Residential Decarbonization Industry Paper Series

Economic Impacts of a Wage and Benefit Labor Standard for the Bay Area Residential Decarbonization Industry

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Residential Decarbonization Industry Paper Series

This Economic Impact Assessment is the second in a series produced by the High Road Training Partnership: Bay Area Residential Building Decarbonization, facilitated by Rising Sun Center for Opportunity in partnership with Construction Trades Workforce Initiative (CTWI), to support the Vision of the Partnership:

> A residential building decarbonization industry that supports quality jobs, has accessible entry points and pathways to build a qualified workforce, and provides stable career pathways for disadvantaged workers while simultaneously reducing greenhouse gas emissions, creating healthier and more affordable housing benefits for residents, and building more resilient and empowered communities.

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Executive Summary

Decarbonizing our building stock is a critical step in reducing emissions and slowing the effects of climate change. Residential decarbonization involves replacing all gas appliances, including stoves, dryers, water heaters, and HVAC systems with electric systems and increasing the energy efficiency of homes by upgrading windows, doors, air sealing, and insulation. The federal government and the state of California have made historic large-scale investments to encourage homeowners to retrofit their homes. Creating labor standards to mandate wage floors and benefits levels in the industry can ensure that residential decarbonization investments improve job quality rather than reinforcing labor practices that undermine workers' well-being.

Climate advocates want building decarbonization investments to go as far and fast as possible toward reaching climate goals. Some have expressed concerns that attaching labor standards could raise the costs of residential decarbonization work significantly, reducing the number of projects that can be completed with available funds and slowing down the timeframe for reducing emissions. This paper explores the potential economic impacts of adopting labor standards for the residential decarbonization industry in the 9-county Bay Area. Our study compares the status quo in the industry to two different labor standards that could be adopted: (1) prevailing wages and benefits and (2) setting a wage floor of 180 to 250 percent of the state minimum wage, depending on a worker's trade, and requiring that employers provide health insurance and retirement plans. For each of these potential labor standards, we estimate the potential impact on worker earnings, operating costs for employers, project prices for consumers and public agencies, the size of the local economy, and local government revenues and expenditures.

Overall, our results suggest that an industry labor standard would substantially improve earnings and benefits for workers, increase racial equity in worker earnings, grow the local economy, increase government revenues, and maximize the impact of climate investments by improving project quality while increasing consumer prices by only a small amount. We find that:

- Under a prevailing wage or minimum-wage-based labor standard, as many as four out of five residential decarbonization workers would see an increase in their wages. Under prevailing wage, between 2,200 and 3,700 Bay Area workers would see an increase in their earnings. Under a minimum-wage-based labor standard, between 2,100 and 3,500 workers would receive higher wages.
- A prevailing wage standard would result in an average increase of $14.50 per hour and $25,951 annually among workers who would be impacted. This represents a 71 percent increase in these workers' annual earnings. Collectively, this would represent between $61 and $100 million in additional earnings for Bay Area residential decarbonization workers each year.
- A minimum-wage-based labor standard (with workers earning at least 180 or 250 percent of the state minimum wage and employers providing health insurance and retirement

plans) would result in an average increase of between $11.26 in hourly wages and $20,839 in annual earnings, among workers who would be impacted. This represents a 60 percent increase in these workers' annual earnings. Collectively, this would represent between $44 and $74 million in additional earnings for residential decarbonization workers each year.

- Latinx residential decarbonization workers in the Bay Area, who make up a majority of workers in the industry, earn only 65 cents for every dollar that White non-Hispanic workers earn. A prevailing wage standard or a minimum-wage-based labor standard would eliminate most, if not all, of this racial wage gap for workers in the bottom half of the wage distribution.
- Nearly one in four residential decarbonization workers would gain access to an employer-sponsored health insurance plan as a result of either of the two modeled labor standards, representing between 700 and 1,100 workers. Many additional workers who already have employer-sponsored health insurance would likely see improvements in the health plans offered by their employer, as prevailing wage health insurance contribution requirements are significantly higher than what California employers pay on average.
- Under a prevailing wage labor standard, four out of five residential decarbonization workers (2,200 to 3,600 workers) would be newly enrolled in an employer-sponsored retirement plan. Many additional workers would receive significant increases in employer contributions to their retirement plan, as prevailing wage standards require much higher contributions than what California employers currently contribute on average. Under a minimum-wage-based labor standard requiring employers to offer a retirement plan with at least a three percent match on employee contributions, about two out of three residential decarbonization workers (1,800 to 3,000 workers) would be newly enrolled in an employer-sponsored retirement plan.
- After accounting for increases in worker productivity and retention associated with higher compensation, we estimate that a prevailing wage and benefits standard would increase employer labor costs by 28 percent, and a minimum-wage-based labor standard would increase labor costs by 14 percent.
- After accounting for the share of operating costs that go towards labor costs, we estimate that a prevailing wage standard would increase total operating costs for residential decarbonization firms by 10 percent, and a minimum-wage-based labor standard would increase total operating costs by 5 percent.
- Consumer prices for residential decarbonization projects would increase by between 6 and 9 percent under a prevailing wage standard and between 3 and 4 percent under a minimum-wage-based labor standard, after accounting for productivity gains as the result of increased compensation and the proportion of operating costs that go to labor expenses, and the proportion of increased costs that we expect would be passed on to consumers.
- A prevailing wage standard would increase local GDP by between $115 and $189 million and a minimum-wage-based labor standard would increase local GDP by between $83

and $139 million as workers would spend their additional earnings on housing, transportation, food, and other goods and services in the local economy.

- A prevailing wage standard would generate between $29 and $46 million in additional tax revenues, including between $7 and $10 million in local tax revenues. A minimum-wage-based labor standard would generate between $18 and $34 million in additional tax revenues, including between $4 and $7 million in local tax revenues.
- Currently, at least half of residential decarbonization worker families are enrolled in at least one safety net program, such as Medicaid, the Children's Health Insurance Program (CHIP), the Supplemental Nutrition Assistance Program (SNAP), and the Earned Income Tax Credit (EITC), costing at least $15 to $24 million annually. A labor standard would reduce these government expenditures on safety net programs as fewer residential decarbonization worker families would need to rely on safety net programs.
- The combined impact of increased government revenues and decreased government expenditures would provide a net public benefit of between $44 and $70 million under a prevailing wage standard and between $33 and $58 million under a minimum-wage-based labor standard.

Introduction

Decarbonizing our building stock is a critical step in reducing emissions and slowing the effects of climate change. Residential decarbonization involves replacing all gas appliances, including stoves, dryers, water heaters, and HVAC systems with electric systems and increasing the energy efficiency of homes by upgrading windows, doors, air sealing, and insulation. In California, residential buildings contributed eight percent of the state's carbon emissions in 2021 (California Air Resources Board 2023). Retrofitting the residential building stock will be necessary to meet the state's goal of reducing anthropogenic emissions to 85 percent below 1990 levels by 2045 (California Air Resources Board 2022).

The federal government and the state of California have made historic large-scale investments to encourage homeowners to retrofit their homes. This investment has the potential to not only move us closer toward our climate goals but also create high-quality jobs. While the construction industry is perceived as providing competitive wages, low-road employment practices are widespread among residential remodeling and repair firms specifically (Littlehale 2019; Center for California Construction Economics 2024). Creating labor standards to mandate wage floors and benefits levels in the industry can ensure that residential decarbonization investments contribute to improving job quality rather than reinforcing labor practices that undermine workers' well-being.

Climate advocates want building decarbonization investments to go as far and fast as possible toward reaching climate goals. Some have expressed concerns that attaching labor standards could raise the costs of residential decarbonization work significantly, reducing the number of projects that can be completed with available funds and slowing down the timeframe for reducing emissions. However, little research has been conducted to determine if there is a tradeoff between ensuring high job quality and maximizing the reach of climate investments.

The following paper aims to fill that gap by exploring the potential economic impacts of adopting labor standards for the residential decarbonization industry in the Bay Area (including Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties). Our study compares the status quo in the industry to two different wage and benefit standards that could be adopted: (1) prevailing wages and benefits and (2) setting a wage floor of 180 to 250 percent of the state minimum wage, depending on a worker's trade, and requiring that employers provide health insurance and a retirement plan with an employer match of at least 3 percent. For each of these potential labor standards, we estimate the impact on worker earnings, operating costs for employers, project prices for consumers and public agencies, the size of the local economy, and local government revenues and expenditures. This papers describes the labor standards modeled in our analysis, the data and methods we use to estimate economic impacts, and the findings of our study.

Methods and Data

Our methods for estimating the economic impacts of a labor standard for the residential decarbonization industry are based on a model developed by the Center for Wages and Employment Dynamics (CWED) and the UC Berkeley Labor Center (Perry, Thomason, and Bernhardt 2016). This model has been used to produce studies of the economic impacts of minimum and living wage policies for multiple local and state government agencies in California as well as several other states.[1]

Figure 1 shows our theoretical model of the economic impacts of adopting a labor standard for the industry. When a labor standard is adopted, workers are paid more and receive more comprehensive and higher-quality benefits. They then spend more, which increases the size of the local economy and the amount of tax revenues collected by government agencies. When workers earn more and receive better benefits, they are also less likely to enroll in safety net programs, reducing government expenditures for these programs. Employers see their payroll costs increase for each individual worker but also experience an increase in worker retention and productivity, which somewhat offset the increase in payroll costs. We expect that some or all of the increased costs to employers will be passed on to consumers in the form of higher prices for residential decarbonization projects.

[1] A similar, but more simplified model was used by the UC Berkeley Labor Center to discuss the potential impacts of wage increases on total costs and consumer prices in the solar industry (Jones 2020).

Figure 1: Theoretical model for estimating the economic impacts of a labor standard

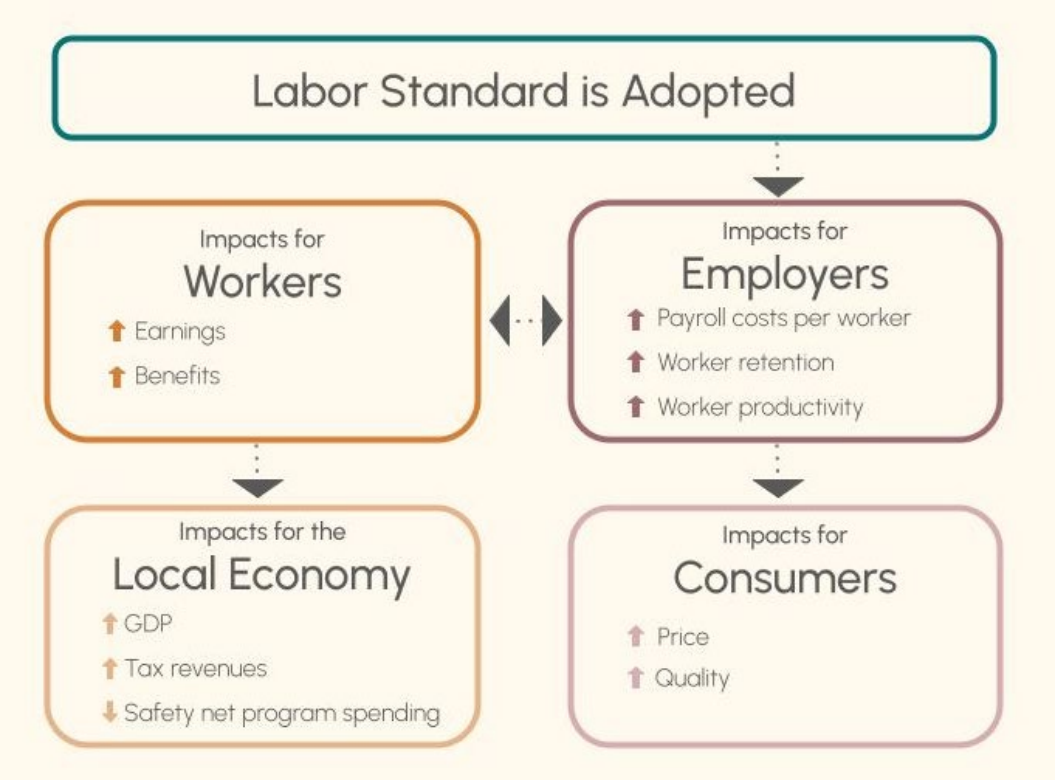


Figure 2 provides a high-level overview of our methods for estimating these economic impacts as well as the key data sources used as inputs for each step in our model. We provide additional detail on our data and methods alongside our description of findings as needed to provide context for interpreting our results. An in-depth description of our methods and data sources is included in our Technical Appendix.

To estimate **worker impacts**, we build a microsimulation model using individual-level data from the American Community Survey (ACS) combined with a number of additional data on worker earnings, the distribution of residential decarbonization workers by trade, the prevalence of access to employer-sponsored benefits, and the average cost of employer-sponsored benefits. We define residential decarbonization projects as replacing gas appliances, water heaters, and HVAC systems with all-electric systems and improving the energy efficiency of single-family or small multi-family homes (4 units or less).[2] This model allows us to estimate wages and benefits for workers under two scenarios:

1. Baseline scenario: estimates of each worker's current wages and benefits
2. Simulation scenario: estimates of each worker's wages and benefits if a labor standard was adopted.

[2] We exclude from our definition of residential decarbonization the installation of gas appliances, even if they are energy efficient.

