimes.com/1993/03/22/us/the-price-of-tobacco-the-basics.html>.
- The Solar Foundation. “2017 National Solar Jobs Census.” Accessed November 26, 2018. <https://www.thesolarfoundation.org/national/>.
- . “2018 National Solar Jobs Census.” Accessed June 24, 2019. <https://www.thesolarfoundation.org/national/>.
- . “Solar Jobs Census 2017.” Accessed November 12, 2018. <https://www.solarstates.org/#states/solar-jobs/2017>.
- Thomas, Ashley K. “Successes of Construction Careers.” LAANE: A New Economy For All, August 2014. <https://www.laane.org/wp-content/uploads/2015/04/Successes-of-Construction-Careers-Report.pdf>.
- Thornberg, Christopher, Hoyu Chong, and Adam Fowler. “2017 California Green Innovation Index.” Next 10, 2017. <http://next10.org/sites/default/files/2017-CA-Green-Innovation-Index-2.pdf>.
- Thornberg, Christopher, Adam Fowler, Hoya Chong, and Robert Nakano. “2018 California Green Innovation Index.” Next 10, 2018. <http://next10.org/sites/default/files/2018-ca-green-innovation-index.pdf>.
- Ting, Philip. AB-109 Budget Act of 2017, Chapter 249, Statutes of 2017 § (2017). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB109.
- Tobacco Control Legal Consortium. “The Master Settlement Agreement: An Overview.” Public Health Law Center, August 2015. <http://www.publichealthlawcenter.org/sites/default/files/resources/tclc-fs-msa-overview-2015.pdf>.
- Ton, Zeynep. *The Good Jobs Strategy: How the Smartest Companies Invest in Employees to Lower Costs and Boost Profits*. Boston, MA: New Harvest, 2013.
- Transport & Environment. “How Will Electric Vehicle Transition Impact EU Jobs?,” September 2017. <https://www.transportenvironment.org/sites/te/files/publications/Briefing%20-%20How%20will%20electric%20vehicle%20transition%20impact%20EU%20jobs.pdf>.
- Tree Mortality Task Force. “Tree Mortality: Facts and Figures,” April 2018. https://accensus.org/wp-content/uploads/2018/06/TMFacts_and_Figures_April_2018.pdf.



- Tsuchida, Bruce, Sanem Sergici, Bob Mudge, Will Gorman, Peter Fox-Penner, and Jens Schoene. "Comparative Generation Costs of Utility-Scale and Residential-Scale PV in Xcel Energy Colorado's Service Area." The Brattle Group, July 2015. <https://www.brattle.com/news-and-knowledge/publications/comparative-generation-costs-of-utility-scale-and-residential-scale-pv-in-xcel-energy-colorados-service-area>.
- Tucker, Jill. "Garbage Collectors in Training Bag Good Jobs." *San Francisco Chronicle*, May 29, 2018. <https://www.sfchronicle.com/bayarea/article/Garbage-collectors-in-training-bag-good-jobs-12948267.php>.
- UC Berkeley Center for Labor Research and Education. "California City and County Living Wage Ordinances." Accessed September 26, 2018. <http://laborcenter.berkeley.edu/minimum-wage-living-wage-resources/california-city-and-county-living-wage-ordinances/>.
- UC Davis California Lighting Technology Center. "Advanced Controls." Accessed June 16, 2019. <https://cltc.ucdavis.edu/research/advanced-controls>.
- Ulin, David L. "Synonymous with Sun, Los Angeles Needs More Shade." *Los Angeles Times*, August 30, 2018. <http://www.latimes.com/opinion/op-ed/la-oe-ulin-tree-cover-20180830-story.html>.
- United Association: Union of Plumbers, Fitters, Welders, and Service Techs. "Continuing Education." Accessed December 10, 2018. <http://www.ua.org/education>.
- United Contractors. "Skilled and Trained Workforce Requirements: REVISED: Skilled and Trained Workforce Guide," November 17, 2017. https://www.unitedcontractors.org/storage/documents/Contractor_Resource_Center/Master_Labor_Agreements/Skilled_and_Trained_Workforce_Guide_11.17.2017.pdf.
- University of California, Division of Agriculture and Natural Resources. "Sustainable Groundwater Management Act." Accessed September 24, 2018. <http://groundwater.ucdavis.edu/SGMA>.
- Urban Design 4 Health, and AECOM. "Active Transportation Health and Economic Impact Study." Southern California Association of Governments, November 7, 2016. http://www.ochealthiertogether.org/content/sites/ochca/Local_Reports/SCAG_Active_Transportation_Health_and_Economic_Impact_Study_2016.pdf.
- U.S. Bureau of Ocean Energy Management. "California Activities - Offshore Wind," 2018. <https://www.boem.gov/California/>.
- U.S. Census Bureau. "County Business Patterns 2016," April 19, 2018. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=B-P_2016_00A1&prodType=table.



