



February 2009

UC BERKELEY CENTER FOR LABOR RESEARCH AND EDUCATION

# POLICY BRIEF

## ADDRESSING THE EMPLOYMENT IMPACTS OF AB 32, CALIFORNIA'S GLOBAL WARMING SOLUTIONS ACT

**Carol Zabin, Ph.D**

**Andrea Buffa**

UC Berkeley Center for Labor Research and Education

### EXECUTIVE SUMMARY

This policy brief analyzes the job impacts of AB 32, the Global Warming Solutions Act of 2006, and highlights the policy design options that can best promote both lower greenhouse gas emissions and good jobs.

### Main Findings

**A review of the two macro-economic forecasts commissioned by the California Air Resources Board (ARB) of economy-wide effects in 2020 shows small overall job growth due to AB 32.**

ARB commissioned two macro-economic computable general equilibrium models, the E-DRAM and BEAR models, to forecast overall economic output and employment. The BEAR and E-DRAM forecasts are high quality examples of this type of economic modeling, but such forecasts have inherent limitations. With these limitations in mind, both of these models forecast small but positive impacts on California jobs, in comparison with their Business As Usual (BAU) forecasts. The main driver for these results is the savings to households from lower expenditures on fuel and energy due to energy efficiency measures. The most significant savings arise from the Pavley vehicle emissions regulations, which alone are expected to account for \$11 billion in annualized savings for households in the year 2020.

**A review of the two macro-economic forecasts commissioned by ARB that examine specific economic sectors shows small job growth and loss by sector; but inconsistencies between the models lend doubt to the credibility of the results.**

The E-DRAM and BEAR models are capable of forecasting job growth and job loss in all the specific sectors of the economy. Credible estimates of sector job growth and loss are extremely important to policymakers, because they can guide initiatives to assist displaced workers and train workers with the skills needed for jobs in growing industries.

Both models show small net job loss in some energy and energy-intensive industries that are directly affected by AB 32 measures, compared to the BAU scenario, and net job gain in construction and other services, as households' savings are spent throughout the economy. However, significant differences exist between the sector forecasts of the two models. For example the E-DRAM model shows a 33 percent decline in jobs in the generation and distribution of electricity, compared to the BAU scenario, while the BEAR model shows a 2 percent gain in this sector. These differences lend doubt to the credibility of sector forecasts.

**The industries subject to new regulations and/or a cap-and-trade program, due to AB 32, account for about 20 percent of California jobs, have higher than average wages and union density, and are disproportionately filled by men and by Latinos.**

The second job impact analysis provided in this policy brief profiles the jobs in the heavy-emitting industries subject to new ARB regulations and/or a cap-and-trade program. These include a wide range of manufacturing industries, fuel extraction and energy generation, and waste and water services. These industries account for over three million jobs, a full 20 percent of California's jobs in 2006.

These sectors also are sectors with a high concentration of well-paying blue-collar union jobs. Private sector union density in these sectors is 16 percent, compared to 10 percent in all sectors, and wages are \$2.00 per hour more than the state average. These jobs are disproportionately filled by men, Latinos, and workers with lower than average years of education. While only a portion (how much cannot be determined at this time) of the jobs in the heavy-emitting industries will require retraining, the sheer number of jobs in this group dwarfs the number of jobs in new green businesses. This suggests the importance of addressing the training needs of the incumbent workforce, as industries adopt changing processes and as some carbon-intensive industries face the possibility of job loss.

**A review of available studies shows that new green jobs still account for less than 1 percent of jobs in the California economy.**

The third job impact analysis summarizes other studies of jobs associated with new green businesses. The most comprehensive California-wide study estimates that there are currently about 3,000 green businesses in the state, accounting for about 44,000 jobs (*Clean Technology and the Green Economy*, 2008). Green businesses, defined as products and services that reduce environmental impact or improve natural resource use, are concentrated in energy generation and energy efficiency services. By North American Industry Classification System (NAICS) sectors, the study finds that 36 percent of California's green businesses are in professional, scientific and technical services;

19 percent are in construction; and 15 percent are in manufacturing. These green businesses and jobs are likely to expand rapidly as AB 32 is implemented.

## Recommendations

Overall, this policy brief supports ARB's policy recommendations but urges ARB to take action to protect workers and improve job quality. We recommend the following:

### Need for Comprehensive Job Impact Analysis

ARB should fund in-depth research on the sectors most affected by climate change policy, including empirical research on leakage, workforce preparedness, job training gaps, and job impacts by detailed sector.

### Cap and Trade

- ▶ *Cap and auction:* If California implements a cap-and-trade program, the state should have a goal of auctioning 100 percent of the carbon allowances, to be reached after a short adjustment period for some key enterprises. Auctioning carbon allowances rather than giving them away for free will prevent windfall profits from accruing to private companies. Additionally, the auction proceeds will be needed for a variety of programs that will smooth the transition to a green economy for workers, low-income consumers and businesses in California.
- ▶ *Leakage:* ARB should adopt policies to address leakage to assure that jobs don't leave California due to competition from regions with less stringent carbon emissions laws. Policies should be determined after full evaluation of the costs and benefits of alternative policy options, including output-based rebates, border adjustments, and allowance waivers. Additionally, a careful assessment of the specific industries that might be affected by leakage should be carried out, because only a limited number of industries are both energy-intensive and subject to competition from non-California businesses.
- ▶ *Offsets:* Offsets allow a company to invest in an emissions reduction project outside the capped sectors instead of reducing emissions itself. Offsets should be limited to a small portion of covered entities' compliance obligations, and offset projects located in California should be given preference. This geographic preference would keep jobs and investment in California. Offset projects should also meet job quality standards and environmental justice criteria. Offsets must be verifiable and enforceable by a state agency.