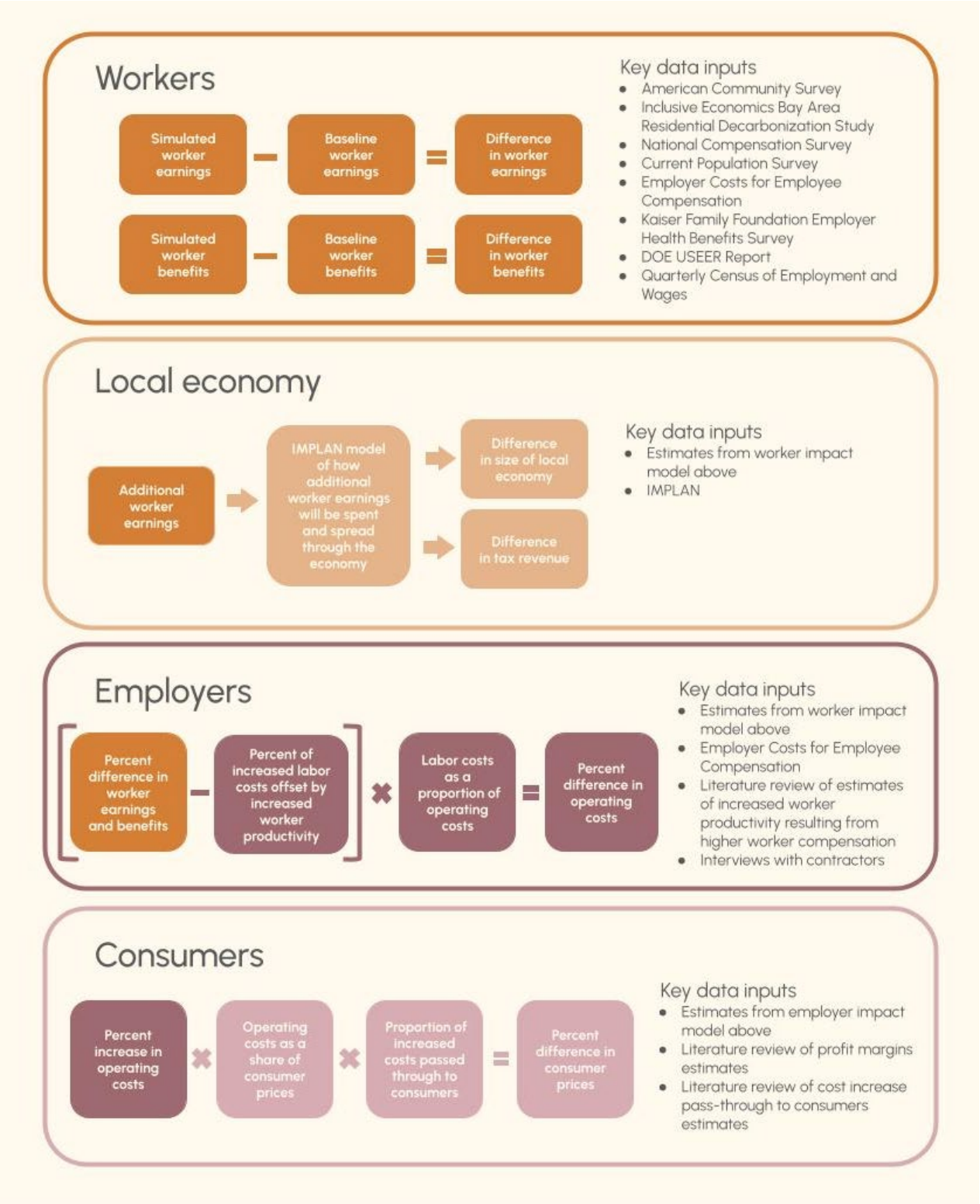
Our estimates of the labor standard's impact on worker earnings and benefits are equal to the difference between earnings and benefits in the baseline and simulation scenarios.

To estimate **employer impacts**, we apply an estimate of the proportion of increased labor costs that would be offset by an increase in worker productivity and an estimate of the proportion of operating expenses that go toward labor costs to our estimates of the percentage increase in labor costs from our worker microsimulation model.

To estimate **consumer impacts**, we apply a range of estimates of profit margins and an estimate of the proportion of operating cost increases that will be passed on to consumers in the form of higher prices to our estimates of the percent increase in employer operating costs to arrive at an estimate of the percent increase in the price of residential decarbonization projects for consumers.

To estimate **impacts on the local economy**, we aggregate our estimates from our microsimulation model of the average difference in annual wages per worker by multiplying by an estimate of the number of full-time equivalent residential decarbonization jobs in the Bay Area. We then use an economic input-output modeling software called IMPLAN to model the amount and impact of additional spending in the local economy by residential decarbonization workers because of their higher earnings.

Figure 2: Methods for estimating the economic impacts of a labor standard



We use this same IMPLAN model, along with estimates from a study of the impact of increased compensation on the usage of social safety net programs, to estimate the **impacts on government revenues and expenditures.**

Data on residential decarbonization workers and firms are generally extremely limited, especially for those in the Bay Area. Data is often only available for broader geographical regions and/or industry categories. For all of our model inputs, we select data sources that (1) are most reliable and accurate, (2) are most relevant to the Bay Area, and (3) are most likely to overestimate, rather than underestimate, the cost impacts for firms and consumers. Choosing data sources that we believe are most likely biased in the same direction allows us to assume that our overall estimates of the cost impacts for firms and consumers are conservative and can be interpreted as upper bounds to the likely range of cost impacts.

Modeled wage and benefits standards

We model the economic impacts of two different potential wage and benefits labor standards that could be adopted in the residential decarbonization industry:

1. Prevailing wage standard: All workers are paid at least the prevailing wage rate most applicable for their trade and geographic area. Employers contribute the hourly rates specified by this prevailing wage policy towards health insurance, retirement plan or pension, and other benefits.
2. Minimum-wage-based standard: Workers are paid at least 180 or 250 percent of the California state minimum wage, depending on their trade. Employers provide access to an employer-sponsored health insurance plan and retirement plan with at least a three percent match on employee contributions.

Table 1 compares our estimates of the average wages of residential decarbonization workers in the Bay Area to the wage floor levels we use in each of our simulations. Here, we see that some of the wage floors we model in our simulation are close to or higher than the median wage, meaning that they are higher than the wages earned by half of the workers in our sample.

Table 1: Average baseline wages compared to simulated wage floors

Estimate of average wages for residential decarbonization workers	$32.87
Wage floor in prevailing wage simulation (varies by trade)	$32.09 - $57.50
Wage floor in minimum-wage-based labor standard simulation (180 or 250 percent of the California state minimum wage, depending on trade)	$27.90 - $38.75

Source: Authors' analysis of IPUMS 2018-2022 American Community Survey, 2019 National Compensation Survey data, and California Department of Industrial Relations Prevailing Wage Determinations.

Prevailing Wage and Apprenticeships

California regulations require that employers contracted on public works projects pay prevailing wages (applies to projects with more than $1,000 in public funds) and participate in state apprenticeship programs (applies to projects with more than $30,000 in public funds), regardless of whether the firm is union or nonunion (State of California Department of Industrial Relations 2024b; 2016). Residential decarbonization subsidy programs currently are not covered by state prevailing wage and apprenticeship requirements. Only one program, California's Equitable Building Decarbonization program, recommends but does not require that contractors pay prevailing wages (Appel and Hammerling 2023).

The State of California Department of Industrial Relations sets prevailing wage rates every six months based on the average wages paid to workers on public works projects (State of California Department of Industrial Relations 2024a). Separate prevailing wage levels are set by trade, geography, residential vs. commercial work, and level of training and experience. For example, there are separate prevailing wage rates for residential plumbers in Alameda County, depending on whether they are classified as Journeyman, Helper Class 1, Helper Class 2, Helper Class 3, Helper Class 4, or Trainee. Prevailing wage rates also include hourly rates for employee benefits and training. For example, the prevailing wage rate for a residential plumber in Alameda County classified as Journeyman is $48.95 an hour, and for each hour worked, employers must also contribute $12.25 for health insurance benefits, $8.00 for a retirement plan or pension, $1.10 for training, and $0.35 for other benefits (California Department of Industrial Relations 2023b).

Apprenticeship programs include classroom training and on-the-job mentorship and must be certified by the State of California Department of Industrial Relations to ensure quality. Union apprenticeship programs are designed jointly by employers and workers. However, some nonunion employers also design their own apprenticeship programs. The apprenticeship system trains workers in all aspects of a trade, including training for specific technologies or types of projects, such as those used in residential decarbonization projects. Developing this broadly applicable skill set that can be transferred between different employers and types of projects within a trade opens up a clear career path for workers with many employment options (Zabin 2020).

While its overall workforce has diversified over time, the construction industry is very bifurcated, with some workers receiving high wages and generous benefits (primarily those that are union and/or covered by prevailing wage) and others earning low wages and few benefits (Littlehale 2019). The apprenticeship system, particularly pre-apprenticeship programs that prepare workers for apprenticeship programs, has been a critical tool for diversifying workers in high-quality construction jobs (Zabin 2020). Currently, 73 percent of workers in California's apprenticeship programs are workers of color (California Division of Apprenticeship Standards 2024).

Combined, prevailing wage and apprenticeship programs provide high-quality jobs and career pathways for workers, improve work quality by ensuring that work is done by well-trained and experienced workers, reduce race and gender wage inequity in the industry by establishing set wage levels, and encourage a market where firms compete based on work quality instead of lowest worker compensation (Appel and Hammerling 2023).

In reality, the prevailing wage is not a wage floor - most trades have a number of different wage levels based on training, experience, geography, and residential vs. commercial work. We assume residential prevailing wage rates for trades with specific residential rates and otherwise assume that commercial rates apply. We take the average of county-level prevailing wage rates for trades with county-level rates and otherwise assume that regional or state-level rates apply. For trades with separate prevailing wage rates for different job titles, we select the job title that most closely resembles the residential decarbonization occupation. Most trades have different prevailing wage rates based on training and experience. Since our data do not allow us to see training and experience levels, we are unable to identify the specific prevailing wage level that would apply to each individual worker. Instead, we have selected prevailing wage levels somewhat in the middle of the distribution within the trade, and we treat this wage level as the "wage floor" for workers within the occupation (See the Technical Appendix for the specific prevailing wage rate assumptions used for each trade/occupation in our model).

Our analysis only addresses the economic impacts of increasing compensation and benefits for residential decarbonization workers and does not consider how a labor standard could be implemented and enforced in the industry. Public funding for residential decarbonization projects is spread across a wide variety of local, state, and federal programs. These programs vary in terms of their delivery method for distributing subsidies and are administered by many different agencies and organizations. Additional analysis would be needed to identify pathways for achieving industry-wide adoption of a wage and benefits labor standard.

Impact on Workers

We first model the impact that a prevailing wage or minimum-wage-based labor standard would have on the earnings and benefits of residential decarbonization workers.

Earnings

We model two different ways that a labor standard may impact worker earnings. Workers who earn less in the baseline than the wage floor for their trade, as modeled in the simulation, are **directly impacted**. In the simulation, these workers now earn the labor standard wage floor for their trade. Workers in the baseline who earn just at or above the wage floor for their trade modeled in the simulation are **indirectly impacted**. Employers typically pay different wage levels to workers based on differences in their position titles or responsibilities and education levels, skillsets, and experience. Our model assumes that these workers will receive a small wage increase as employers attempt to maintain wage differences (and avoid wage compression) across their workforce. We use the same method as the CWED model to account for these "spillover effects" for indirectly impacted workers (see the Technical Appendix for more detail).

Table 2 reports our findings on the number and proportion of workers who would experience an increase in their wages as the result of the adoption of a wage and benefits standard in the

residential decarbonization industry. We estimate that under a prevailing wage or minimum-wage-based labor standard, as many as four out of five residential decarbonization workers would see an increase in their wages. Under prevailing wage, between 2,200 and 3,800 workers would see an increase in their earnings. Under a minimum-wage-based labor standard, between 2,100 and 3,500 workers would receive higher wages. In both simulations, most impacted workers would be directly impacted, and a smaller number would receive an indirect wage increase.

Table 2 also shows our estimates of the impact on worker earnings. We estimate that a prevailing wage standard would result in an average increase of $14.50 per hour and $25,951 annually among workers who would be impacted. This represents a 71 percent increase in these workers' annual earnings. Collectively, this would represent between $61 and $100 million in additional earnings for residential decarbonization workers in the Bay Area each year.

Table 2: Estimates of the impact of a wage and benefits standard on worker earnings

	Estimated impact of a prevailing wage standard			**Estimated impact of a minimum-wage-based standard**		
	Directly impacted workers	Indirectly impacted workers	All impacted workers	Directly impacted workers	Indirectly impacted workers	All impacted workers
Proportion of workers	66 percent	11 percent	77 percent	62 percent	8 percent	70 percent
Number of workers	1,900 - 3,300	300 - 500	2,200 - 3,800	1,900 - 3,500	200 - 400	2,100 - 3,500
Median increase in hourly wage	$16.59	$0.78	$14.50	$12.38	$0.66	$11.26
Median increase in annual earnings	$31,248	$1,597	$25,951	$24,042	$1,338	$20,839
Percentage point increase in annual earnings	82 percent	2 percent	71 percent	67 percent	2 percent	60 percent

Source: Authors' analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, and 2019 National Compensation Survey data. Dollar amounts are adjusted to 2023 dollars using the Consumer Price Index for San Francisco-Oakland-Hayward Urban Wage Earners and Clerical Workers (CPI-W). See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

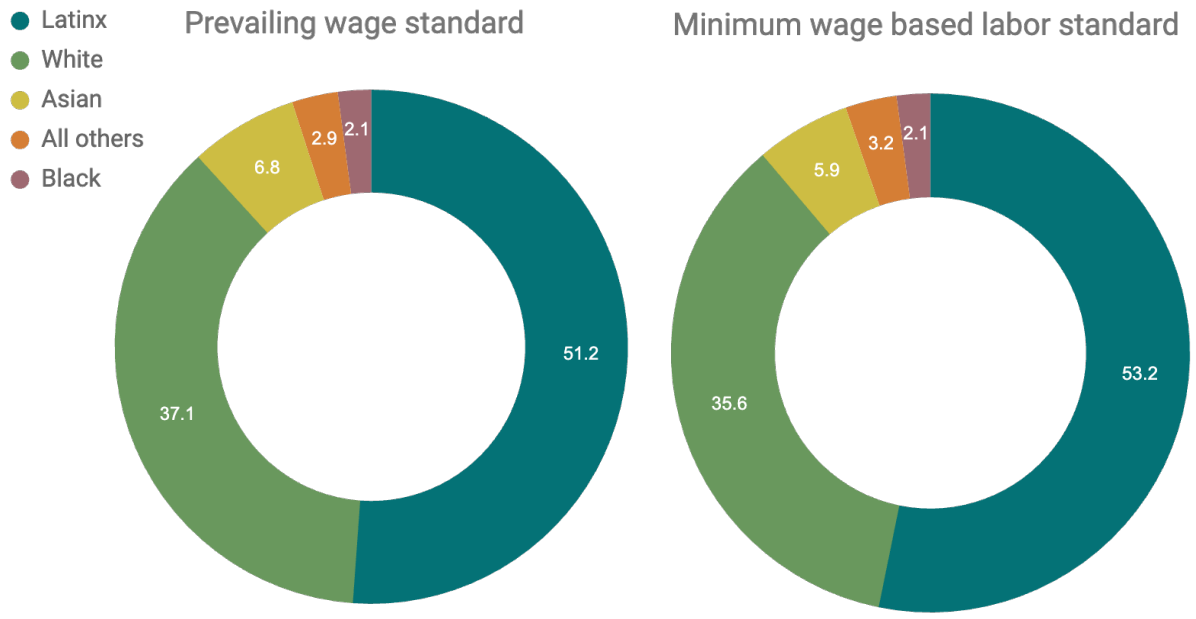
We estimate that a minimum-wage-based labor standard would result in an average earnings increase of $11.26 per hour and $20,839 annually among workers who would be impacted. This represents a 60 percent increase in these workers' annual earnings. Collectively, this would represent between $44 and $74 million in additional earnings for residential decarbonization workers in the Bay Area each year.