- . “County Business Patterns (CBP).” Accessed October 19, 2018. <https://www.census.gov/programs-surveys/cbp.html>.
- . “QuickFacts: Calexico City, California; United States.” Accessed November 26, 2018. <https://www.census.gov/quickfacts/fact/table/calexicocitycalifornia,US/PST045217>.
- . “QuickFacts: California; Imperial County, California.” Accessed November 26, 2018. <https://www.census.gov/quickfacts/fact/table/CA,imperialcountycalifornia/PST045218#viewtop>.
- . “QuickFacts: Imperial County, California; United States.” Accessed November 26, 2018. <https://www.census.gov/quickfacts/fact/table/imperialcountycalifornia,US/PST045217>.
- . “QWI Explorer.” Accessed November 2, 2018. <https://qwiexplorer.ces.census.gov/static/explore.html#x=0&g=0>.
- U.S. Chemical Safety and Hazard Investigation Board. “Regulatory Report: Chevron Richmond Refinery Pipe Repture Fire,” May 2014. https://www.csb.gov/assets/1/20/chevron_regulatory_report_06272014.pdf?15267.
- U.S. Department of Energy. “Combined Heat and Power Installation Database | Facilities in CA.” Accessed November 12, 2018. <https://doe.icfwebservices.com/chpdb/state/CA>.
- U.S. Department of Labor. “What Is Registered Apprenticeship?” Apprenticeship.Gov, 2014. <https://www.doleta.gov/OA/apprenticeship.cfm>.
- U.S. Department of Labor, Bureau of Labor Statistics. “California - May 2017 OES State Occupational Employment and Wage Estimates.” Occupational Employment Statistics. Accessed June 24, 2019. https://www.bls.gov/oes/2017/may/oes_ca.htm.
- . “May 2017 OES National Industry-Specific Occupational Employment and Wage Estimates,” May 2017. <https://www.bls.gov/oes/2017/may/oesrci.htm>.
- . “May 2017 OES State Occupational Employment and Wage Estimates- California (Farming, Fishing, and Forestry Occupations).” Occupational Employment Statistics, March 30, 2018. https://www.bls.gov/oes/2017/may/oes_ca.htm#45-0000.
- . “May 2018 OES State Occupational Employment and Wage Estimates - California (45-4011 - Forest and Conservation Workers).” Accessed April 2, 2019. https://www.bls.gov/oes/current/oes_ca.htm#45-0000.



- . “Occupational Employment and Wages, May 2017: 43-5111 Weighers, Measurers, Checkers, and Samplers, Recordkeeping.” Accessed November 5, 2018. <https://www.bls.gov/oes/current/oes435111.htm>.
- . “Occupational Employment and Wages, May 2017 47-2231 Solar Photovoltaic Installers.” Occupational Employment Statistics. Accessed June 20, 2019. <https://www.bls.gov/oes/2017/may/oes472231.htm#ind>.
- . “Occupational Employment and Wages, May 2017: 49-3031 Bus and Truck Mechanics and Diesel Engine Specialists,” May 2017. <https://www.bls.gov/oes/2017/may/oes493031.htm>.
- . “Occupational Employment and Wages, May 2017: 53-7062 Laborers and Freight, Stock, and Material Movers, Hand,” March 30, 2018. <https://www.bls.gov/oes/current/oes537062.htm>.
- . “Occupational Employment and Wages, May 2018: 45-2093 Farmworkers, Farm, Ranch, and Aquacultural Animals.” Accessed January 14, 2019. <https://www.bls.gov/oes/current/oes452093.htm>.
- . “Occupational Outlook Handbook.” Accessed January 2, 2019. <https://www.bls.gov/ooh/home.htm>.
- . “Occupational Outlook Handbook, Construction and Extraction, Ironworkers,” 2015. <https://www.bls.gov/ooh/construction-and-extraction/structural-iron-and-steel-workers.htm>.
- . “OES Research Estimates by State and Industry.” Occupational Employment Statistics, March 30, 2018. https://www.bls.gov/oes/current/oes_research_estimates.htm.
- . “Private, 1013 Manufacturing, All States and U.S. 2017 Annual Averages, All Establishment Sizes.” Quarterly Census of Employment and Wages. Accessed August 28, 2018. https://data.bls.gov/cew/apps/table_maker/v4/table_maker.htm#type=0&year=2017&qtr=A&own=5&ind=1013&supp=0.
- . “QCEW Data Views,” 2017. https://data.bls.gov/cew/apps/data_views/data_views.htm#tab=Tables.
- . “Quarterly Census of Employment and Wages.” Accessed January 2, 2019. <https://www.bls.gov/cew/>.
- . “Quarterly Census of Employment and Wages: Private, NAICS 562 Waste Management and Remediation Services, All Counties in California, 2018 First Quarter, All Establishment Sizes.” Accessed July 13, 2018. https://data.bls.gov/cew/apps/table_maker/v4/table_maker.htm#type=2&st=06&year=2018&qtr=1&wn=5&ind=562&supp=0.