### Renewables Portfolio Standard

When the California legislature codifies the new renewables portfolio standard (RPS), language should limit the use of credits for energy imported from out of state, in order to assure the development of renewable energy jobs in California.

## Public Investment

- ▶ *Workforce development:* Investment is needed in workforce development initiatives that will complement the most successful of the state's already-established workforce development programs. Many of these are union apprenticeship programs and other high-road labor-management training partnerships. Such programs provide a tremendous asset for the green transition, particularly because of the key role of construction occupations in new green building, energy efficiency building retrofits, solar energy installation, and construction of renewable energy plants. Incumbent worker training in heavy-emitting industries that must adopt new processes to lower emissions is needed, as well as training for workers in new industries.
- ▶ *Worker adjustment assistance:* Public investment is needed for transitional support and retraining for workers whose jobs may be lost, using the principals of trade adjustment assistance, but with adequate funding to help workers retrain for jobs with similar compensation or create bridges to retirement. Current forecasts predict no significant job loss due to AB 32 implementation, but protections should be in place and are likely to be low cost because of the small number of workers who may be affected.
- ▶ *Equity programs:* Without adequate protections, low-income consumers and communities may end up bearing the brunt of increased energy costs that result from the implementation of AB 32. ARB should prioritize equity programs that would protect low-income consumers from the impacts of higher energy prices. Investment in mass transit, residential efficiency retrofits, urban infill, and other strategies can lower households' energy use and vehicle miles traveled, while promoting good jobs.

Another equity consideration is the potential of a cap-and-trade system to exacerbate "hot spots," which occur when pollutants co-produced with GHGs are concentrated in specific low-income communities. ARB should provide incentives for companies to clean up their emissions in low-income communities, thereby supporting environmental justice while at the same time creating employment in those communities.

- ▶ *Attaching job and training quality standards to public investment and incentives:* Public investment in green infrastructure and green training should include prevailing wage or other wage and benefit standards, to avoid the creation of low-wage jobs. As much as is feasible, public investment in job creation should be linked to certified training programs, including certified apprenticeship programs.

# ADDRESSING THE EMPLOYMENT IMPACTS OF AB 32, CALIFORNIA'S GLOBAL WARMING SOLUTIONS ACT

## INTRODUCTION

In December of 2008, the California Air Resources Board voted to approve the implementation plan (called the “scoping plan”) for AB 32, California’s landmark Global Warming Solutions Act. This law mandates reductions of California greenhouse gas emissions (GHGs) to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050, with implementation of most provisions to begin in 2012. California is the first state to adopt such a statewide, comprehensive plan to cut GHG emissions, making it a model for other states as well as for the nation.

The scoping plan creates a blueprint for how to implement AB 32 but still leaves many specific regulations and rules to be determined before 2012, particularly with regard to design options within the cap-and-trade program, one of the most important components of the scoping plan. AB 32’s success in meeting its goals of reducing emissions while maintaining a strong California economy will depend on the details of implementation and the design options that the California Air Resources Board (ARB) and other California agencies choose.

AB 32 offers tremendous economic opportunities for California. With successful implementation of AB 32, the state can become a center of green innovation and an export powerhouse for new technologies, products, and services. AB 32 will induce billions of dollars in private and public investment in energy efficiency retrofits, new construction, and renewable energy generation, presenting growth opportunities in traditional sectors and in new markets yet to be developed. Policymakers, in partnership with business, organized labor, and community stakeholders, can use the economic changes brought about by AB 32 to develop a new array of well-paying jobs with good benefits. At the ground level of the green economy, California has the opportunity to make quality jobs accessible to low-income communities.

The implementation of AB 32 also presents daunting challenges. Green technologies will not flourish without a well-trained technical and blue-collar labor force. In the absence of careful and far-sighted implementation, AB 32 could potentially cause serious detrimental effects: losing business to

other regions with less stringent emissions requirements; trading well-paying jobs for new jobs of lesser quality; creating a greater concentration of environmental damage in low-income communities; and inducing higher energy costs that disproportionately affect working and low-income people. In the context of the current severe economic downturn, these risks are magnified as investment funds diminish, the massive state budget deficit persists, and workers face job loss.

The goals of AB 32 are ambitious. Reaching these goals, while also avoiding the economic pitfalls *and* seizing the economic opportunities of AB 32, will require careful attention by California legislators and government agencies. But the impact of AB 32 on jobs and on working people in California has thus far received less attention than is necessary to adequately address workforce issues. While there has been much excitement in the news media and among politicians about the potential for creating “green jobs” in new and emerging industries, there has been less discussion and little research—by either ARB or independent researchers—of the impact of AB 32 on jobs in existing industries. Jobs throughout the economy, not just in new industries, will change and may require new skills and new investments in workforce development. Pathways to good jobs in the new green economy must be created, and protections for workers in declining industries must be instituted. Affected industries will include construction, energy generation, cement manufacturing, oil refining, steel production, ventilation and air conditioning, and many more. Many of the jobs in these industries are currently well-paying union jobs with good benefits.

To ensure the successful implementation of AB 32 for California’s workers and its economy, policymakers and the public should consider the effects of AB 32 on:

- ▶ the number of jobs in California, overall and by sector;
- ▶ the skills sets needed for the workforce in growing and new industries;
- ▶ the capacity of the state’s training and education infrastructure to upgrade worker skills; and
- ▶ wages, benefits, and career opportunities within and across declining and growing sectors.