An increase in earnings of this scale would have a large impact on the lives of workers and their families. Numerous studies have found connections between higher earnings due to labor standards and improved health outcomes, mental health, and school performance for workers and their families (Avila and Frakt 2021; Regmi 2020; Leigh and Du 2018). Research has also shown that prevailing wage regulations reduce income inequality within the construction industry, eliminating nearly half of the gap between the highest and lowest earners (Manzo IV and Bruno 2014). In addition, states with prevailing wage laws have been shown to have lower injury rates among workers (Z. Li et al. 2019; Kelsey and Manzo IV 2019).

Racial wage gap

The construction industry has become more diverse over time, with Latinx workers making up a growing proportion of workers over the last two decades (Gallagher 2022). However, Latinx construction workers earn significantly less than White construction workers. Both wage standards we model would reduce racial wage disparities within the Bay Area construction industry by standardizing wage rates to some extent regardless of race, based on a recent study of state prevailing wage policies (Manzo, Bruno, and Manzo IV 2018). Over half of workers who would receive a wage increase under a prevailing wage or minimum-wage-based labor standard would be workers of color (see Figure 3). Just over half of the workers receiving a wage increase would be Latinx workers. By comparison, we estimate that Latinx workers comprise 48 percent of the residential decarbonization workforce, and White non-Hispanic workers comprise 39 percent (Thomason et al. 2024).

Figure 3: Workers receiving a wage increase by race/ethnicity



Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, 2019 National Compensation Survey data, and BLS Employer

Costs for Employee Compensation data. See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

Our data only allows for comparing the earnings of Latinx and White non-Hispanic residential decarbonization workers in the Bay Area, as sample sizes for other groups of workers are too small. Currently, Latinx residential decarbonization workers earn only 65 cents for every dollar that White non-Hispanic residential decarbonization workers earn. We find that under a prevailing wage standard or a minimum-wage-based labor standard, the median wage of Latinx workers would be almost the same as the median wage of White non-Hispanic workers. This is due to the fact that in our model, more than half of workers would receive a wage increase under either a prevailing wage or minimum-wage-based labor standard. As a result, the median wages for White non-Hispanic and Latinx workers are almost identical in our simulations of the labor standards. If a labor standard were to be adopted, inequities in pay may persist among workers who are higher in the wage distribution. Our prevailing wage model is also not able to assign prevailing wage rates at their full level of detail because our data do not allow us to capture differences in experience and specific positions within trades/occupations. Therefore, we may underestimate the wage gap in the simulations if White workers have more experience than Latinx workers on average. However, our findings suggest that a labor standard would eliminate most, if not all, of the wage gap between Latinx and White workers, for at least workers in the bottom half of the wage distribution.

Table 3: Estimates of the impact on the wage gap between White and Latinx workers

	Median hourly wage of Latinx workers	**Median hourly wage of White non-Hispanic workers**	**Wage gap** (dollar amount that Latinx workers earn for each $1 earned by White non-Hispanic workers)
Baseline	$24.86	$38.24	$0.65
Prevailing wage scenario	$45.01	$45.44	$0.99
Minimum-wage-based labor standard scenario	$38.46	$38.58	$1.00

Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, 2019 National Compensation Survey data, and BLS Employer Costs for Employee Compensation data. See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

Health insurance and retirement benefits

Nearly one in four residential decarbonization workers would gain access to an employer-sponsored health insurance plan as a result of either of the two modeled labor standards, representing between 700 and 1,100 workers (see Table 4). In the minimum-wage-based standard simulation, we model that employers would provide the same level of health insurance

benefits as California employers on average. We assume that health insurance costs for single workers will be the same as the average employer spending on individual plans and that health insurance costs for workers who live with a family member would be the same as the average employer spending on family plans. In the prevailing wage-based standard, we model that employers would contribute an hourly rate towards health insurance costs based on the prevailing wage regulations for each worker's trade. In this case, many workers who already had employer-sponsored health insurance would likely see improvements in the health plans offered by their employer, as prevailing wage health insurance contribution requirements are significantly higher than what California employers currently pay on average.

Table 4: Estimates of the impact on worker health insurance and retirement benefits

	Prevailing wage standard	**Minimum-wage-based standard**
Proportion of workers that would be newly enrolled in employer-sponsored health insurance	23 percent	23 percent
Number of workers that would gain access to employer-sponsored health insurance	700 - 1,100	700 - 1,100
Proportion of workers that would be newly enrolled in employer-sponsored retirement or pension plans	72 percent	60 percent
Number of workers that would be newly enrolled in employer-sponsored retirement or pension plans	2,200 - 3,600	1,800 - 3,000

Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, Kaiser Family Foundation Employer Health Benefits Survey, BLS Employer Costs for Employee Compensation data, and 2019-2023 IPUMS Current Population Survey data. See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

Under a prevailing wage labor standard, three out of four residential decarbonization workers (2,200 to 3,600) would be newly enrolled in an employer-sponsored retirement plan. Because prevailing wage regulations require that employers contribute an hourly rate towards retirement benefits, regardless of whether workers contribute a portion of their earnings, we assume that all workers would be enrolled in an employer-sponsored plan in our prevailing wage simulation.

Under a minimum-wage-based labor standard requiring employers to offer a retirement plan with at least a three percent match on employee contributions, about two out of three residential decarbonization workers (1,800 to 3,000 workers) would be newly enrolled in an employer-sponsored retirement plan. In our minimum-wage-based labor standard model, we do not assume that all workers would enroll in their employer's retirement plan because we know that not all workers who currently have access to a retirement plan choose to enroll. We assume that the take-up rate for workers who would newly gain access to an employer-sponsored retirement

plan would be the same as the take-up rate among workers who currently have access to an employer-sponsored retirement plan (81 percent).[3]

Under each labor standard that we model, worker benefits would improve. Table 5 shows our estimates of average employer contributions to health insurance premiums and retirement plans in the baseline and our simulations. Under a prevailing wage standard, on average, annual employer contributions per worker would increase by $15,000 for health insurance premiums and $18,500 for retirement plans. Under a minimum-wage-based standard, on average, annual employer contributions per worker would increase by $2,000 for health insurance premiums and $1,500 for retirement plans.

Table 5: Estimates of impact on employer contributions to health insurance premiums and retirement plans

	Baseline	Prevailing wage standard simulation	Minimum-wage-based standard simulation
Median annual per-worker employer contribution to health insurance premiums	$11,000	$26,000	$13,000
Median annual per-worker employer contribution to retirement plans	$1,500	$20,000	$3,000

Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, 2019 National Compensation Survey, Kaiser Family Foundation Employer Health Benefits Survey, BLS Employer Costs for Employee Compensation data, and 2019-2023 IPUMS Current Population Survey data. Dollar amounts are adjusted to 2023 dollars using the Bay Area CPI-W. See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

Impact on Employers

As described in our previous section, we find that under either a prevailing wage or minimum-wage-based labor standard, employers would pay individual workers considerably more each year in wages and benefits. However, overall employer costs would not increase nearly as much for two reasons. First, when worker compensation increases, worker productivity and retention also increases, offsetting some of the additional compensation costs. Second, labor costs only represent a portion of residential decarbonization contractor operating costs, including materials, marketing, and other expenses. In this section, we describe our estimates of (1) the increase in labor costs for employers after accounting for expected productivity and retention gains and (2) the increase in total operating costs for employers after accounting for the proportion of costs that typically go toward labor costs for residential decarbonization firms.

[3] Authors' analysis of IPUMS Current Population Survey data 2019-2023 for California construction workers.

Increase in labor costs after accounting for productivity gains

A wide body of literature has demonstrated the connections between providing better compensation to workers through labor standards, such as minimum wage and prevailing wage policies, and gains in worker productivity. Labor standards increase worker productivity in several different ways.

First, higher wages and better benefits incentivize workers to continue working for a specific employer. This reduces worker turnover for employers, reducing associated costs with recruiting, onboarding, and training new workers. Studies of minimum wage increases have found that cost savings associated with reductions in turnover offset the costs of wage increases by between 15 and 20 percent (Pollin and Wicks-Lim 2015; Dube, Freeman, and Reich 2010; Dube, Lester, and Reich 2010; Reich et al. 2016). Several studies comparing states with prevailing wage regulations to states that recently repealed prevailing wages find that prevailing wages are associated with lower turnover rates (Manzo IV and Duncan 2018).

Second, higher wages and better benefits lead workers to continue working within the construction industry more broadly for a longer period of time, even if they move between employers. When workers continue working in the construction industry for longer periods, they gain valuable experience that increases their productivity on the job over time. Research has shown that average years of construction industry experience are higher in states with prevailing wage laws (Phillips 2014).

Third, when employers pay higher compensation, workers receive more training and education, increasing their productivity on the job. Multiple studies have found that in states with prevailing wage laws, workers have higher levels of formal education, receive more training from employers, and are more likely to participate in apprenticeship programs (Bilginsoy 2003; Dickson Quesada et al. 2013; Phillips 2014).

Finally, higher wages incentivize workers to exert more effort, increasing the amount of work they complete over a given period of time (Ku 2022).

Multiple studies have found that labor standards such as minimum wage or prevailing wage policies lead to significant productivity gains through the above-mentioned pathways combined. A study conducted by Peter Philips finds that in states with prevailing wage laws, where workers earn 18 percent more in wages and employers contribute 56 percent more to retirement plans, health insurance premiums, and apprenticeship programs, productivity is 16 percent higher than in states without prevailing wage laws (2014). Studies of minimum wage policies in the US and internationally find that every 1.0 percent increase in the minimum wage increases productivity by between 0.3 and 0.8 percent (Haelbig, Mertens, and Müller 2023; Nguyen 2019; Ku 2022; Riley and Rosazza Bondibene 2017; Mayneris, Poncet, and Zhang 2018). The findings from two of these studies provide sufficient detail to estimate how much productivity gains offset the cost of additional wages. A study of the impact of a minimum wage increase on farmworkers in Florida

by Ku (2022) finds that increases in worker productivity offset 52 percent of the cost of higher wages. A study of the impact of a minimum wage increase on manufacturing and service industries in Germany by Haelbig, Mertens, and Müller (2023) finds that productivity gains offset between 30 and 50 percent of the additional costs to employers. We take the average of the estimates from these two studies and assume that under a prevailing wage or minimum-wage-based labor standard, 46 percent of the increase in compensation costs to employers would be offset by increases in worker productivity.

To estimate the increase in labor costs for employers, we first model the difference in employer costs for wages, health insurance premiums, and retirement plan contributions separately. In addition to wages, health insurance premiums, and retirement plan contributions, we assume that employer labor costs also include payroll taxes (7.65 percent of wages), worker's compensation insurance (7.9 percent of wages), and paid leave (18.6 percent of wages) (see the Technical Appendix for more detail on these assumptions). We then apply the estimate described above of the proportion of additional compensation costs that we expect will be offset by productivity gains (46 percent). After accounting for increases in worker productivity associated with increased compensation, we estimate that a prevailing wage standard would increase labor costs by 28 percent, and a minimum-wage-based labor standard would increase labor costs by 14 percent (Table 6).

We would not expect productivity gains to be immediate, but evidence from previous research finds that productivity does increase in the short term. A study by Duncan et al. (2009) found that the adoption of prevailing wage in British Columbia decreased productivity in the months immediately after implementation but that productivity had increased significantly within 17 months. The study of the impact of a minimum wage on Florida farmworkers (Ku 2022) found that worker productivity increased within weeks of the wage increase.

Increase in total operating costs

Labor represents only one of the multiple types of expenses that contribute to the overall operating costs of residential decarbonization firms. Other costs may include materials, equipment, permits, marketing, administrative expenses, and office space. Based on our interviews with 11 residential decarbonization firms in the Bay Area, we estimate that labor costs represent about 35 percent of total operating costs on average (see Figure 4). Our estimate is within the range of other estimates of the labor share of operating costs for residential decarbonization and residential remodeling work nationally and for residential construction more broadly here in California (23 to 46 percent; see the Technical Appendix for more detail).

Figure 4: Labor costs as a share of operating costs for residential decarbonization employers

Source: Authors' interviews with Bay Area residential decarbonization contractors, 2023. See the Technical Appendix for more detail on interview methods.