- . “State Occupational Injuries, Illnesses, and Fatalities, California.” Accessed July 17, 2017. <https://www.bls.gov/iif/oshstate.htm#CA>.
- U.S. Department of Labor, Employment and Training Administration. “California Demographic Characteristics: Crop Workers,” n.d. https://www.doleta.gov/naws/pages/research/docs/Table13.NAWS_California_Demographics.xlsx.
- . “OFLC Performance Data.” Accessed October 9, 2018. <https://www.foreignlaborcert.doleta.gov/performancecdm.cfm>.
- . “Trade Adjustment Assistance for Workers Program,” Fiscal Year 2013. <https://www.doleta.gov/tradeact/docs/AnnualReport13.pdf>.
- U.S. Department of Labor, Occupational Safety & Health Administration. “Green Job Hazards: Waste Management and Recycling.” Accessed September 21, 2018. <https://www.osha.gov/dep/greenjobs/recycling.html>.
- U.S. Department of Labor, Wage and Hour Division. “Davis-Bacon and Related Acts.” Accessed February 26, 2018. <https://www.dol.gov/whd/govcontracts/dbra.htm>.
- . “McNamara-O’Hara Service Contract Act (SCA).” Accessed June 20, 2018. <https://www.dol.gov/whd/govcontracts/sca.htm>.
- U.S. Department of the Interior. “New Analysis Shows 2018 California Wildfires Emitted as Much Carbon Dioxide as an Entire Year’s Worth of Electricity,” November 30, 2018. <https://www.doi.gov/pressreleases/new-analysis-shows-2018-california-wildfires-emitted-much-carbon-dioxide-entire-years>.
- U.S. Department of the Interior Office of Wildland Fire. “Wildland Fire Resilient Landscapes Activities,” 2015. Available via Internet archive at <https://web.archive.org/web/20150912025640/https://www.doi.gov/wildlandfire/wildland-fire-resilient-landscapes-program>.
- U.S. Energy Information Administration. “California State Profile and Energy Estimates: Profile Analysis,” October 20, 2016. <https://www.eia.gov/state/analysis.php?sid=CA>.
- U.S. Environmental Protection Agency. “Anaerobic Digestion Facilities Processing Food Waste in the United States in 2015: Survey Results.” Overviews and Factsheets. US EPA, August 14, 2018. <https://www.epa.gov/anaerobic-digestion/anaerobic-digestion-facilities-processing-food-waste-united-states-2015-survey>.
- . “General Risk Management Program Guidance - Chapter 2: Applicability of Program Levels,” April 2004. <https://www.epa.gov/rmp/general-rmp-guidance-chapter-2-applicability-program-levels>.