To that end, the purpose of this briefing paper is to inform policymakers of what we know so far about the expected impacts of AB 32 on jobs and workers in California, to highlight the need for workforce development as part of the overall strategy to restructure California’s economy, and to underscore the key policy choices that will affect job creation, job quality, workforce development, and the needs of California workers. ARB staff and board members, other government agencies and California elected officials will have ample time to weigh in on these issues and craft policies to ensure a smooth transition to a new low-carbon economy during the two-year-long rule-making process when the AB 32 regulations will be developed. Additionally, the California legislature may be asked to vote on key issues during this time period, such as appropriate uses for revenues generated by the auction of carbon allowances under a cap-and-trade program and guidelines for the new renewables portfolio standard (RPS).

This report presents analyses of available data addressing:

- ▶ the estimated job growth and potential job loss by sector, using forecasts from the E-DRAM and BEAR models, the macroeconomic models commissioned by ARB to assess the economic impact of the scoping plan;

- ▶ job and worker profiles in the heavy GHG-emitting sectors that will face new regulations and be covered by the proposed cap-and-trade program, and where changes in worker skills set requirements are likely to be concentrated; and
- ▶ a summary of the studies on jobs resulting from new green technology businesses.

Analysis of the job impacts of AB 32 is challenging due to both data and methodological limitations, and the results presented here address these issues only in a partial manner. Further research by ARB and independent researchers should be conducted if policymakers are to make well-informed decisions about how to ensure the successful implementation of AB 32 for California's workers and its economy.

California has the opportunity to help shape this major restructuring of the state's economy in a way that reduces its carbon footprint *and* creates good jobs with access to training and career opportunities. This will require specific policy decisions by ARB, other local, regional, and state decision-makers, and elected officials. It will also require transparency about and fair distribution of the costs and benefits of climate change mitigation efforts.

Overall, this report supports the AB 32 scoping plan but urges ARB and other state and local decision-makers to take action to prepare California's workforce for changes in the economy, protect workers who may face job loss, and promote good jobs with career opportunities.

## POTENTIAL EMPLOYMENT IMPACTS OF AB 32

This preliminary analysis presents several views of the potential job impacts of the AB 32 scoping plan that was approved by the California Air Resources Board on Dec. 11, 2008. Further research on job impacts is needed and should be carried out by ARB and independent researchers. We first present results on the overall economic impact of AB 32 scoping plan measures from the E-DRAM and BEAR models, the macro-economic models used by ARB to evaluate the impact of AB 32 scoping plan measures on the California economy. We then drill down and present three types of job impacts in specific sectors: 1) the estimated job growth and potential job loss for each sector, using forecasts from the E-DRAM and BEAR models; 2) a job and worker profile of the heavy GHG-emitting sectors that will face new regulations and be covered by the proposed cap-and-trade program, and where changes in worker skills set requirements are likely to be concentrated; and 3) a summary of the studies on jobs resulting from new green technology businesses. Important insights for policymakers and community stakeholders emerge from each of these views of the labor market.

### Overall Economic Impact Forecasts

ARB is required by law to evaluate the economic impact of each of its proposed measures. In the fall of 2008, ARB reported the results of the E-DRAM and the BEAR models, which were used to assess the overall economic impact of the scoping plan measures that will be used to meet California's 2020 goal to reduce GHG emissions by 169 million metric tons CO<sub>2</sub> equivalent (MMTCO<sub>2e</sub>).<sup>1</sup> The

<sup>1</sup> ARB also commissioned the Energy 2020 model that was designed to interact with the economic models, but results from this model were not reported. See <http://www.arb.ca.gov/cc/scopingplan/economics-sp/models/models.htm> for an explanation of ARB's economic models.

E-DRAM and BEAR models are similar macro-economic models, based on the same underlying data and estimates of the costs of policy measures. Such models are commonly used to forecast the economic impact of alternative policy scenarios in a particular state or nation. The models divide the overall economy into a large number of production and consumption sectors that interact with one another, and can trace the effects of a policy change in one sector on the other sectors, and ultimately the economy as a whole.

The preliminary forecasts, shown in Table 1 (below), estimate that the California economy can absorb the costs of lowering GHG emissions to the AB 32 goals for the year 2020 without reducing employment. Table 1 shows employment for the 2020 forecast for “Business As Usual” (BAU) and the 2020 forecast with the scoping plan policy changes.

**Table 1**  
**Net California job forecasts for AB 32 scoping plan measures**

| <b>Baseline and model forecasts</b>   | <b>Number of jobs</b> |
|---|-----------------------|
| 2007  | 16,410,000*           |
| 2020 Business as Usual Forecast   | 18,410,000*           |
| E-DRAM Forecast:<br>2020 Total Jobs with<br>AB 32 scoping plan implementation | 18,530,000*           |
| BEAR Forecast:<br>2020 Total Jobs with<br>AB 32 scoping plan implementation   | 18,431,000**          |

Source: \*Climate Change Proposed Scoping Plan p. 74; \*\*Climate Change Draft Scoping plan, Economic Evaluation Supplement. Appendix III, p. III -12.

The two models both show very small positive overall job growth due to implementation of the AB 32 policy measures, compared to the BAU forecast with no policy changes. The reason for these very optimistic predictions is that most of the significant scoping plan measures are cost-effective efficiency measures, as shown in Table 2. The measures with negative costs actually illustrate reductions in households’ expenditures on energy. The main driver for increased employment in the models comes from these households’ savings from energy expenditures, which are then spent on other goods and services, increasing demand and output throughout the state economy. The single largest source of energy efficiency savings is the Pavley light-duty vehicle emissions regulations (which will reduce GHG emissions from California passenger vehicles), which are expected to save households approximately \$11 billion per year on an annualized basis, out of a total of the approximately \$16 billion in total net annualized savings identified by the plan.