Table 6: Estimates of percentage increase in labor costs

	Prevailing wage standard simulation	Minimum-wage-based standard simulation
Percentage increase in labor costs (after accounting for productivity gains associated with increased worker compensation)	28 percent	14 percent
Percentage increase in total operating costs (increase in labor costs multiplied by the labor share of operating costs)	10 percent	5 percent

Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, 2019 National Compensation Survey data, Kaiser Family Foundation Employer Health Benefits Survey, BLS Employer Costs for Employee Compensation data, Ku (2022) and Haelbig, Mertens, and Müller (2023), and interviews with Bay Area residential decarbonization contractors. See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

To estimate the impact of a labor standard on total operating costs, we multiply our estimate of the impact on labor costs by our estimate of the labor share of operating costs. We find that a prevailing wage standard would increase total operating costs by ten percent, and a minimum-wage-based standard would increase total operating costs by five percent (see Table 6).

Impact on Consumer Prices

The impact that each labor standard will ultimately have on prices for consumers (defined as homeowners and public agencies that fund residential decarbonization projects) depends on (1) the percentage increase in operating costs for employers, (2) the size of profit margins for residential decarbonization firms, and (3) the proportion of operating cost increases that are passed on to consumers (see Figure 2). To estimate the impact on consumer prices, we apply estimates of operating costs as a proportion of revenues (using estimates of profit margins) and estimates of the proportion of operating cost increases that are likely to be passed on to consumers to our estimates from the previous section of the overall increase in operating costs for employers.

Figure 5: Operating costs as a share of revenues for residential decarbonization firms

Source: Lee et al. (2021) and Chan, Less, and Walker (2021).

We assume that operating costs make up between 80 and 88 percent of revenues, based on estimates of 12 to 20 percent profit margins for HVAC and residential decarbonization retrofit projects nationally (Chan, Less, and Walker 2021; Walker, Less, and Casquero-Modrego 2023). We also assume that between 80 and 100 percent of the increase in operating costs will be passed on to consumers in the form of higher prices (see the Technical Appendix for a discussion of estimates of cost pass-through to consumers in construction and related industries). Applying both of these estimates to our estimates of the overall increase in operating costs for employers, we find that consumer prices would increase by between six and nine percent under a prevailing wage standard and between three and four percent under a minimum-wage-based labor standard (see Table 7).

Table 7: Estimates of the impact on consumer prices

	Prevailing wage standard simulation	**Minimum-wage-based standard simulation**
Percentage increase in consumer prices (after accounting for profit margins and the proportion of increased operating costs that will be passed on to consumers)	6 - 9 percent	3 - 4 percent

Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, 2019 National Compensation Survey data, Kaiser Family Foundation Employer Health Benefits Survey, BLS Employer Costs for Employee Compensation data, Ku (2022) and Haelbig, Mertens, and Müller (2023), interviews with Bay Area residential decarbonization contractors, Walker, Less, and Casquero-Modrego (2023), and Chan et al. (2021). See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

Our findings compared to similar studies

We were unable to identify existing research that estimates the impact of a labor standard on residential decarbonization project prices in California or elsewhere. A large number of studies have estimated the impact of prevailing wage laws on public infrastructure construction costs using a variety of methods and have primarily found that prevailing wage has no impact on project bids or final costs. In a review by Manzo IV et al. of 20 peer-reviewed studies conducted between 2000 and 2023, four out of five found that prevailing wage standards had no impact on the total cost of public construction projects (2023). There are a number of reasons why these studies find that prevailing wage laws do not increase the cost of public construction projects despite significantly increasing individual worker wages and benefits. First, union firms typically provide prevailing wage-level compensation to their workers as defined in their Collective Bargaining Agreements regardless of whether or not it is required by law, so some of the work completed in the absence of a prevailing wage law may still be completed by workers compensated at the equivalent of prevailing wage. Second, some or all of the additional costs of wages and benefits may be offset by increases in worker productivity or decisions by employers

to substitute materials for labor, such as by automating some processes. Finally, firms may absorb any remaining operating cost increases through reduced profit margins (Mahalia 2008).

These findings substantiate our assumption that our estimates of the impact on project costs are more of an upper-bound estimate and that the actual cost difference may be even lower. However, the types of construction projects that the studies reviewed by Manzo IV et al. focus on differ from residential decarbonization projects in several important ways that may also cause the impact of a labor standard to be different. The studies reviewed by Manzo IV et al. all focus on non-residential public construction projects, including the construction of highways, schools, and other public buildings and structures. Public infrastructure construction is more costly than residential construction overall, and in California, residential construction workers earn 25 percent less than other construction workers on average and are less likely to have employer-sponsored health insurance or retirement benefits (Littlehale 2019). Given the difference in the nature of work, the breakdown of costs and profit margins are likely very different between residential decarbonization retrofit work and new construction of public infrastructure. Only one recent study has looked at the impact of labor standards on residential construction specifically, reaching a very different conclusion about the impact of prevailing wage on construction costs. Dunn et al. (2005) estimate that prevailing wage laws in California increase the cost of constructing public low-income housing by between 9 and 37 percent. However, this study focuses on publicly contracted projects and on large-scale multi-family housing, which are still significantly different from the single-family and small multi-family residential decarbonization projects that our study focuses on, the majority of which currently are contracted by homeowners directly and not through public agencies (Thomason et al. 2024).

Labor standards and quality of residential decarbonization work

Although a labor standard would lead to increased consumer prices, evidence from the literature suggests that it will also increase the likelihood that those projects will successfully reduce the residential carbon footprint. Increasing the quality of jobs has been demonstrated to increase the quality of residential decarbonization projects, ensuring that public investments maximize their impact on emissions reductions. Currently, residential decarbonization workers earn less than other construction workers on average, suggesting that the industry may currently be at risk of developing into a low-road industry, providing lower-than-average compensation to workers compared to other types of construction (Thomason et al. 2024). This type of business model typically leads to lower quality work, as workers receive less training and have less experience on average, as they tend to leave their positions and/or the industry entirely after a short period of time (Singla et al. 2022).Poor quality residential decarbonization installations reduce their energy savings benefits by between 30 and 40 percent (California Energy Commission 2021).

The correlation between job quality, quality of work, and energy savings outcomes has been increasingly demonstrated through research. A recent seven-state study by the US Department of Energy found that an increased focus on training and education for workers led to an increase in energy code compliance and over $18 million in annual energy savings (Blandling et al. 2022). A

2014 study commissioned by the California Public Utilities Commission finds that including workforce standards such as better training, prevailing wages and benefits, and more robust recruitment efforts would most likely contribute to a better trained and retained workforce, thereby improving the quality of ratepayer-supported energy efficiency work (Zabin Ph.D., Halpern-Finnerty, and Scott 2014). The US Department of Energy has emphasized the importance of training and education to maximize energy and cost savings and is currently underway on multiple research projects and policy initiatives that focus on the importance of high labor standards and quality jobs to address climate change through more effective energy savings programs and installation measures (Office of Energy Efficiency & Renewable Energy, US Department of Energy 2022).

Potential impact of increased public investment on consumer prices

To estimate the impact of adopting a labor standard for consumer prices, we assume that other factors that may influence supply and demand in the industry remain constant. In reality, the industry is in a rapid shift as a series of historic climate investments made by the state and federal governments begin to take effect (Thomason et al. 2024). While we do not attempt to quantitatively estimate the impact that these two phenomena would have if they occur simultaneously, existing research and economic theory suggest that adopting a labor standard and increasing public investment for residential decarbonization projects would likely have opposite effects on the quantity of projects completed, but both would push consumer prices higher (see the Technical Appendix for a more detailed explanation of the likely impact of simultaneous adoption of a labor standard and increased public investment.).

Impact on the Local Economy

As we report above, a prevailing wage labor standard would increase residential decarbonization worker annual earnings by between $61 and $100 million, and a minimum-wage-based labor standard would increase annual earnings by between $44 and $74 million. When these workers and their families spend additional earnings on housing, food, transportation, and other goods and services, additional jobs are created in other industries, growing the size of the local economy. This creates a “multiplier effect,” where an increase in worker income creates an even larger increase in the size of the local economy.

We use IMPLAN to model the impact of these additional worker earnings on the size of the Bay Area economy. We find that a prevailing wage standard would increase local GDP by between $115 and $189 million, and a minimum-wage-based labor standard would increase local GDP by between $83 and $139 million (see Table 8).

Table 8: Estimates of the impact of a wage and benefits standard on the local economy

	Prevailing wage standard simulation	Minimum-wage-based standard simulation
Increase in size of local economy due to higher worker wages (additional local GDP generated by additional earnings)	$115-$189 million	$83-$139 million

Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, 2019 National Compensation Survey, Kaiser Family Foundation Employer Health Benefits Survey, BLS Employer Costs for Employee Compensation data, and IMPLAN. Dollar amounts are adjusted to 2023 dollars using the Bay Area CPI-W. See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

Our model may underestimate the true impact on the local economy for several reasons. First, our estimates are based on the current size of the residential decarbonization workforce. However, due to increases in public investments (Thomason et al. 2024), the workforce is expected to add additional jobs in 2025. As the workforce grows, the potential impact of a labor standard on the local economy also increases.

Second, these estimates only include the impact of wage increases and do not take into account additional health insurance benefits that might lead workers and their families to use more health care services.

Finally, multiple studies have found that prevailing wage laws increase the likelihood that local firms are hired for construction projects. This suggests that implementing a labor standard in the residential decarbonization sector would lead to a higher proportion of the work being completed by firms and workers local to the Bay Area and for their earnings to contribute to the local economy and tax revenues (Duncan, Case, and Manzo IV 2024; Manzo IV, Bruno, and Littlehale 2014; Duncan and Lantsberg 2015), thereby ensuring that public investment stays within the local economy. Our analysis assumes that residential decarbonization firms and workers doing work in the Bay Area are already based in Bay Area counties. If that is not the case, then the adoption of a labor standard would likely increase the proportion of workers living in Bay Area counties. In this case, the difference in the impact on the local economy between the baseline and simulation scenarios would be not just the difference in earnings for workers but also the entire earnings for workers that would be living outside of the Bay Area in the baseline and within Bay Area counties in the simulations. Therefore, our estimate of the impact on the local economy and local government revenues may be an underestimate.

We do not estimate the impact that a labor standard would have on the number of employed workers in the residential decarbonization industry. The impacts of labor standards on employment have been widely debated, particularly in the context of minimum wage increases, as opponents frequently argue that minimum wage increases will lead to a large loss of jobs (see Zipperer (2022) for an in-depth summary of research findings on employment and minimum

wage policies). However, several recent retrospective studies have found that minimum wage increases either had no impact on the number of jobs or had very small negative or positive employment effects (Wiltshire et al. 2024), including for low-wage industries and small businesses (Wursten and Reich 2023). Even if a labor standard were to reduce the number of residential decarbonization jobs by a small amount, this would likely be offset by the expected growth in the number of jobs in the industry in the next few years due to the increase in public investment (Thomason et al. 2024).

Impact on Government Revenues and Expenditures

The additional earnings for workers in the residential decarbonization industry and in other industries across the local economy that would see increases in employment as a result of workers spending these additional earnings would lead to additional tax revenues for all levels of government. These additional tax revenues would come from many different taxes, including income and sales taxes.

We use the same IMPLAN model described in the previous section to estimate the additional tax revenues for all levels of government. We find that a prevailing wage standard would generate between $29 and $46 million in additional tax revenues, including between $7 and $10 million in local tax revenues. We find that a minimum-wage-based labor standard would generate between $18 and $34 million in additional tax revenues, including between $4 and $7 million in local tax revenues.

Table 9: Estimates of the impact on government revenues

	Prevailing wage standard simulation	**Minimum-wage-based standard simulation**
Local government	+$7-$10 million	+$4-$7 million
State government	+$8-$13 million	+$5-$10 million
Federal government	+$14-$23 million	+$9-$17 million

Source: Author's analysis of 2018-2022 IPUMS American Community Survey data, US Energy & Employment Jobs Report data, Quarterly Census of Employment and Wages data, 2019 National Compensation Survey, Kaiser Family Foundation Employer Health Benefits Survey, BLS Employer Costs for Employee Compensation data, and IMPLAN. Dollar amounts are adjusted to 2023 dollars using the Bay Area CPI-W. See the Technical Appendix for a detailed description of methods used to arrive at these estimates.

A labor standard would also reduce some public expenditures, as fewer workers and their families rely on public safety net programs to meet their basic needs. A study by the UC Berkeley Labor Center called "The Public Cost of Low-Wage Jobs in California's Construction Industry" finds that nearly half of the families of construction workers in California are enrolled in a public safety net program such as Medicaid, the Children's Health Insurance Program (CHIP), the Supplemental Nutrition Assistance Program (SNAP), and the Earned Income Tax Credit (EITC)

(Jacobs and Huang 2021). This suggests that government expenditures for safety net programs for Bay Area residential decarbonization worker families are currently $15 to $24 million annually, and likely higher given that residential decarbonization workers earn less than other construction workers on average and are therefore more likely to qualify for safety net programs (Thomason et al. 2024). These expenditures would likely be significantly reduced or even eliminated if a labor standard was adopted for the industry.

The combined impact of increased government revenues and decreased government expenditures would provide a net public benefit of between $44 and $70 million under a prevailing wage standard and between $33 and $58 million under a minimum-wage-based labor standard.

Conclusion

The Bay Area has led the state and the country in residential decarbonization investment and consumer uptake. The region now has the opportunity to become a leader in modeling what a High Road[SM] residential decarbonization industry could look like and share effective strategies to achieve this systemic change. Many climate advocates have valid concerns about ensuring climate investments are used cost-effectively to reduce emissions as much as possible. Following this line of thinking may lead some to see a tradeoff between maximizing the impact of climate investments and ensuring that jobs in the industry are High Road[SM]. However, the findings of our study, employing widely accepted methods for estimating the economic impacts of labor standards and building upon decades of research on labor standards in the construction industry specifically, suggest that this is not the case - adopting a labor standard will not significantly increase residential decarbonization project costs. In contrast, a labor standard is likely to increase the quality of residential decarbonization work and, therefore, the likelihood that projects will successfully reduce residential carbon emissions while also magnifying the impact of climate investments on the local economy by drastically improving the lives of workers and their families, reducing the racial wage gap, and boosting local tax revenues.