- . “Lean and Six Sigma Process Improvement Methods.” Overviews and Factsheets, April 3, 2014. <https://www.epa.gov/lean/lean-and-six-sigma-process-improvement-methods>.
- . “Regulations for Greenhouse Gas Emissions from Commercial Trucks & Buses.” Accessed November 21, 2018. <https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-commercial-trucks>.
- . “What Is Green Infrastructure?” Accessed September 24, 2018. <https://www.epa.gov/green-infrastructure/what-green-infrastructure>.
- U.S. Forest Service. “Good Neighbor Authority.” Accessed October 19, 2018. <https://www.fs.fed.us/managing-land/farm-bill/gna>.
- U.S. General Services Administration. “Wage Determination 1977-0727: Forestry and Land Management Services.” Wage Determinations Online, July 3, 2018. <https://beta.sam.gov/search?keywords=1977-0727&page=1&index=wd>.
- U.S. Global Change Research Program. “Climate Science Special Report: Fourth National Climate Assessment, Volume 1.” Washington, D.C.: U.S. Global Change Research Program, 2017. <https://science2017.globalchange.gov/>.
- U.S. Office of the Press Secretary. “Fact Sheet: Administration Announces New Economic and Workforce Development Resources for Coal Communities through POWER Initiative.” President Barack Obama White House Archives, August 24, 2016. <https://obamawhitehouse.archives.gov/the-press-office/2016/08/24/fact-sheet-administration-announces-new-economic-and-workforce>.
- Veloz. “Monthly U.S. Sales,” April 5, 2018. http://www.veloz.org/wp-content/uploads/2018/04/3_mar_2018_Dashboard_PEV_Sales_veloz-2.pdf.
- Villao, Daniel, Uyen Le, Hugo Sarmiento, and Stefanie Ritoper. *Beyond Green Jobs: Building Lasting Opportunities in Energy Efficiency*. Los Angeles, CA: UCLA Labor Center, 2012. <https://books.labor.ucla.edu/p/77/beyondgreenjobs>.
- Viscelli, Steve. “Stalled: Make Big Trucks More Fuel Efficient.” Kleinman Center for Energy Policy, March 15, 2017. <https://kleinmanenergy.upenn.edu/policy-digests/stalled-make-big-trucks-more-fuel-efficient>.
- . *The Big Rig: Trucking and the Decline of the American Dream*. University of California Press, 2016.
- . “The Trouble with Trucking.” In *Shifting to the High Road: Improving Job Quality in Low-Wage Industries* (Paul Osterman Ed.). Cambridge, MA: MIT Press, forthcoming.



- Visher, Christy, Sara Debus, and Jennifer Yahner. "Employment after Prison: A Longitudinal Study of Releasees in Three States." Urban Institute Justice Policy Center, October 2008. <https://www.urban.org/sites/default/files/publication/32106/411778-Employment-after-Prison-A-Longitudinal-Study-of-Releasees-in-Three-States.PDF>.
- Waitzman, Emma, and Peter Philips. "Project Labor Agreements and Bidding Outcomes: The Case of Community College Construction in California." UC Berkeley Center for Labor Research and Education, January 9, 2017. <http://laborcenter.berkeley.edu/project-labor-agreements-and-bidding-outcomes/>.
- Walsh, Denny, and Sam Stanton. "Court Documents Reveal Probe into Complaints by Mexican Forest Laborers." *Sacramento Bee*, July 17, 2014. <https://www.sacbee.com/news/politics-government/article2604061.html>.
- Ward, Beverly G., and Eric T. Hill. "Women in Transit: Findings from African-Americans, Other Minorities, and Women in the Transit Industry." *Women's Travel Issues: Proceedings from the Second National Conference* FHWA-PL-97-02 (October 1996). <https://www.fhwa.dot.gov/ohim/womens/chap32.pdf>.
- Washington State Office of Financial Management. "I-1631 Reducing Pollution: Fiscal Impact Summary," August 24, 2018. https://ofm.wa.gov/sites/default/files/public/budget/ballot/2018/I-1631_Fiscal_Impact_Statement-082418.pdf.
- Water Systems Optimization, Inc., and Cavanaugh & Associates. "Water Loss Technical Assistance Program Final Report." Prepared for The California Nevada Section of the American Water Works Association, 2018. <https://ca-nv-awwa.org/canv/downloads/2018/WLTapFinalReport.pdf>.
- Weber, Shirley. AB-2515 Water Conservation in Landscaping Act: model water-efficient landscaping ordinance, Chapter 576, Statutes of 2016 § (2016). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB2515.
- Western, Bruce. "The Impact of Incarceration on Wage Mobility and Inequality." *American Sociological Review* Vol. 67, no. 4 (August 2002): 526–46.
- White, Sarah. "CWDB Equity, Climate & Job Series, 2018." California Workforce Development Board, 2018.
- White, Sarah, and Jason Walsh. "Greener Pathways: Jobs and Workforce Development in the Clean Energy Economy." Center on Wisconsin Strategies (COWS), The Workforce Alliance, and The Apollo Alliance, March 12, 2008. <https://www.cows.org/greener-pathways-jobs-and-workforce-development-in-the-clean-energy-economy>.