**Table 2**  
**Scoping plan’s greenhouse gas (GHG) emissions reductions, by sector<sup>a</sup>**

(GHG emissions in MMTCO<sub>2</sub>E in 2020)  
(Dollars in Millions)

| Sector                              | Business-as-Usual GHG Emissions | Scoping Plan GHG Emissions Reductions | Net Annualized Cost/Savings <sup>b</sup> |
|-------------------------------------|---------------------------------|---------------------------------------|--|
| Transportation                      | 225.4                           | 62.4                                  | -\$14,047                                |
| Electricity                         | 139.2                           | 45.3                                  | -1,191                                   |
| Industry                            | 100.5                           | 1.4                                   | -60                                      |
| High global warming potential gases | 46.9                            | 20.3                                  | 129                                      |
| Commercial and residential          | 46.7                            | 4.4                                   | -470                                     |
| Recycling and waste management      | 7.7                             | 1.0                                   | 52                                       |
| Forests                             | —                               | 5.0                                   | 50                                       |
| Subtotals                           | 596.2                           | 139.8                                 | -\$15,537                                |
| Regional cap and trade              | —                               | 35.0                                  | —  |
| <b>Totals</b>                       | <b>596.2</b>                    | <b>174.8</b>                          | <b>-\$15,537</b>                         |

<sup>a</sup> Does not include 7.8 millions of metric tons of carbon dioxide equivalents (MMTCO<sub>2</sub>E) of reductions in water and agricultural sectors, because water reductions are accounted for in business-as-usual scenario and agricultural reductions are voluntary.

<sup>b</sup> Negative dollar amounts represent net savings.

Source: California Legislative Analyst’s Office Critique of the AB32 Scoping Plan Economic Analysis, p. 6

The BEAR and E-DRAM forecasts are high quality examples of this type of economic modeling, but such forecasts have inherent limitations. On the one hand, the models assume quick responses to price signals, access to credit, and full employment of resources, including labor. As a consequence, they do not fully capture the dislocations that can occur in specific industries and firms and that may result in job loss for some. On the other hand, they also do not fully capture the productivity improvements from future technological innovations that may lower energy use over time.

The models were reviewed both by a peer review panel of economists and by the California Legislative Analyst’s Office.<sup>2</sup> These reviews criticize the forecasts for a variety of reasons, while acknowledging that they are high quality examples of this kind of economic model. The critiques

<sup>2</sup> See the LAO Critique of the AB 32 Scoping Plan Economic Analysis, [http://www.lao.ca.gov/2008/rsrc/ab32/AB32\\_scoping\\_plan\\_112108.pdf](http://www.lao.ca.gov/2008/rsrc/ab32/AB32_scoping_plan_112108.pdf), and Peer Review of the Economic Supplement to the AB 32 Draft Scoping Plan: Major Peer Review Comments and Air Resources Board Staff Responses, <http://www.arb.ca.gov/cc/scopingplan/document/appendix2.pdf>

include doubts about the optimistic estimation of cost reductions due to energy efficiency measures, inadequate transparency and sensitivity analysis, and other deficiencies.

While the models may not forecast the future completely accurately, they do represent the best forecasts we have. Overall, they suggest that for the 2020 goals, the California economy is strong enough to absorb the costs of climate solutions policies and there is ample room to pick “low hanging fruit”—low-cost ways to lower GHG emissions—without hurting the economy. The models do not address the much more significant economic restructuring and behavioral changes that will be necessary to achieve the goals for 2050.

It should also be noted that even with a very low-cost transition to lower GHG emissions, it may be that the efforts in California and elsewhere will not be enough to stop global warming, which will necessitate a variety of major new public investments to help the state adapt to higher ocean waters, droughts, flooding, wildfires, and other environmental problems that disrupt economic activity.

## Sector Forecasts

The E-DRAM and BEAR models are also capable of forecasting job growth and job loss in all the specific sectors in the economy. Credible estimates of sector job growth and loss are extremely important to policymakers, because they can guide initiatives to assist displaced workers and train workers with the skills needed for jobs in growing industries. Macro-economic models like the E-DRAM and BEAR models are uniquely able to trace job changes not only in industries directly affected by AB 32 measures, but also in industries that are indirectly affected. Indirect impacts occur in industries that supply inputs or purchase goods and services from the directly regulated sectors. In addition, indirect effects (sometimes called induced effects) occur in other sectors due to changing demand patterns, as household incomes change due to changes in the prices of goods and services impacted by AB 32 measures. These indirect and induced impacts are as important as the direct impacts.

Table 3 (pp. 11–13) shows 2006 employment by sector, and the forecast for employment by sector in 2020 for “Business As Usual” (BAU)—i.e., the forecasted employment without the implementation of AB 32. It then shows the forecasts for 2020, from the BEAR and E-DRAM models, of the change in employment by sector induced by the AB 32 policy measures.<sup>3</sup>

Comparing the number of jobs in 2006 to the forecasts for 2020 due to the implementation of AB 32, the E-DRAM model shows an absolute decline in jobs only in the electricity (10,600 fewer jobs), natural gas (4,336 fewer jobs), oil refining (585 fewer jobs), and automobile manufacturing sectors (285 fewer jobs). The same comparison yields less job loss in the BEAR model, with no job loss in the electricity or fuels sectors, and only several hundred fewer jobs in the electrical appliance and auto sectors.

---

<sup>3</sup> The results of the E-DRAM and BEAR models are not strictly comparable because the measures that the BEAR model evaluates differ in very small ways from the final scoping plan measures that are evaluated in the E-DRAM model. In addition, our estimates for the number of jobs in the BAU case is higher than that estimated in the E-DRAM model, because we start with a larger 2007 baseline job estimate due to our inclusion of self-employed workers. However, these differences are very small and the comparisons still reveal the basic differences between the two models’ results.