Technical Appendix

Identifying residential decarbonization workers in ACS data

Residential decarbonization work does not have a specific NAICS industry code assigned to it, and these workers are mixed in with other workers across multiple industry categories. As a result, no Census or Bureau of Labor Statistics datasets allow for identifying residential decarbonization workers specifically. Instead, we assign individuals as residential decarbonization workers in our ACS microsimulation model if they work in the construction industry and in a residential decarbonization occupation as defined by an O-NET list of energy efficiency occupations (O*NET Resource Center 2023).

Since ACS data only allow us to see workers in the construction industry as a whole and not in the residential decarbonization industry specifically, the proportion of workers in our ACS data in each occupation reflects their proportions in the overall construction industry. To make our ACS sample better reflect the actual distribution of workers across occupations in the residential decarbonization industry, we reweight workers in our sample according to an estimate from Inclusive Economics of the distribution of residential decarbonization project work hours across trades in the Bay Area (Inclusive Economics 2020).

Baseline wage estimates

Our microsimulation model estimates worker wages using IPUMS American Community Survey (ACS) data.

Adjusting for inflation

We inflate ACS annual earned income to 2023 dollars using the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) for San Francisco - Oakland - Hayward (California Department of Industrial Relations 2023a).

Constructing an hourly wage variable

The ACS provides data on annual earned income for individual workers. To construct an hourly wage variable, we divide annual earned income by weeks worked per year and usual hours worked per week. As the ACS weeks worked variable is only available as a categorical variable for years 2008-2018, we use the midpoint of each response category for the weeks worked in our calculation of hourly wages.

Next, we randomly add a dollar amount between $-0.25 and $0.25 to each individual's estimated hourly wage, which smoothes out some of the bunching in the wage estimates and creates a more realistic wage distribution curve.

Finally, we use the same method used by the Economic Policy Institute in their annual State of Working America reports to trim outliers (Economic Policy Institute 2019). This approach involves dropping observations with an estimated hourly wage of less than $0.50 or more than $100 in 1989 dollars.

Adjusting wages using National Compensation Survey data

We are not able to identify residential decarbonization workers specifically in the ACS dataset due to limitations on the granularity of the industry and occupation variables. Instead, we include all Bay Area workers in the construction industry in trades that do residential decarbonization work. Therefore, our estimates of wages include other kinds of construction workers who likely earn more on average than residential decarbonization workers. For example, residential construction workers earn less than commercial construction workers, but our sample includes both types of workers. Because of this, estimating wages using ACS data alone would likely overestimate the current wages of residential decarbonization workers, causing us to underestimate the cost of lifting all workers to the two wage standards modeled in our study.

To account for these issues, we adjust our ACS data using unpublished data from the 2019 National Compensation Survey provided by Scott Littlehale at the California Center for Construction Economics. This data allows us to calculate the ratio of residential construction wages to all construction wages nationally (84 percent). We apply this ratio to estimated wages for each of the individual workers in our microsimulation model to adjust for the difference between average residential and all construction wages.

The residential decarbonization industry is a subset of the residential construction industry and wages may differ from those across all residential construction. The best available data that we were able to identify on the wages of residential decarbonization workers in the Bay Area specifically is a survey of contractors by BayREN. The BayREN survey data has a number of limitations as a measure of average wages for workers in the industry. It only includes a small number of contractors (38) that meet all requirements of becoming BayREN-affiliated contractors, including providing certification training for staff and meeting minimum insurance coverage requirements. Therefore, these contractors may not be representative of all residential decarbonization firms, potentially paying their workers more on average. In addition, this dataset only includes the range of wages each contractor pays their workers and does not include data about either the number of employees at each firm or the distribution of wages within each firm. For these reasons, we do not use data from the BayREN survey to adjust the data in our ACS microsimulation model. However, the ratio of the average of the lowest and highest wages paid by firms in the BayREN dataset to the median wage of construction workers in our ACS dataset (85 percent) is almost the same as the ratio of residential construction wages to all construction wages in the 2019 National Compensation Survey (84 percent) that we use to adjust wages in our microsimulation model.

Recoding low estimated hourly wages

Finally, we recode worker earnings to the California state minimum wage ($15.50) if their ACS estimated hourly wage is less than the California state minimum wage. Low estimates for hourly wages using ACS data often are the result of the imprecision of the constructed hourly wage variable, which relies on dividing annual earnings by usual weeks worked per week and the midpoint of a categorical variable of the number of weeks worked per year, and are unlikely to reflect the true proportion of workers earning less than minimum wage.

Simulation wage estimates

For our simulation scenarios, we model individual worker wages based on their baseline wage and the simulation scenario wage floor. We assume all workers who earn less than the prevailing wage in the baseline would earn the prevailing wage rate in the prevailing wage simulation. In the minimum-wage-based labor standard simulation, we assume that all workers who in the baseline earned less than 180 or 250 percent of the state minimum wage now earn 180 or 250 percent of the state minimum wage, depending on their trade.

We also assume that workers who in the baseline earn just at or above the simulation scenario wage floor will also receive an increase in their wages as employers avoid wage compression among their employees. Wage compression exists when workers with little experience, training, and/or education earn nearly the same as workers with more experience, training, or education. We follow the same method used by CWED and the UC Berkeley Labor Center to estimate these "spillover effects," assuming that the wage increase for these indirectly affected workers would be equal to 0.25 times the difference between the worker's estimated baseline wage and 115 percent of the simulated wage floor for their occupation/trade (Perry, Thomason, and Bernhardt 2016). This method is based on a study of state and federal minimum wage increases between 1983 and 2002 that found a modal ripple effect of 115 percent of newly implemented minimum wage levels (Wicks-Lim 2006).

Table A1 describes the wage floor levels we model in our prevailing wage simulation and the specific prevailing wage rates that they are based on. California prevailing wage levels differ by trade, experience and training levels, geography, and whether or not the project is commercial or residential. We assign the prevailing wage rate that most closely fits each occupation category in our dataset. We assign residential prevailing wage levels where they exist and otherwise assign commercial prevailing wage levels. Where county-level prevailing wage levels exist, we take the average prevailing wage level across Bay Area counties; otherwise, we assign the regional or state prevailing wage rates.

Some construction workers in our sample are in an occupation category called "frontline supervisor" that we are not able to identify as a specific trade. To account for the likely higher earnings of these workers, we assume their prevailing wage rate is equal to ten percent more

than the average prevailing wage rates for all of the other residential decarbonization occupation categories we identify.

Table A1: Prevailing wage standard assumptions by trade

Census Occupation Code	Census Occupation Description	Prevailing wage categories used to assign wage floor and benefits contribution rates	Wage floor	Health insurance hourly contribution rate	Retirement plan/pension hourly contribution rate
6355	Electricians	Average rates for "Residential Electrician: Inside Wireman" in Alameda, Marin, Napa, San Francisco, and Santa Clara counties and "Electrician inside wireman technician" for Contra Costa and San Mateo counties.	$52.85	$15.53	$10.18
6442	Plumbers, Pipefitters, and Steamfitters	Average rates for "Residential Plumber" in Alameda, Contra Costa, Napa, Santa Clara, and Solano counties; "Plumber, Steamfitter, Refrigeration Fitter (HVAC)" for San Francisco county; and "Plumber steamfitter" for San Mateo and Sonoma counties.	$57.50	$14.29	$13.02
7315	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	California Residential A/C Specialist	$32.09	$14.42	$4.93
6660	Construction and Building Inspectors	California Building/Construction Inspector and Field Soils and Material Tester Group 4	$40.84	$13.38	$11.57
1530	Engineers, all other	Northern California Area 1 Laborers Group 6 (E)	$34.85	$9.60	$13.86
6400	Insulation Workers	Average rates for "Residential Carpenter" in Alameda, Contra Costa, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.	$34.85	$9.60	$13.86
6600	Helpers, Construction Trades	Northern California Area 1 Laborers Group 6 (E)	$34.85	$9.60	$13.86
6765	Miscellaneous Construction and Related Workers	Northern California Area 1 Laborers Group 6 (E)	$34.85	$9.60	$13.86
7610	Helpers--Installation, Maintenance, and Repair Workers	Northern California Area 1 Laborers Group 6 (E)	$34.85	$9.60	$13.86

6200	First-Line Supervisors of Construction Trades and Extraction Workers	10 percent higher than the average rates of the above occupations	$43.70	$12.91	$13.32

Source: Authors' analysis of California Department of Industrial Relations Prevailing Wage Determinations as of May 2023 (2023b)

Table A2 describes the wage floor levels we model in our minimum-wage-based simulation. Here, we assume a wage floor of either 180 percent ($27.90) or 250 percent ($38.75) of the California state minimum wage based on a classification of trades as either "basic" or "specialized."

Table A2: Minimum-wage-based standard wage floor assumptions by trade

Census Occupation Code	Census Occupation Description	Basic or Specialized	Wage floor
1530	Engineers, all other	Specialized	$38.75
6200	First-Line Supervisors of Construction Trades and Extraction Workers	Specialized	$38.75
6355	Electricians	Specialized	$38.75
6442	Plumbers, Pipefitters, and Steamfitters	Specialized	$38.75
6660	Construction and Building Inspectors	Specialized	$38.75
7315	Heating, Air Conditioning, and Refrigeration Mechanics and Installers	Specialized	$38.75
6400	Insulation Workers	Basic	$27.90
6600	Helpers, Construction Trades	Basic	$27.90
6765	Miscellaneous Construction and Related Workers	Basic	$27.90
7610	Helpers--Installation, Maintenance, and Repair Workers	Basic	$27.90

Note: Simulated wage floors are based on either 180 or 250 percent of the California state minimum wage, 2023

Size of residential decarbonization workforce

We use two different methods to estimate the current size of the residential decarbonization workforce, producing lower and upper-bound range estimates. Both of our estimates are based on data from the Department of Energy's USEER reports (US Department of Energy 2023), Quarterly Census of Wages and Employment (QCEW), the Inclusive Economics analysis of residential decarbonization work in the Bay Area (Inclusive Economics 2020), IPUMS American Community Survey, and our interviews with contractors.

Our methods, described below, estimate the number of frontline construction workers engaged in Bay Area residential decarbonization projects for single-family and small multi-family homes for at least a proportion of their work hours. We also describe our methods for converting these total worker count estimates to full-time equivalent job estimates.

Lower bound worker count estimate

For the lower bound estimate, we start with estimates from the DOE USEER report of the number of energy-efficiency construction workers in California. Due to sample size limitations, state-level USEER estimates of the number of energy efficiency workers include all kinds of energy efficiency work, including the installation of appliances that are considered energy efficient but use nonrenewable energy sources such as natural gas. The national USEER report estimates that 54 percent of energy efficiency jobs include at least some proportion of work hours on "net zero" projects that do not involve the installation of fossil fuel burning equipment. We therefore apply this 54 percent national estimate to the USEER California estimate to arrive at an estimate of the number of workers involved in residential decarbonization projects specifically, excluding workers who are counted as "energy efficiency" workers in the USEER data because they install energy-efficient gas appliances, but that do not spend work hours on "net zero" projects.

We then divide that number by the number of total construction workers in the state of California using QCEW data. This gives us an estimate of the proportion of all construction workers in California who work on residential decarbonization projects. We then apply this proportion to an estimate from QCEW of the total number of residential construction workers in Bay Area counties. Next, we apply an estimate from the Inclusive Economics Bay Area analysis of the proportion of residential decarbonization work hours used for single-family and small multi-family homes (86.0 percent). We use IPUMS American Community Survey data to estimate the proportion of Bay Area construction workers who are frontline workers, excluding managerial workers, and apply this percentage to our estimate (85.7 percent).

Upper bound worker count estimate

For the upper bound estimate, we start with estimates from the DOE USEER report of the number of energy efficiency workers in Bay Area counties. As with our lower bound estimate described above, we adjust this estimate using an estimate from the USEER national report of the proportion of energy efficiency workers that work on "net zero" projects (54 percent) to arrive at an estimate of the number of workers involved in residential decarbonization projects specifically.

The USEER estimate of the number of energy-efficiency workers in the Bay Area includes all industries. We use state-level USEER data to estimate the proportion of all energy efficiency workers in California who are in the construction industry (52.2 percent) and apply this proportion to the USEER estimates of the number of energy efficiency workers in all industries in the Bay Area to arrive at an estimate of the number of energy efficiency workers in the Bay Area who are in the construction industry.

We adjust our estimates to exclude commercial construction workers by applying an estimate of the proportion of Bay Area construction workers that work in residential construction using QCEW data (45.8 percent). Next, we apply an estimate from the Inclusive Economics Bay Area analysis of the proportion of residential decarbonization work hours used for single-family and small multi-family homes (86.0 percent). We use IPUMS American Community Survey data to estimate the proportion of Bay Area construction workers who are frontline workers, excluding managerial workers, and apply this percentage to our estimate (85.7 percent).

Estimate of full-time equivalent jobs

Many residential decarbonization workers are employed at firms that carry out residential decarbonization projects and the installation of HVAC and other appliances that use nonrenewable energy sources. Therefore, our estimates of the total number of workers include workers for whom energy efficiency work only makes up a portion of their work hours. In our interviews with contractors, we asked about the proportion of their work hours used for residential decarbonization work. On average, about half of the firms' work hours are used for residential decarbonization work. We apply this proportion to our estimates of the total number of workers to arrive at an estimate of the number of full-time equivalent jobs.