- Wiener, Scott. SB-35: Planning and zoning: affordable housing: streamlined approval process, Chapter 366, Statutes of 2017 § 65400, 65582.1 and 65913.4 (2017). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180SB35.
- Wiggins, Patricia. SB-1016 Diversion: compliance: per capita disposal rate, Chapter 343, Statutes of 2008 § (2008). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=200720080SB1016.
- Wiles, J. C., B. Brooks, and B. -O Schultze. “PV Installations, a Progress Report.” In *Conference Record of the Twenty-Ninth IEEE Photovoltaic Specialists Conference, 2002.*, 1461–64, 2002. <https://ieeexplore.ieee.org/document/1190885>.
- Los Angeles County Supervisor Sheila Kuehl. “Will Metro Contractors Make The Grade On Female Hires?,” December 1, 2017. <https://supervisorkuehl.com/will-metro-contractors-make-grade-female-hires/>.
- Williams, Das. AB-802 Energy efficiency, Chapter 590, Statutes of 2015 § (2015). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB802.
- . AB-1594 Waste management, Chapter 719, Statutes of 2014 § (2014). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB1594.
- Williams, James H., Andrew DeBenedictis, Rebecca Ghanadan, Amber Mahone, Jack Moore, William R. Morrow, Snuller Price, and Margaret S. Torn. “The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity.” *Science* 335, no. 6064 (January 6, 2012): 53–59. <https://doi.org/10.1126/science.1208365>.
- Wilmsen, Carl. Executive Director, Northwest Forest Worker Center. Email with author, June 14, 2018.
- . Executive Director, Northwest Forest Worker Center. Interview with author, August 21, 2018.
- . Executive Director, Northwest Forest Worker Center. Phone conversation with California Workforce Development Board, May 21, 2019.
- . Executive Director, Northwest Forest Worker Center. Email conversation with California Workforce Development Board, June 3, 2019.
- Wilmsen, Carl, Diane Bush, and Dinorah Barton-Antonio. “Working in the Shadows: Safety and Health in Forestry Services in Southern Oregon.” *Journal of Forestry* 113, no. 3 (May 2015): 315–24. <https://doi.org/10.5849/jof.13-076>.
- Wilson, Michael P. National Director for Occupational and Environmental Health, BlueGreen Alliance. Personal communication with author, December 6, 2018.



- Wisconsin Regional Training Partnership. “Manufacturing Better Opportunity & A Stronger Economy,” June 4, 2013. https://www.cows.org/_data/documents/1481.pdf.
- Witcover, Julie. “Status Review of California’s Low Carbon Fuel Standard, 2011–2018 Q1.” Research Report. UC Davis Institute of Transportation Studies, September 24, 2018. <https://escholarship.org/uc/item/445815cd#main>.
- Wolk, Lois. SB-43 Electricity: Green Tariff Shared Renewables Program, Chapter 413, Statutes of 2013 § (2013). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB43.
- . SB-555 Urban retail water suppliers: water loss management, Chapter 679, Statutes of 2015 § (2015). https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB555.
- Womach, Jasper. “Compensating Farmers for the Tobacco Settlement.” Congressional Research Service, July 6, 1998. https://www.everycrsreport.com/files/19980706_98-133ENR_7d619c539e22176ed4d9455fa47901770b076ae0.pdf.
- Woods, Jeffrey G. “An Analysis of Apprentices in the U.S. Construction Trades: An Overview of Their Training and Development with Recommendations for Policy Makers.” *Education + Training* 54, no. 5 (June 29, 2012): 401–18. <https://doi.org/10.1108/00400911211244696>.
- Wright, Rod. AB-1393 Low-income electric and gas customers, Pub. L. No. Chapter 700, § 2790, 327, 381.5, Public Utilities Code (1999). http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=199920000AB1393.
- Yager, Loren. “Trade Adjustment Assistance: Improvements Necessary, but Programs Cannot Solve Communities’ Long-Term Problems.” Testimony Before the Committee on Finance, Subcommittee on International Trade, U.S. Senate. U.S. General Accounting Office, July 20, 2001. <https://www.gao.gov/assets/110/108928.pdf>.
- Yen Liu, Yvonne, and Daniel Flaming. “Sinking Underground: The Growing Informal Economy in California Construction.” Economic Roundtable, September 1, 2014. <https://economicrt.org/publication/sinking-underground/>.
- Yes On 1631. “Building a Cleaner Future Together.” Accessed October 17, 2018. Available via Internet archive at <https://web.archive.org/web/20190206224755/https://yeson1631.org/learn/>.