Table 3

## Employment forecasts due to AB 32, by sector, for E-DRAM and BEAR Models

| Industrial Sector                            | 2006    | Business As Usual (BAU) 2020 | BEAR Model                |  | E-DRAM Model |                           |  |         |
|--|---------|------------------------------|---------------------------|--|--------------|---------------------------|--|---------|
|  |         |                              | 2006-2020 forecast change | 2020 Job change due to AB 32 compared to BAU |              | 2006-2020 forecast change | 2020 Job change due to AB 32 compared to BAU |         |
|  |         |                              |                           | total  | percent      |                           | total  | percent |
| Agriculture, fisheries, non-cattle livestock | 397,700 | 538,900                      | 138,977                   | -2,223                                       | 161,442      | 20,242                    | 3.8%   |         |
| Cattle production                            | 6,100   | 8,100                        | 1,941                     | -59  | 2,143        | 143                       | 1.8%   |         |
| Dairy production                             | 29,400  | 42,300                       | 12,953                    | 53   | 13,646       | 746                       | 1.8%   |         |
| Forestry, mining, quarrying                  | 2,400   | 3,800                        | 1,403                     | 3  | 1,502        | 102                       | 2.7%   |         |
| Oil and gas extraction                       | 5,900   | 7,400                        | 293                       | -1,207                                       | 4,060        | 2,560                     | 34.6%  |         |
| Mining                                       | 13,900  | 16,700                       | 2,641                     | -159   | 2,375        | -425                      | -2.5%  |         |
| Generation and distribution of electricity   | 33,900  | 34,800                       | 1,730                     | 830  | -10,600      | -11,500                   | -33.0%                                       |         |
| Natural gas distribution                     | 33,700  | 31,800                       | 4,781                     | 6,681  | -4,336       | -2,436                    | -7.7%  |         |
| Water, sewage, steam                         | 33,800  | 44,000                       | 9,305                     | -895   | 12,108       | 1,908                     | 4.3%   |         |
| Residential construction                     | 683,700 | 1,048,600                    | 380,934                   | 16,034                                       | 377,648      | 12,748                    | 1.2%   |         |
| Non-residential construction                 | 390,400 | 530,800                      | 162,088                   | 21,688                                       | 145,402      | 5,002                     | 0.9%   |         |
| Construction of utilities, roads, etc.       | 124,300 | 169,400                      | 47,931                    | 2,831  | 33,192       | -11,908                   | -7.0%  |         |
| Food processing                              | 201,000 | 221,200                      | 14,893                    | -5,307                                       | 25,905       | 5,705                     | 2.6%   |         |
| Textiles and apparel                         | 121,900 | 142,700                      | 20,556                    | -244   | 5,028        | -15,772                   | -11.1%                                       |         |
| Wood, pulp, and paper                        | 38,800  | 59,300                       | 20,554                    | 54   | 20,775       | 275                       | 0.5%   |         |
| Printing and publishing                      | 97,600  | 128,400                      | 30,753                    | -47  | 32,573       | 1,773                     | 1.4%   |         |
| Oil and gas refineries                       | 14,600  | 19,500                       | 1,253                     | -3,647                                       | -585         | -5,485                    | -28.1%                                       |         |
| Chemicals                                    | 96,400  | 135,900                      | 37,831                    | -1,669                                       | 42,729       | 3,229                     | 2.4%   |         |
| Pharmaceuticals                              | 27,700  | 33,900                       | 5,940                     | -260   | 6,393        | 193                       | 0.6%   |         |
| Cement                                       | 22,300  | 31,100                       | 9,428                     | 628  | 10,133       | 1,333                     | 4.3%   |         |

table continued on next page

Table 3 (continued)

## Employment forecasts due to AB 32, by sector, for E-DRAM and BEAR Models

| Industrial Sector                            | 2006      | Business As Usual (BAU) 2020 | BEAR Model                |  |         | E-DRAM Model              |  |         |
|--|-----------|------------------------------|---------------------------|--|---------|---------------------------|--|---------|
|  |           |                              | 2006–2020 forecast change | 2020 Job change due to AB 32 compared to BAU |         | 2006–2020 forecast change | 2020 Job change due to AB 32 compared to BAU |         |
|  |           |                              |                           | number                                       | percent |                           | number                                       | percent |
| Metal manufacture and fabrication            | 167,700   | 276,800                      | 107,185                   | -1,915                                       | -0.7%   | 115,615                   | 6,515  | 2.4%    |
| Aluminum production                          | 6,600     | 10,500                       | 3,805                     | -95  | -0.9%   | 4,096                     | 196  | 1.9%    |
| General machinery                            | 71,600    | 85,200                       | 13,429                    | -171   | -0.2%   | 14,193                    | 593  | 0.7%    |
| Air conditioner, refrigerator, manufacturing | 4,700     | 6,300                        | 1,929                     | 329  | 5.2%    | 1,766                     | 166  | 2.6%    |
| Semiconductors                               | 331,400   | 499,100                      | 177,073                   | 9,373  | 1.9%    | 173,675                   | 5,975  | 1.2%    |
| Electrical appliances                        | 32,300    | 32,200                       | -378                      | -278   | -0.9%   | 2,200                     | 2,300  | 7.1%    |
| Automobiles and light truck manufacturing    | 2,700     | 2,500                        | -127                      | 73   | 2.9%    | -285                      | -85  | -3.4%   |
| Other vehicle manufacturing                  | 43,500    | 55,900                       | 13,038                    | 638  | 1.1%    | 13,372                    | 972  | 1.7%    |
| Aeroplane and aerospace manufacturing        | 66,900    | 96,000                       | 30,043                    | 943  | 1.0%    | 30,021                    | 921  | 1.0%    |
| Other industry                               | 199,500   | 281,600                      | 81,856                    | -244   | -0.1%   | 85,381                    | 3,281  | 1.2%    |
| Wholesale trade                              | 770,100   | 1,112,500                    | 353,345                   | 10,945                                       | 1.0%    | 344,048                   | 1,648  | 0.1%    |
| Retail vehicle sales and service             | 235,300   | 326,900                      | 99,128                    | 7,528  | 2.3%    | 89,777                    | -1,823                                       | -0.6%   |
| Air transport services                       | 45,700    | 62,200                       | 16,731                    | 231  | 0.4%    | 16,312                    | -188   | -0.3%   |
| Ground transportation & delivery             | 144,100   | 233,500                      | 104,670                   | 15,270                                       | 6.5%    | 91,865                    | 2,465  | 1.1%    |
| Water transport                              | 2,900     | 3,700                        | 795                       | -5   | -0.1%   | 815                       | 15   | 0.4%    |
| Trucking                                     | 153,400   | 214,500                      | 60,215                    | -885   | -0.4%   | 65,841                    | 4,741  | 2.2%    |
| Public transit                               | 31,900    | 44,500                       | 12,805                    | 205  | 0.5%    | 12,737                    | 137  | 0.3%    |
| Retail appliances                            | 93,100    | 137,300                      | 44,470                    | 270  | 0.2%    | 45,452                    | 1,252  | 0.9%    |
| General retail services                      | 1,611,200 | 1,974,100                    | 375,391                   | 12,491                                       | 0.6%    | 382,522                   | 19,622                                       | 1.0%    |
| Information and communication services       | 545,100   | 721,600                      | 189,785                   | 13,285                                       | 1.8%    | 179,729                   | 3,229  | 0.4%    |