Health benefit estimates

Table A3 describes our assignment of employer health insurance costs for workers in our microsimulation, based on whether or not they have health insurance in our baseline scenario and whether or not they are single or have a family. The ACS data we use in our microsimulation model includes data on whether or not individuals have health insurance and whether or not their health insurance plan is employer-sponsored. We assume that if a worker is covered by an employer-sponsored health insurance plan, the plan is sponsored by their employer. However, some of these workers may instead be enrolled in a plan sponsored by their spouse's employer. This may cause us to slightly overestimate health insurance costs to employers in the baseline.

For the baseline scenario, we assume that the amount that employers contribute towards each worker's health insurance premiums is equal to estimates of the average annual contribution of California employers in the agriculture/mining/construction industries from the Kaiser Family Foundation Employer Health Benefits Survey (Claxton, Rae, and Damico 2023). We assume employers pay $5,674 annually (79 percent of the premium cost) for workers with individual plans and $13,249 annually (66 percent of the premium cost) for workers with family plans. We assume that individuals in our microsimulation have family coverage if they live with a spouse or family member. Otherwise, we assume that they have an individual plan. For workers in our sample who do not have employer-sponsored insurance, we assume that the employer costs for their health benefits are zero.

Prevailing wage regulations stipulate an amount that employers must contribute to health insurance coverage per hour worked. For the prevailing wage simulation, we assume that

employers contribute this rate for every worker. Table A1 shows how we assign health benefit contribution levels by occupation/trade.

For the minimum-wage-based labor standard simulation, we assume that all workers will have employer-sponsored health insurance coverage. We assume that the per-worker employer costs for health insurance coverage would be the same as the per-worker employer costs in the baseline scenario for workers with employer-sponsored health insurance.

Table A3: Assumptions of annual health insurance premium costs for employers in baseline and simulation scenarios

Category of worker based on baseline characteristics	Baseline	Prevailing wage simulation	Minimum-wage-based labor standard simulation
Has employer-sponsored health insurance and has a spouse/family	$13,249*	Prevailing wage health insurance contribution hourly rate multiplied by annual hours worked	$13,249*
Has employer-sponsored health insurance and is single	$5,674*	Prevailing wage health insurance contribution hourly rate multiplied by annual hours worked	$5,674*
Does not have employer-sponsored health insurance and has a spouse/family	$0	Prevailing wage health insurance contribution hourly rate multiplied by annual hours worked	$13,249*
Does not have employer-sponsored health insurance and is single	$0	Prevailing wage health insurance contribution hourly rate multiplied by annual hours worked	$5,674*

** Estimates of the average annual amount contributed by California employers in the agriculture/mining/construction industries to health insurance premiums for employees with individual and family coverage from Claxton (Claxton, Rae, and Damico 2023).*

Our model may overestimate health care costs in our minimum-wage-based labor standard simulation for two reasons. First, in the simulation scenario, we assume all workers would be enrolled in an employer-sponsored health insurance plan. In reality, some workers currently not enrolled in an employer-sponsored health insurance plan may have access to such a plan but choose not to enroll. Particularly if the plan offered by an employer requires that workers pay most or all of the premium cost, workers may decide that the plan is too expensive or may be able to get better or more affordable coverage elsewhere, such as through Medicaid. If this is the case, some workers still might choose not to enroll in the health insurance plan offered by their employer even if a new labor standard is adopted unless the labor standard specifies the type of coverage that employers must offer and the proportion of premium costs they must cover. ACS data allows us to see the proportion of workers enrolled in employer-sponsored health insurance plans but does not allow us to see the proportion of workers offered an employer-sponsored health insurance plan.

Second, we assume that employers who in the baseline do not provide health insurance coverage would in the simulation scenario provide the same level of coverage as other employers on average. However, if a labor standard was adopted that required employers to provide health insurance plans, employers who previously did not offer plans might choose the lowest cost plan available. In that case, our estimates of the increased health insurance costs for employers in the minimum-wage-based labor standard scenario would be an overestimate. Table A4 compares the average annual premium cost estimates we use in our model to the average annual premium costs for Covered California plans at different levels of coverage. The estimates of average annual costs that we use in our model are higher than the average annual costs for all levels of Covered California health insurance plans (Covered California 2023).

Table A4: Comparison of average premium cost estimates for workers in the construction industry and for Covered California plans

	Average annual cost	85 percent of the average annual cost	75 percent of the average annual cost
Employer-sponsored plans for California workers in the agriculture/mining/ construction industries	$13,552	$11,519	$10,164
Covered California Bronze Plan	$7,464	$6,344	$5,598
Covered California Silver Plan	$8,808	$7,487	$6,606
Covered California Gold Plan	$10,620	$9,027	$7,965
Covered California Platinum Plan	$10,740	$9,129	$8,055

Source: Authors' analysis of 2022 Kaiser Family Foundation Employer Health Benefits Survey data and 2023 Covered California Open Enrollment Data

Retirement benefit estimates

The ACS data we use in our microsimulation model does not include information about whether or not a worker has an employer-sponsored retirement or pension plan or how much their employer contributes to such a plan. We instead use data from the Current Population Survey to estimate the proportion of California workers in the construction industry that have access to a retirement plan through their employer (29 percent) and the proportion that are enrolled in a retirement plan sponsored by their employer (24 percent). For workers in the baseline that we assume are enrolled in an employer-sponsored plan, we assume that employers contribute 9.5 percent of each worker's annual earnings to their retirement plan. This estimate is based on our analysis of Bureau of Labor Statistics Employer Costs for Employee Compensation June 2023 data, which shows that, within the construction industry, employers contribute 9.5 percent of earnings (wages plus supplemental pay) to each worker on average (this average is across all

workers, including those that do not receive any contributions to a retirement or pension plan from their employer).

In our prevailing wage simulation, we assume that all workers receive prevailing wage level retirement/pension plan contributions from their employer (Bureau of Labor Statistics 2023). In our minimum-wage-based labor standard simulation, we assume that the rate of enrollment in the retirement plan would be the same as the rate of enrollment among California construction workers with access to an employer-sponsored retirement plan (83 percent) and that employer contributions would be equal to 3 percent of worker earnings.

Prevailing wage regulations stipulate an amount that employers must contribute to retirement or pension plans per hour worked. We use the crosswalk from Table A1 to assign retirement/pension plan contribution levels by occupation/trade.

Table A5: Assumptions of annual retirement/pension plan employer cost

	Average annual cost assumptions
Baseline	9.5 percent of annual earnings*
Prevailing wage and benefits simulation	Prevailing wage hourly retirement contribution rate multiplied by annual hours worked
Minimum-wage-based labor standard simulation	3 percent of annual earnings; 83 percent enrollment rate**

** Estimate of the average employer contribution to worker retirement/pension accounts in the construction industry as a percentage of wages, authors' analysis of Employer Costs for Employee Compensation June 2023 data (Bureau of Labor Statistics 2023).*
*** Take-up rate calculated using 2019-2023 IPUMS Current Population Survey data*

Employer operating cost impact estimates

Total labor cost estimates

For the purposes of our model, we define total labor costs as the sum of annual wage, health insurance, retirement, paid leave, payroll tax, workers' compensation insurance, and training/other costs across all workers in our microsimulation. In the sections above, we describe how we estimate wage costs, health insurance benefits, and retirement benefits in our simulations.

We use the same payroll tax assumptions as the CWED/UCB Labor Center minimum wage studies - 6.2 percent for Social Security and 1.45 percent for Medicare for both our baseline and simulation scenarios (Reich et al. 2016).

We use an estimate from the Workers' Compensation Insurance Rating Bureau of California (WCIRB of California) that construction firms on average spend $7.90 on workers' compensation

insurance premiums per $100 in payroll for both our baseline and simulation scenarios (2014). This is the most recent estimate we are able to get for this datapoint specific to the construction industry. However, more recent reports produced by the WCIRB of California show that workers' compensation insurance premiums as a proportion of total payroll have decreased since 2014. Our estimates may, therefore, overestimate the cost of workers' compensation insurance and the overall impact on consumer prices.

We apply an estimate of the average construction industry employer costs for paid leave as a percentage of worker wages from Employer Costs for Employee Compensation June 2023 data (18.6 percent) for both our baseline and simulation scenarios (Bureau of Labor Statistics 2023). The prevailing wage regulations for some, but not all, trades specify that employers of those workers must contribute a certain dollar amount per hour worked towards paid leave. However, we did not apply these rates for paid leave in our simulation because the contribution levels were lower than what the ECEC data shows that construction industry firms are already contributing towards paid leave compensation on average.

Prevailing wage regulations for some trades require contributions to training and "other costs." We assume that these costs are zero in the baseline scenario. For the prevailing wage simulation, we use the same crosswalk from Table A1 to determine employer costs for training and other costs by occupation/trade.

To estimate the difference in total labor costs between our baseline and simulation scenarios, we first take a weighted sum of the labor costs for each individual worker in our microsimulation in the baseline and simulation scenarios separately. We do this by multiplying the total of all labor costs for each individual worker in our sample by our weight variable, which is equal to the ACS individual person weight (which represents how many workers in the population each observation represents) multiplied by the weight we construct to reweight observations to match the distribution of workers across trades from the Inclusive Economics Bay Area report (Inclusive Economics 2020). We then sum this weighted labor cost across all workers in the baseline and the simulation scenario separately. Finally, we calculate the percent difference between the aggregate labor costs in the baseline and simulation scenarios.

Labor share of operating cost estimates

Labor costs comprise just a portion of the operating costs for residential decarbonization work firms. In our interviews with contractors, we asked about the proportion of their total operating costs that go to labor costs. On average, these firms said that 35 percent of their operating costs go to labor expenses. We use this as our estimate of the labor share of operating costs. We only interviewed a small number of contractors (12), and the wage ranges reported by the contractors we interviewed suggest that they may be on the higher end of the wage distribution within the residential decarbonization industry (they reported wage ranges similar to prevailing wage levels while experts knowledgeable about the industry believe wages are substantially lower). If these firms spend more than average on worker compensation, then our estimate of the labor share of

operating cost based on their responses would likely cause us to overestimate the impact of each modeled labor standard on employer operating costs. However, our interviews with contractors provide the only known source of information on the labor share of operating costs for residential decarbonization firms in the Bay Area specifically. This estimate is also in the range of other estimates of the labor share of operating costs:

- 35 percent for residential construction in California (Lantsberg and Littlehale 2016)
- 46 percent for residential remodeling nationally (Walker, Less, and Casquero-Modrego 2023)
- 23 percent for home performance and general contractors doing deep energy retrofits nationally (Chan, Less, and Walker 2021)

Estimates of pass-through of increased operating costs to consumer prices

In our analysis of the impact of a labor standard on consumer prices, we assume that between 80 and 100 percent of the increase in operating costs for employers will be passed on to consumers in the form of higher prices for residential decarbonization projects. We use this range of estimates in our analysis based on evidence in the existing literature on this topic, some of which suggests that costs are fully passed on to consumers and some of which suggests that most, but not all, of the costs are passed on to consumers, particularly in industries where there is more competition between a larger number of firms.

Studies of the proportion of costs associated with minimum wage increases that are passed on to consumers in the form of higher prices have found that costs are completely passed on to consumers in the grocery store industry (Renkin, Montialoux, and Siegenthaler 2020; Leung 2021) and mostly passed on to consumers in the restaurant industry (Aaronson 2001; Aaronson, French, and MacDonald 2008). However, these industries differ substantially from residential decarbonization and the studies do not consider worker productivity or retention gains. Duncan and Lantsberg (2015) find that, on average, construction profits are just slightly lower in states with prevailing wage laws, suggesting that firms absorb at least some of the additional costs associated with a prevailing wage standard and that cost increases are not fully passed through to consumers. Several studies of the California solar industry find that the pass-through rate for public incentives to consumer prices is between about 60 and 100 percent (Gillingham and Tsvetanov 2019; Chen 2018; C. Dong, Wiser, and Rai 2018; Y. Li 2018; Pless and van Benthem 2019).

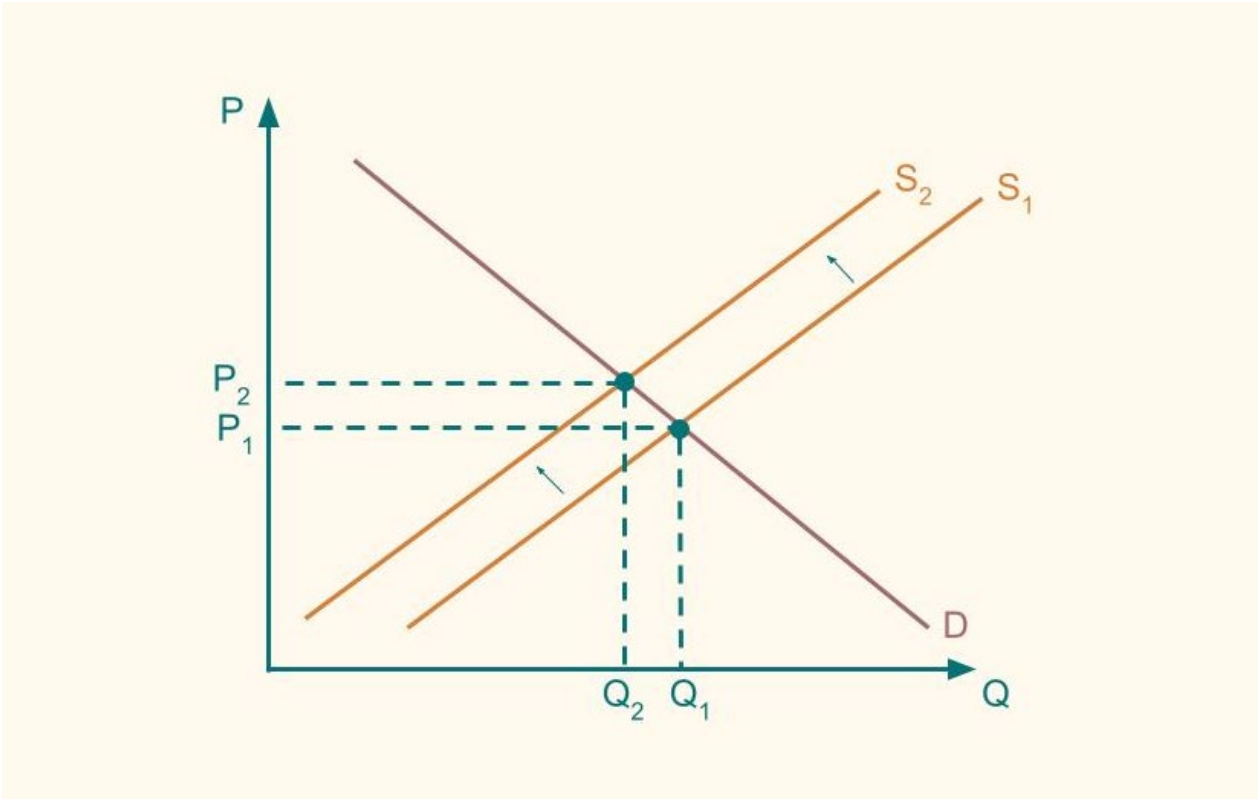
Anecdotal evidence suggests that there is not a great deal of competition in the residential decarbonization industry among firms that are registered with local agencies to do residential decarbonization work funded in part through incentive programs, allowing firms more room to set prices and pass on increased costs to consumers. However, there may be more competition among contractors that do residential decarbonization projects but are not registered with specific incentive programs. Given that competition and ability to pass costs onto consumers may differ across the industry, and based on the findings from the research summarized above,

we assume a pass-through of between 80 and 100 percent of increased operating costs to consumers.