- Zabin, Carol, Karen Chapple, Ellen Avis, and Jessica Halpern-Finnerty. “California Workforce Education & Training Needs Assessment for Energy Efficiency, Distributed Generation, and Demand Response.” UC Berkeley Donald Vial Center on Employment in the Green Economy, March 2011. <http://laborcenter.berkeley.edu/california-workforce-education-and-training-needs-assessment-for-energy-efficiency-distributed-generation-and-demand-response/>.
- Zabin, Carol, Kevin Duncan, and Erica Paul. “Proposition 39 Job Creation & Quality, 2014-2018: A Report to the Citizens Oversight Board of the California Clean Energy Jobs Act.” California Workforce Development Board, 2019. https://www.energy.ca.gov/efficiency/proposition39/citizens_oversight_board/documents/2019_COB_Final_Report/APPENDIX_D-CALIFORNIA_WORKFORCE_DEVELOPMENT_BOARD_PROPOSITION_39_JOBS_REPORTING_METHODODOLOGY_AND_INNOVATION_REPORT.pdf.
- . “Proposition 39 Job Creation and Quality, 2014-2017, A Report to the Citizens Oversight Board of the California Clean Energy Jobs Act.” UC Berkeley Center for Labor Research and Education, Green Economy Program, February 9, 2017. https://ww2.energy.ca.gov/efficiency/proposition39/citizens_oversight_board/documents/3rd_annual_report/Appendix_E-CaliforniaWorkforceDevelopment-BoardJobsReportingReport.pdf.
- Zabin, Carol, Jessica Halpern-Finnerty, Megan Emiko Scott, Betony Jones, Robin Walther, Cecilia Estolano, Alex Paxton, et al. “Workforce Issues and Energy Efficiency Programs: A Plan for California’s Utilities (WE&T Guidance Plan).” UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2014. <http://laborcenter.berkeley.edu/workforce-issues-and-energy-efficiency-programs-a-plan-for-californias-utilities/>.
- Zabin, Carol, Abigail Martin, Rachel Morello-Frosch, Manuel Pastor, and Jim Sadd. “Advancing Equity in California Climate Policy: A New Social Contract for Low-Carbon Transition.” UC Berkeley Donald Vial Center on Employment in the Green Economy, September 13, 2016. <http://laborcenter.berkeley.edu/advancing-equity/>.
- Zabin, Carol, and Megan Emiko Scott. “Proposition 39: Jobs and Training for California’s Workforce.” UC Berkeley Donald Vial Center on Employment in the Green Economy, May 2013. <http://laborcenter.berkeley.edu/proposition-39-jobs-and-training-for-californias-workforce/>.
- Zahniser, David. “Two Property Owners Sue Over L.A.’s Recycling Program, Saying It Imposes an Illegal Tax.” *Los Angeles Times*, June 15, 2018. <http://www.latimes.com/local/lanow/la-me-ln-trash-lawsuit-20180615-story.html>.



BIBLIOGRAPHY

Zerolnick, Jon. “Liquid Assets: How Stormwater Infrastructure Builds Resilience, Health, Jobs, & Equity.” LAANE: A New Economy For All, March 2018. http://laane.org/wp-content/uploads/2018/03/LAANE_Liquid-Assets_Stormwater-Report.pdf.

Zients, Jeffrey. “Trade Adjustment Assistance: What You Need to Know.” The White House - President Barack Obama, June 11, 2015. <https://obamawhitehouse.archives.gov/blog/2015/06/11/trade-adjustment-assistance-what-you-need-know>.

Zimring, Carl. “The Brutal Life of a Sanitation Worker.” *The New York Times*, February 9, 2018. <https://www.nytimes.com/2018/02/09/opinion/sanitation-workers-deaths-unions.html>.



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