table continued on next page

**Table 3 (continued)**  
**Employment forecasts due to AB 32, by sector, for E-DRAM and BEAR Models**

| Industrial Sector                             | 2006              | Business As Usual (BAU) 2020 | BEAR Model                |  | E-DRAM Model |                           |  |         |
|---|-------------------|------------------------------|---------------------------|--|--------------|---------------------------|--|---------|
|   |                   |                              | 2006-2020 forecast change | 2020 Job change due to AB 32 compared to BAU |              | 2006-2020 forecast change | 2020 Job change due to AB 32 compared to BAU |         |
|   |                   |                              |                           | number                                       | percent      |                           | number                                       | percent |
| Financial services                            | 1,136,500         | 1,434,800                    | 283,091                   | -15,209                                      | -1.1%        | 326,971                   | 28,671                                       | 2.0%    |
| Other professional services                   | 1,344,100         | 1,737,600                    | 405,154                   | 11,654                                       | 0.7%         | 418,581                   | 25,081                                       | 1.4%    |
| Bus. services, delivery, warehousing, storage | 1,587,800         | 2,118,900                    | 547,167                   | 16,067                                       | 0.8%         | 579,028                   | 47,928                                       | 2.3%    |
| Waste services                                | 37,500            | 55,400                       | 17,459                    | -441   | -0.8%        | 19,464                    | 1,564  | 2.8%    |
| Landfill                                      | 4,900             | 7,200                        | 2,158                     | -142   | -2.0%        | 2,161                     | -139   | -1.9%   |
| Educational services                          | 1,187,000         | 1,535,500                    | 423,312                   | 74,812                                       | 4.9%         | 394,604                   | 46,104                                       | 3.0%    |
| Medical services                              | 1,665,500         | 1,934,600                    | 247,999                   | -21,101                                      | -1.1%        | 290,952                   | 21,852                                       | 1.1%    |
| Recreation and cultural activity              | 388,900           | 524,000                      | 148,304                   | 13,204                                       | 2.5%         | 40,450                    | -94,650                                      | -18.1%  |
| Hotel and restaurant services                 | 1,364,200         | 1,840,400                    | 484,059                   | 7,859  | 0.4%         | 495,129                   | 18,929                                       | 1.0%    |
| Other private services                        | 910,500           | 1,274,000                    | 383,394                   | 19,894                                       | 1.6%         | 373,574                   | 10,074                                       | 0.8%    |
| <b>Total</b>                                  | <b>16,562,100</b> | <b>21,887,900</b>            |                           |  |              |                           |  |         |

Source: The projections in this table were estimated as follows: First we compiled a 2006 baseline estimate of total jobs in California in 2006 from two sources: for the private and public sectors we used the Quarterly Census of Employment and Wages, for self-employed individuals we used the Current Population Survey. Then, we calculated the projections of employment for the 2020 business as usual (BAU) case by multiplying the baseline estimate by the growth rates for each sector for 2006 to 2020 provided to us by David Roland-Holst, the author of the BEAR model. We then calculated the impact of the AB32 measures by multiplying the 2020 BAU number of jobs by sector with the percent change in jobs by sector which were predicted by each model. These forecasts of percent change by sector were provided to us by ARB for the E-DRAM and David Roland-Holst for the BEAR model. Because we started with a larger baseline job number, due to our inclusion of self-employed workers, the results reported in this table for total employment and employment changes are also larger than those reported in ARB documents. An additional difference also occurs because the BEAR and E-DRAM models predict different amounts for the BAU case. However, the comparisons between each model and the baseline remain valid, and the comparisons between the two models are as accurate as possible.

Comparing the 2020 “ Business As Usual” (BAU) forecast with the AB 32 scoping plan measures forecast, predicted job losses in energy are the most significant in the E-DRAM model, but job loss, though small, does spread to other sectors in the economy. In the BEAR model, oil and gas extraction and refining are hardest hit, while electricity and natural gas distribution actually grow, and job loss is minimal in other sectors.