Potential interaction effects of increased public investment and adoption of an industry labor standard

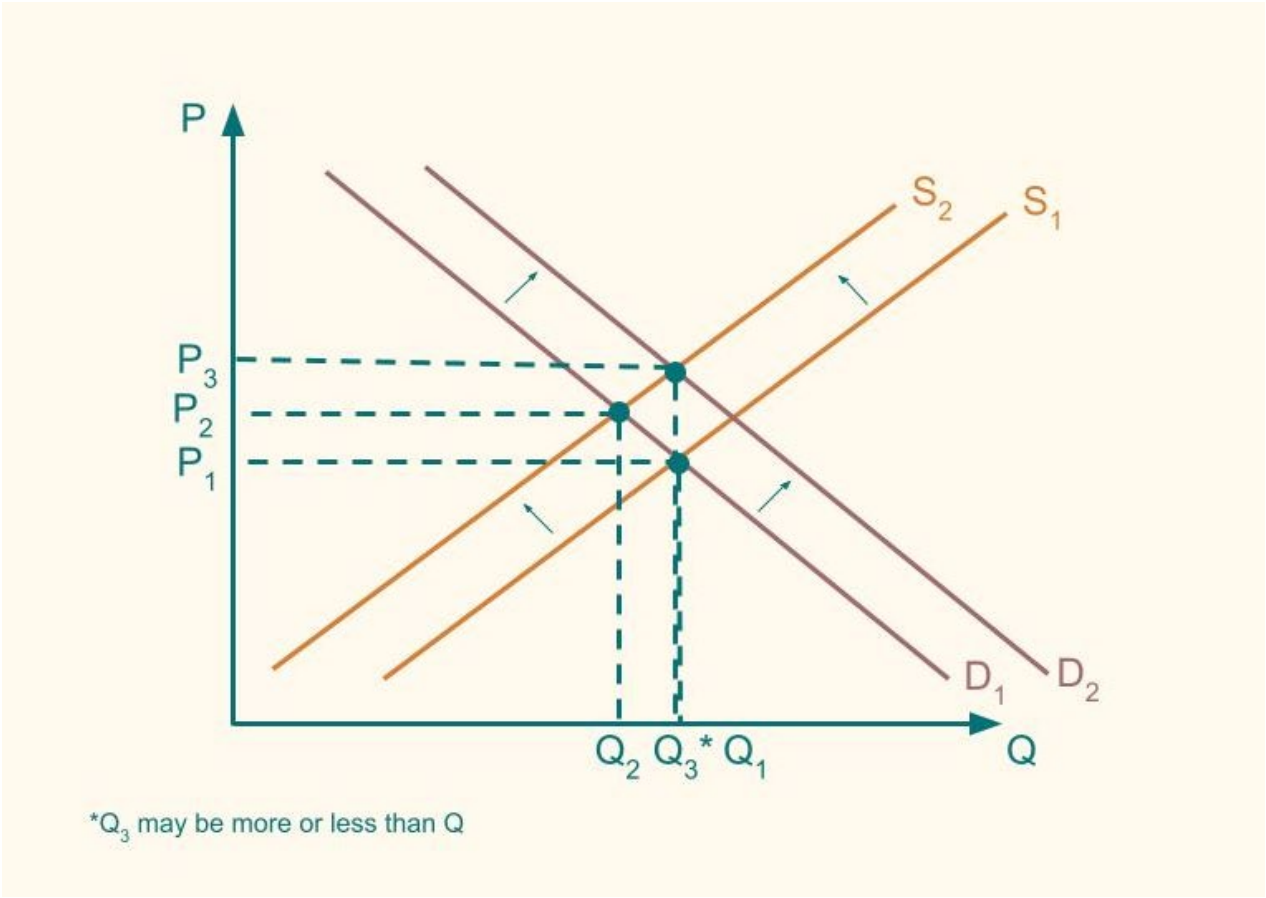
Imposing a labor standard would impact supply. If labor costs increase, it becomes more expensive for firms to produce goods and services. As a result, they may produce fewer goods at every potential price level. This implies an overall decrease in supply, as the number of projects that firms are willing to complete decreases for every potential price point, causing a leftward supply curve shift. This results in a decrease in the quantity of projects supplied and an increase in the market equilibrium price (see Figure A1). The extent to which supply decreases largely depends on the price elasticity of supply and the relative impact on production costs of imposing a labor standard. Our finding that a labor standard would only increase consumer prices by between three and nine percent suggests that the shift in the supply curve would be relatively small.

Figure A1: Residential decarbonization supply and demand curve shifts if a labor standard is adopted



As public investment increases, consumer demand for residential decarbonization projects will increase. Many existing programs offer incentives directly to the customer, effectively decreasing the cost of decarbonization projects. In a classic supply and demand model, we expect overall demand to increase at every price point, shifting the demand curve to the right and increasing the quantity of completed projects. However, the extent to which quantity increases depends on the price elasticity of demand, with higher price elasticity resulting in a larger increase. Previous research on both the solar and residential decarbonization industry suggests that demand for residential decarbonization projects may be relatively elastic, with public investment largely driving consumer demand levels (C. G. Dong, Wiser, and Rai 2014; Opinion Dynamics 2022). Therefore, we expect that increased public investment will lead to an increase in market equilibrium price, regardless of whether a labor standard is adopted. Despite the price increase, the increase in the number of completed projects resulting from increased public investment will likely offset the decrease in the number of projects completed due to the adoption of a labor standard.

Figure A2: Residential decarbonization supply and demand curve shifts if a labor standard is adopted and public investment increases consumer demand



Interviews with residential decarbonization contractors

To gain additional insights for this report, we conducted a series of structured interviews with residential construction contractors to understand and solicit needs, experiences, insights, and feedback from contractors involved in residential decarbonization. The following sections summarize the interview approach, characteristics of participating contractors, and our interview questions.

The intended interviewees were Bay Area contractors focused on energy efficiency and electrification in the residential construction sector. The project team conducted a mapping exercise to identify stakeholders related to building electrification in the residential market by auditing online contractor directories, including Go Green Financing, Bay Area Regional Energy Network (BayREN), California Department of General Services Statewide Supplier Diversity program, Clean Energy Connection, and TECH Clean California. Since the directories entailed hundreds of verified contractors, we selected 20-40 Bay Area contractors to contact.

We interviewed twelve (12) contractors performing varying types of work: Home Energy Auditing, HVAC, Plumbing, Design & Build, Electrical, and Home Performance. Of those interviewed, three (3) were minority-owned contractors, eleven (11) non-union contractors, and one (1) union contractor. Despite our outreach attempts, we were unable to interview an even number of union and non-union contractors. This may be due to the fact that most residential decarbonization firms are non-union.

An interview guide was designed to pose questions about contractors' scope of work, perspectives on the future demand of residential decarbonization projects, employment practices to recruit and retain workers, and challenges related to the emerging residential decarbonization sector. The interviews were conducted remotely through Zoom and on average lasted one hour.

Bibliography

Aaronson, Daniel. 2001. "Price Pass-Through and the Minimum Wage." *The Review of Economics and Statistics* 83 (1): 158–69. https://doi.org/10.1162/003465301750160126.

Aaronson, Daniel, Eric French, and James MacDonald. 2008. "The Minimum Wage, Restaurant Prices, and Labor Market Structure." *The Journal of Human Resources* 43 (3): 688–720.

Appel, Sam, and Jessie HF Hammerling. 2023. "California's Climate Investments and High Road Workforce Standards: Gaps and Opportunities for Advancing Workforce Equity." UC Berkeley Labor Center. https://laborcenter.berkeley.edu/californias-climate-investments-and-high-road-workforce-standards/.

Avila, Cecille Joan, and Austin B. Frakt. 2021. "Raising the Minimum Wage and Public Health." *JAMA Health Forum* 2 (1): e201587. https://doi.org/10.1001/jamahealthforum.2020.1587.

Bilginsoy, Cihan. 2003. "Wage Regulation and Training: The Impact of State Prevailing Wage Laws on Apprenticeship," Working Paper Series, Department of Economics, University of Utah, . https://ideas.repec.org//p/uta/papers/2003_08.html.

Blandling, I, R Bartlett, M Halverson, Y Xie, and J Williams. 2022. "Residential Energy Code Field Studies: Assessing Implementation in Seven States." PNNL-31216. US Department of Energy, Pacific NW National Laboratory. https://www.energycodes.gov/sites/default/files/2022-11/Combined_Residential_Energy_Code_Field_Study_Report_Final%20v3.pdf.

Bureau of Labor Statistics. 2023. "Employer Costs for Employee Compensation - June 2023." News Release. https://www.bls.gov/news.release/pdf/ecec.pdf.

California Air Resources Board. 2022. "2022 Scoping Plan for Achieving Carbon Neutrality - Executive Summary." https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf.

———. 2023. "Current California GHG Emission Inventory Data." 2023. https://ww2.arb.ca.gov/ghg-inventory-data.

California Department of Industrial Relations. 2023a. "California Consumer Price Index." December 2023. https://www.dir.ca.gov/oprl/CAPriceIndex.htm.

———. 2023b. "Current Residential Prevailing Wage Determinations." 2023. https://www.dir.ca.gov/oprl/residential/reslist.html.

California Division of Apprenticeship Standards. 2024. "Registration Dashboard." May 29, 2024. https://public.tableau.com/app/profile/california.apprenticeship/viz/RegistrationDashboard_16301055851260/RegistrationDashboard.

California Energy Commission. 2021. "2021 Integrated Energy Policy Report." California Energy Commission. https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report.

Center for California Construction Economics. "California Construction Employment Dashboard." April 2024. https://public.tableau.com/app/profile/scott.littlehale1839/vizzes.

Chan, Wanyu R., Brennan Less, and Iain Walker. 2021. "DOE Deep Energy Retrofit Cost Survey." Lawrence Berkeley National Laboratory. https://buildings.lbl.gov/publications/doe-deep-energy-retrofit-cost-survey.

Chen, Jin. 2018. "An Unintended Effect of Subsidizing Green Technology: Lessons Learned from California." Stanford University. https://stanford.edu/~jinc/Jin_JMP.pdf.

Claxton, Gary, Matthew Rae, and Anthony Damico. 2023. "California Employer Health Benefits: Cost Burden on Workers Varies — 2023 Edition." California Health Care Foundation. https://www.chcf.org/publication/2023-edition-california-employer-health-benefits/.

Covered California. 2023. "2023 Covered California Open Enrollment Gross Plan Selection Profile." https://hbex.coveredca.com/data-research/.