The sectors experiencing the largest job growth for both models are construction and various service sectors. The E-DRAM model also predicts that agriculture will grow by about 20,000 jobs. Illustrating how the model transmits the measures throughout the economy, certain service sectors like education show marginally higher growth under the policy measures, while others such as medical services and financial services grow, but at a slower rate under AB 32 than they would with no policy implementation.

Unfortunately, the discrepancies between the models undermine the credibility of either model's predictions of job loss or gain by sector. While the overall net job gain is similar when all the sectors are aggregated, the differences in the models are much more pronounced at the disaggregated level. Since the models are based on the same data sources and same cost estimates of the AB 32 measures, it is clear that specifications within the models can make a large difference in the results.

Given the discrepancies between the two models, ARB should dedicate resources for more in-depth analysis of the impact of AB 32 policy changes on employment in specific sectors. This should include a sensitivity analysis to understand the source of the discrepancies as well as a more detailed analysis of employment and linkages in key sectors. Both job growth opportunities and threats of job loss may occur within sectors and be masked by modeling at this level of aggregation.

## Job Characteristics of Heavy-Emitting Industries

An important component of understanding the employment impacts of AB 32 is a detailed job and worker profile in industries that will be affected. ARB has identified the industrial sectors that are heavy emitters of GHGs, and will be subject to new emissions standards. The AB 32 scoping plan proposes major new regulations on energy extraction, generation, and transmission, construction, and transportation. In addition, it proposes a cap-and-trade program to cover these sectors as well as other manufacturing sectors. It also proposes energy audits and mandatory investments in cost-effective energy efficiency measures for major industrial facilities that emit more than 0.5 MMTCO<sub>2e</sub> of GHGs per year. Further regulations on manufacturing are expected over the next several years. While indirect impacts of the AB 32 policies will be felt in other industries, as noted above, an in-depth analysis of the directly impacted industries is both critical and possible given available data.

This section presents the job and worker characteristics in these heavy-emitting sectors using the Current Population Survey and the Quarterly Census of Employment and Wages. The analysis demonstrates that jobs in the affected sectors are largely well-paying, blue-collar, mid-skill-level jobs, in sectors with much higher than average union density. The high-emitting industries are the industries where changes in skills set requirements—necessitating worker retraining—are likely to be concentrated. In addition, within these sectors, businesses that adapt quickly to the new regulatory environment and new market opportunities will be positioned to grow; those that do not may decline.

Table 4 (page 16) shows employment levels in the 24 industry categories identified by ARB as heavy emitters. These industries account for over three million jobs, about 20 percent of all California jobs. As shown on Table 4, construction, agriculture, electronics manufacturing, and warehousing and transport services account for the largest number of jobs in heavy-emitting sectors. These will all be affected by the scoping plan mandatory regulations or the cap-and-trade program, with the exception of non-dairy agriculture. Dairies will be required to regulate methane emissions. Non-dairy agriculture will be affected by regulation of agricultural equipment but otherwise only relatively minor, voluntary measures. For the following analysis of job and worker characteristics, we include dairies, but exclude the rest of agriculture.

Jobs in heavy-emitting industries affected by AB 32 are largely high-wage, heavily unionized, blue-collar jobs. Nearly 60 percent of the workers in heavy-emitting industries are in blue-collar or service occupations, compared to only 38 percent for all workers in California, and nearly one-third of the blue-collar and service workers are employed in heavy-emitting industries. Graph 1 (page 17) shows that on average, jobs in heavy emitting industries (excluding agriculture) pay \$19.52 per hour compared to a California average of \$17.58.

When wages of all jobs except professional and managerial occupations are compared, the wage differential between heavy-emitting industries and other private-sector industries is even more significant,<sup>4</sup> as shown in Graph 2 (page 18). Wages average \$16.49 for these “working-class” occupations in heavy-emitting industries, compared to \$13.93 in working-class occupations for all California industries.

Union density in heavy-emitting industries is almost 50 percent higher than union density in the private sector in California overall. Graph 3 (page 19) shows that 15.6 percent of workers are unionized in the heavy emitting industries, compared to 10.5 percent for all California private sector workers.

Graph 4 (page 20) illustrates the union density for specific heavy-emitting industries. Higher union density in the heavy-emitting industries is concentrated in utilities; construction; transportation; oil and gas refining and extraction; cement; and water, waste, and sewage.

Workers in heavy-emitting industries are also more highly concentrated in low- and mid-skilled occupations, and have lower levels of educational attainment, than California workers as a whole. Sixty percent of workers in heavy-emitting industries are blue-collar or service workers, compared to only 38 percent for all California workers, as shown in Graph 5 (page 21). Fifty-one percent of workers in heavy-emitting industries have no greater than a high school education, while for California as a whole, 37 percent of workers have no more than a high school education, as shown in Graph 6 (page 21).

Male workers clearly dominate these industries, making up 75 percent of workers compared to 55 percent of workers in the California economy as a whole (Graph 7, page 22). Graph 8 (page 22) shows that Latinos are also over-represented, comprising 40 percent of workers in heavy-emitting industries, compared to 31 percent in all sectors.

---

<sup>4</sup> For the discussion of union density in the heavy-emitting sectors, this report compares unionization rates within the private sector only, and excludes the public sector. This is the relevant comparison, because the heavy-emitting industries are primarily private sector industries.