Dickson Quesada, Alison, Frank Manzo IV, Dale Belman, and Robert Bruno. 2013. "A Weakened State: The Economic and Social Impacts of Repeal of the Prevailing Wage Law in Illinois." School of Labor and Employment Relations, Labor Education Program, University of Illinois at Urbana-Champaign. https://lep.illinois.edu/publications/a-weakened-state-the-economic-and-social-impacts-of-repeal-of-the-prevailing-wage-law-in-illinois-full-report/.
Dong, C. G., Ryan Wiser, and Varun Rai. 2014. "Incentive Pass-through for Residential Solar Systems in California," October. https://escholarship.org/uc/item/4w54b6b2.
Dong, Changgui, Ryan Wiser, and Varun Rai. 2018. "Incentive Pass-through for Residential Solar Systems in California." *Energy Economics* 72 (May):154–65. https://doi.org/10.1016/j.eneco.2018.04.014.
Dube, Arindrajit, Eric Freeman, and Michael Reich. 2010. "Employee Replacement Costs." Working Paper 201–10. IRLE, UC Berkeley. http://www.irle.berkeley.edu/workingpapers/201-10.pdf.
Dube, Arindrajit, T. William Lester, and Michael Reich. 2010. "Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties." *The Review of Economics and Statistics* 92 (4): 945–64. https://doi.org/10.1162/REST_a_00039.
Duncan, Kevin, Adam Case, and Frank Manzo IV. 2024. "Prevailing Wages, School Construction Costs, and Bids by out-of-State Contractors: Evidence from the Minneapolis–Saint Paul Metropolitan Area." *Construction Management and Economics*, 1–19. https://doi.org/10.1080/01446193.2024.2314079.
Duncan, Kevin, and Alex Lantsberg. 2015. "Building the Golden State: The Economic Impacts of California's Prevailing Wage Policy." Smart Cities Prevail. http://www.faircontracting.org/wp-content/uploads/2018/06/SCP-Building-the-Golden-State-WEB.pdf.
Duncan, Kevin, Peter Philips, and Mark Prus. 2009. "The Effects of Prevailing Wage Regulations on Construction Efficiency in British Columbia." *International Journal of Construction Education and Research* 5 (2): 63–78. https://doi.org/10.1080/15578770902952280.
Dunn, Sarah, John M. Quigley, and Larry A. Rosenthal. 2005. "The Effects of Prevailing Wage on the Cost of Low-Income Housing." *Industrial and Labor Relations Review* 59 (1). https://urbanpolicy.berkeley.edu/pdf/dqr_ilrr_proof072905.pdf.
Economic Policy Institute. 2019. "Methodology for Measuring Wages and Benefits." https://www.epi.org/data/methodology/.
Gallagher, Claire McAnaw. 2022. "The Construction Industry: Characteristics of the Employed, 2003–20." Bureau of Labor Statistics. April 2022. https://www.bls.gov/spotlight/2022/the-construction-industry-labor-force-2003-to-2020/home.htm.
Gillingham, Kenneth, and Tsvetan Tsvetanov. 2019. "Hurdles and Steps: Estimating Demand for Solar Photovoltaics." *Quantitative Economics* 10 (1): 275–310. https://doi.org/10.3982/QE919.
Haelbig, Mirja, Matthias Mertens, and Steffen Müller. 2023. "Minimum Wages, Productivity, and Reallocation." SSRN Scholarly Paper. Rochester, NY. https://doi.org/10.2139/ssrn.4457826.
Inclusive Economics. 2020. "San Francisco Bay Area Residential Building Decarbonization Jobs Estimates." https://drive.google.com/drive/folders/1zivVSr1lzTT7qt4r-m2JbJTFOAj7nojt.
Jacobs, Ken, and Kuochih Huang. 2021. "The Public Cost of Low-Wage Jobs in California's Construction Industry." UC Berkeley Labor Center. https://laborcenter.berkeley.edu/the-public-cost-of-low-wage-jobs-in-californias-construction-industry/.
Jones, Betony. 2020. "Prevailing Wage in Solar Can Deliver Good Jobs While Keeping Growth on Track." UC Berkeley Labor Center. https://laborcenter.berkeley.edu/prevailing-wage-in-

solar-can-deliver-good-jobs-while-keeping-growth-on-track/.

Kelsey, Michael, and Frank Manzo IV. 2019. "The Impact of Repealing West Virginia's Prevailing Wage Law: Economic Effects on the Construction Industry and Fiscal Effects on School Construction Costs." Midwest Economic Policy Institute. https://illinoisepi.files.wordpress.com/2019/05/umkc-mepi-impact-of-repealing-wvs-prevailing-wage-law-final.pdf.

Ku, Hyejin. 2022. "Does Minimum Wage Increase Labor Productivity? Evidence from Piece Rate Workers." *Journal of Labor Economics* 40 (2): 325–59. https://doi.org/10.1086/716347.

Lantsberg, Alex, and Scott Littlehale. 2016. "California's Housing Crisis, Construction Labor, & the Costs of Multi-Family Housing." *California Forward* (blog). November 9, 2016. https://cafwd.org/news/californias-housing-crisis-construction-labor-the-costs-of-multi-family-hou/.

Leigh, J. Paul, and Juan Du. 2018. "Effects Of Minimum Wages On Population Health." Health Policy Brief. Health Affairs. https://www.healthaffairs.org/do/10.1377/hpb20180622.107025/full/.

Leung, Justin H. 2021. "Minimum Wage and Real Wage Inequality: Evidence from Pass-Through to Retail Prices." *The Review of Economics and Statistics* 103 (4): 754–69. https://doi.org/10.1162/rest_a_00915.

Li, Yumin. 2018. "Incentive Pass-through in the California Solar Initiative – An Analysis Based on Third-Party Contracts." *Energy Policy* 121 (October):534–41. https://doi.org/10.1016/j.enpol.2018.07.015.

Li, Zhi, Chimedlkham Zorigtbaatar, Gabriel Pleites, Ari Fenn, and Peter Phillips. 2019. "The Effect of Prevailing Wage Law Repeals and Enactments on Injuries and Disabilities in the Construction Industry." *Public Works Management & Policy* 24 (4). https://doi.org/10.1177/1087724X18822600.

Littlehale, Scott. 2019. "Rebuilding California:The Golden State's Housing Workforce Reckoning." Smart Cities Prevail. https://www.smartcitiesprevail.org/wp-content/uploads/2019/01/SCP_HousingReport.0118_2.pdf.

Mahalia, Nooshin. 2008. "Prevailing Wages and Government Contracting Costs: A Review of the Research." Economic Policy Institute. https://www.epi.org/publication/bp215/.

Manzo IV, Frank, and Robert Bruno. 2014. "Which Labor Market Institutions Reduce Income Inequality?: Labor Unions, Prevailing Wage Laws, and Right-to-Work Laws in the Construction Industry." Illinois Economic Policy Institute and the School of Labor and Employment Relations Labor Education Program, University of Illinois at Urbana-Champaign. https://illinoisepi.org/site/wp-content/themes/hollow/docs/wages-labor-standards/ILEPI-LEP-Research-Report_Institutions-Income-Inequality_ManzoBruno1.pdf.

Manzo IV, Frank, Robert Bruno, and Scott Littlehale. 2014. "Common Sense Construction: The Economic Impacts of Indiana's Common Construction Wage." Midwest Economic Policy Institute; School of Labor and Employment Relations, University of Illinois at Urbana-Champaign; Smart Cities Prevail. http://www.faircontracting.org/wp-content/uploads/2014/07/Common-Sense-Construction-CCW-Report-FINAL1.pdf.

Manzo IV, Frank, Robert Bruno, and Larissa Petrucci. 2023. "The Economic Impact of Prevailing Wage Law Repeals on Construction Market Outcomes: Evidence from Repeals Between 2015 and 2018." Illinois Economic Policy Institute and the Illinois Labor & Employment Relations Project for Middle Class Renewal. https://lep.illinois.edu/publications/the-economic-impact-of-prevailing-wage-law-repeals-on-construction-market-outcomes-evidence-from-repeals-between-2015-and-2018/.

Manzo IV, Frank, and Kevin Duncan. 2018. "The Effects of Repealing Common Construction Wage

in Indiana: Impacts on Ten Construction Market Outcomes." Midwest Economic Policy Institute. https://midwestepi.files.wordpress.com/2018/01/mepi-csu-effects-of-repealing-common-construction-wage-in-indiana-final.pdf.
Manzo, Jill, Robert Bruno, and Frank Manzo IV. 2018. "State Prevailing Wage Laws Reduce Racial Income Gaps in Construction: Impacts by Trade, 2013-2015." Illinois Economic Policy Institute. https://lep.illinois.edu/publications/state-prevailing-wage-laws-reduce-racial-income-gaps-in-construction-impacts-by-trade-2013-2015/.
Mayneris, Florian, Sandra Poncet, and Tao Zhang. 2018. "Improving or Disappearing: Firm-Level Adjustments to Minimum Wages in China." *ScienceDirect* 135 (November):20–42. https://doi.org/10.1016/j.jdeveco.2018.06.010.
Nguyen, Dong Xuan. 2019. "Minimum Wages and Firm Productivity: Evidence from Vietnamese Manufacturing Firms." *International Economic Journal* 33 (3): 560–72. https://doi.org/10.1080/10168737.2019.1624806.
Office of Energy Efficiency & Renewable Energy, US Department of Energy. 2022. "Growing the Green Buildings Workforce." https://www.google.com/url?q=https://www.energy.gov/eere/buildings/articles/workforce-development-fact-sheet-growing-green-buildings-workforce%23:~:text%3DIn%25202019%252C%2520hiring%2520difficulties%2520were,lack%2520of%2520industry%252Dspecific%2520skills&sa=D&source=docs&ust=1713302860123520&usg=AOvVaw1q0YuWz_X8Ek-_eQpKUqSA.
O*NET Resource Center. 2023. "Green Economy Sector: Green Construction - Occupational Listings." October 24, 2023. https://www.onetcenter.org/green/construction.html.
Opinion Dynamics. "California Heat Pump Residential Market Characterization and Baseline Study." May 17, 2022. https://www.calmac.org/publications/OD-CPUC-Heat-Pump-Market-Study-Report-5-17-2022.pdf.
Perry, Ian, Sarah Thomason, and Annette Bernhardt. 2016. "Data and Methods for Estimating the Impact of Proposed Local Minimum Wage Laws." UC Berkeley Labor Center. http://irle.berkeley.edu/cwed/briefs/2016-04.pdf.
Phillips, Peter. 2014. "Kentucky's Prevailing Wage Law: An Economic Impact Analysis." University of Utah. http://www.faircontracting.org/wp-content/uploads/2014/02/Kentucky-Report-2014-Philips.pdf.
Pless, Jacquelyn, and Arthur A. van Benthem. 2019. "Pass-Through as a Test for Market Power: An Application to Solar Subsidies." *American Economic Journal: Applied Economics* 11 (4): 367–401. https://doi.org/10.1257/app.20170611.
Pollin, Robert, and Jeannette Wicks-Lim. 2015. "A $15 U.S. Minimum Wage: How the Fast-Food Industry Could Adjust Without Shedding Jobs." Working Paper 373. Political Economy Research Institute, University of Massachusetts Amherst. http://www.peri.umass.edu/fileadmin/pdf/working_papers/working_papers_351-400/WP373.pdf.
Regmi, Krishna. 2020. "The Effect of the Minimum Wage on Children's Cognitive Achievement." *Labour Economics* 65 (August):101844. https://doi.org/10.1016/j.labeco.2020.101844.
Reich, Michael, Claire Montialoux, Sylvia Allegretto, Ken Jacobs, Annette Bernhardt, and Sarah Thomason. 2016. "The Effects of a $15 Minimum Wage by 2019 in San Jose and Santa Clara County." *Institute for Research on Labor and Employment, University of California-Berkeley*. http://irle.berkeley.edu/files/2016/The-Effects-of-15-Minimum-Wage-by-2019-in-San-Jose-and-Santa-Clara-County.pdf.
Renkin, Tobias, Claire Montialoux, and Michael Siegenthaler. 2020. "The Pass-through of Minimum Wages into US Retail Prices: Evidence from Supermarket Scanner Data." *Review of Economics and Statistics* 104 (5): 1–99.

Riley, Rebecca, and Chiara Rosazza Bondibene. 2017. "Raising the Standard: Minimum Wages and Firm Productivity." *Labour Economics* 44 (January):27–50. https://doi.org/10.1016/j.labeco.2016.11.010.

Singla, Veena, Kelsey Kane-Ritsch, Chelsea Kirk, Betony Jones, and Lauren Ahkiam. 2022. "Integrating Housing, Workforce, Health and Energy Equity in Building Decarbonization in Los Angeles, California." Natural Resources Defense Council. https://www.nrdc.org/sites/default/files/integrating-equity-building-decarbonization-los-angeles-report-202208.pdf.

State of California Department of Industrial Relations. 2016. "Apprenticeship Requirements." October 2016. https://www.dir.ca.gov/Public-Works/Apprentices.html.

———. 2024a. "Frequently Asked Questions - Prevailing Wage." 2024. https://www.dir.ca.gov/dlse/FAQ_PrevailingWage.html.

———. 2024b. "Public Works Contractors." June 2024. https://www.dir.ca.gov/Public-Works/Contractors.html.

Thomason, Sarah, Chelsey Bryant, Sharon Jan, and Kelly Haines. 2024. "Bay Area Residential Decarbonization Industry and Workforce Overview." Residential Decarbonization Industry Paper Series. High Road℠ Training Partnership: Bay Area Residential Building Decarbonization.

US Department of Energy. 2023. "U.S. Energy & Employment Jobs Report (USEER)." https://www.energy.gov/policy/us-energy-employment-jobs-report-useer.

Walker, Iain, Brennan Less, and Nuria Casquero-Modrego. 2023. "Emerging Pathways to Upgrade the US Housing Stock: A Review of the Home Energy Upgrade Literature," June. https://escholarship.org/uc/item/5rs2t6zs.

Wicks-Lim, Jeanette. 2006. "Mandated Wage Floors and the Wage Structure: New Estimates of the Ripple Effects of Minimum Wage Laws." *Political Economy Research Institute, University of Massachusetts Amherst*, PERI Working Paper Series, 116. http://scholarworks.umass.edu/peri_workingpapers/94/.

Wiltshire, Justin C., Carl McPherson, Michael Reich, and Denis Sosinskiy. 2024. "Minimum Wage Effects and Monopsony Explanations." Institute for Research on Labor and Employment, University of California, Berkeley. https://irle.berkeley.edu/publications/working-papers/minimum-wage-effects-and-monopsony-explanations/.

Workers' Compensation Insurance Rating Bureau of California. 2014. "State of the System: WCIRB Report on the State of the California Workers' Compensation Insurance System." https://www.wcirb.com/document/3044.

Wursten, Jesse, and Michael Reich. 2023. "Small Businesses and the Minimum Wage." Center on Wage and Employment Dynamics. https://irle.berkeley.edu/publications/working-papers/small-businesses-and-the-minimum-wage/.

Zabin, Carol. 2020. "Putting California on the High Road: A Jobs and Climate Action Plan for 2040." UC Berkeley Labor Center.

Zabin Ph.D., Carol, Jessica Halpern-Finnerty, and Megan Emiko Scott. 2014. "Workforce Issues and Energy Efficiency Programs: A Plan for California's Utilities." Donald Vial Center on Employment in the Green Economy, UC Berkeley. https://laborcenter.berkeley.edu/pdf/2014/WET-Plan14.pdf.

Zipperer, Ben. 2022. "Turnover, Prices, and Reallocation: Why Minimum Wages Raise the Incomes of Low-Wage Workers." *Journal of Law and Political Economy* 3 (1). https://doi.org/10.5070/LP63159038.