Table 4

## Employment levels in heavy-emitting industries

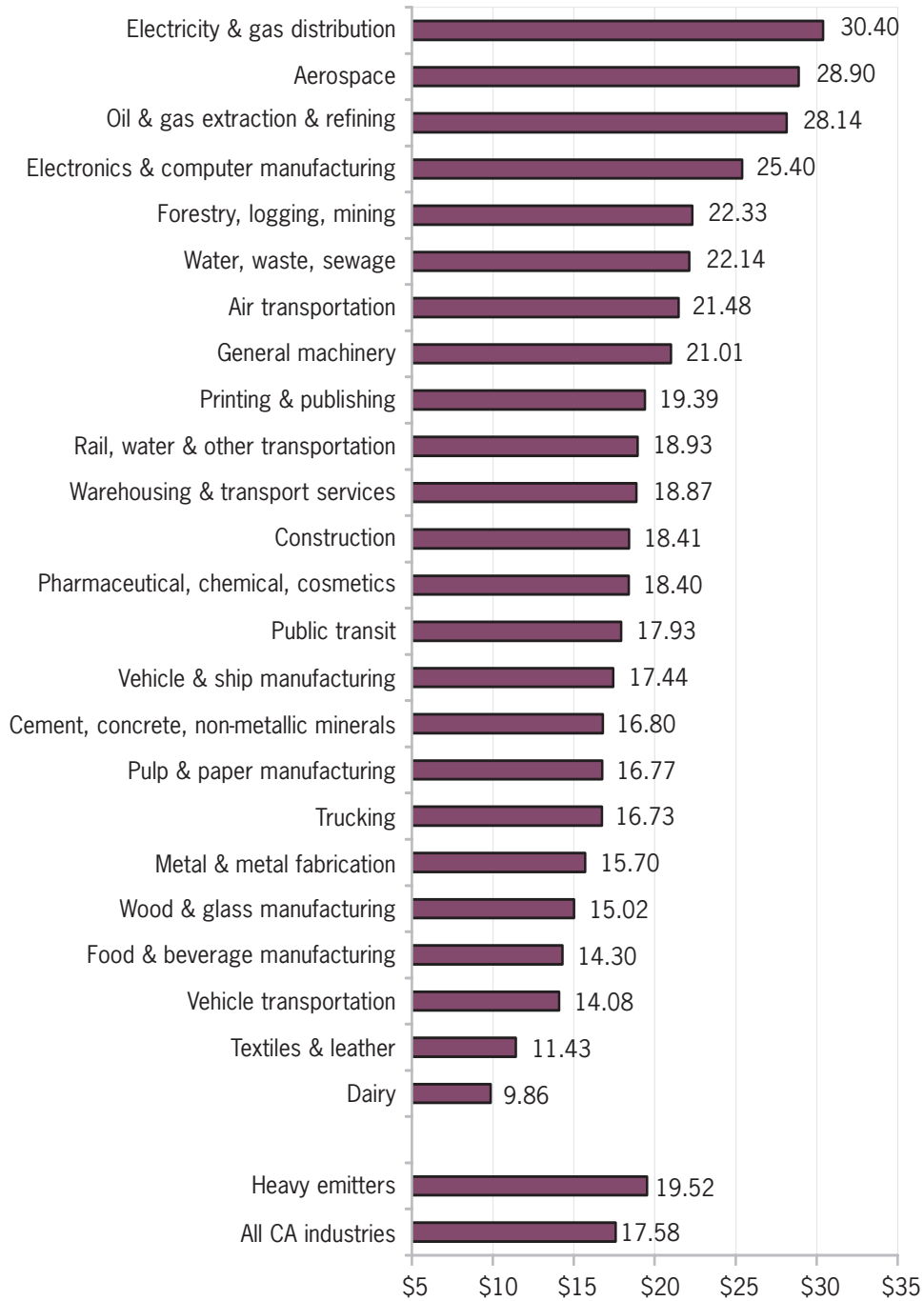
| Heavy-emitting industries                                    | CA jobs           |                     |
|--|-------------------|---------------------|
| Construction—residential                                     | 690,000           |                     |
| Agriculture, livestock, fisheries                            | 400,000           |                     |
| Construction—non-residential                                 | 390,000           |                     |
| Electronics & computer manufacturing                         | 370,000           |                     |
| Warehousing & transport services                             | 350,000           |                     |
| Food & beverage manufacturing                                | 200,000           |                     |
| Metal & metal fabrication                                    | 170,000           |                     |
| Trucking   | 150,000           |                     |
| Pharmaceutical, chemical, cosmetics                          | 120,000           |                     |
| Construction—infrastructure & utilities                      | 100,000           |                     |
| Printing & publishing  | 80,000            |                     |
| Water, waste, sewage   | 80,000            |                     |
| General machinery  | 70,000            |                     |
| Electricity & gas distribution                               | 70,000            |                     |
| Aerospace  | 70,000            |                     |
| Wood & glass manufacturing                                   | 50,000            |                     |
| Vehicle & ship manufacturing                                 | 50,000            |                     |
| Air transportation   | 50,000            |                     |
| Textiles & leather manufacturing                             | 40,000            |                     |
| Dairy production   | 30,000            |                     |
| Cement, concrete, non-metallic minerals                      | 30,000            |                     |
| Vehicle transportation                                       | 30,000            |                     |
| Public transit   | 30,000            |                     |
| Pulp & paper manufacturing                                   | 30,000            |                     |
| Oil & gas extraction & refining                              | 20,000            |                     |
| Forestry, logging, mining                                    | 20,000            |                     |
| Rail, water & other transportation                           | 20,000            |                     |
| Refrigeration & air conditioning                             | 10,000            |                     |
|  |                   | <b>% of CA jobs</b> |
| <b>Heavy emitters w/o agriculture, livestock, fisheries</b>  | <b>3,290,000</b>  | <b>19%</b>          |
| <b>Heavy emitters with agriculture, livestock, fisheries</b> | <b>3,690,000</b>  | <b>21%</b>          |
| <b>All CA jobs</b>   | <b>17,400,000</b> | <b>100%</b>         |

Source: 2006 Quarterly Census of Employment & Wages, CPS



**Graph 1**

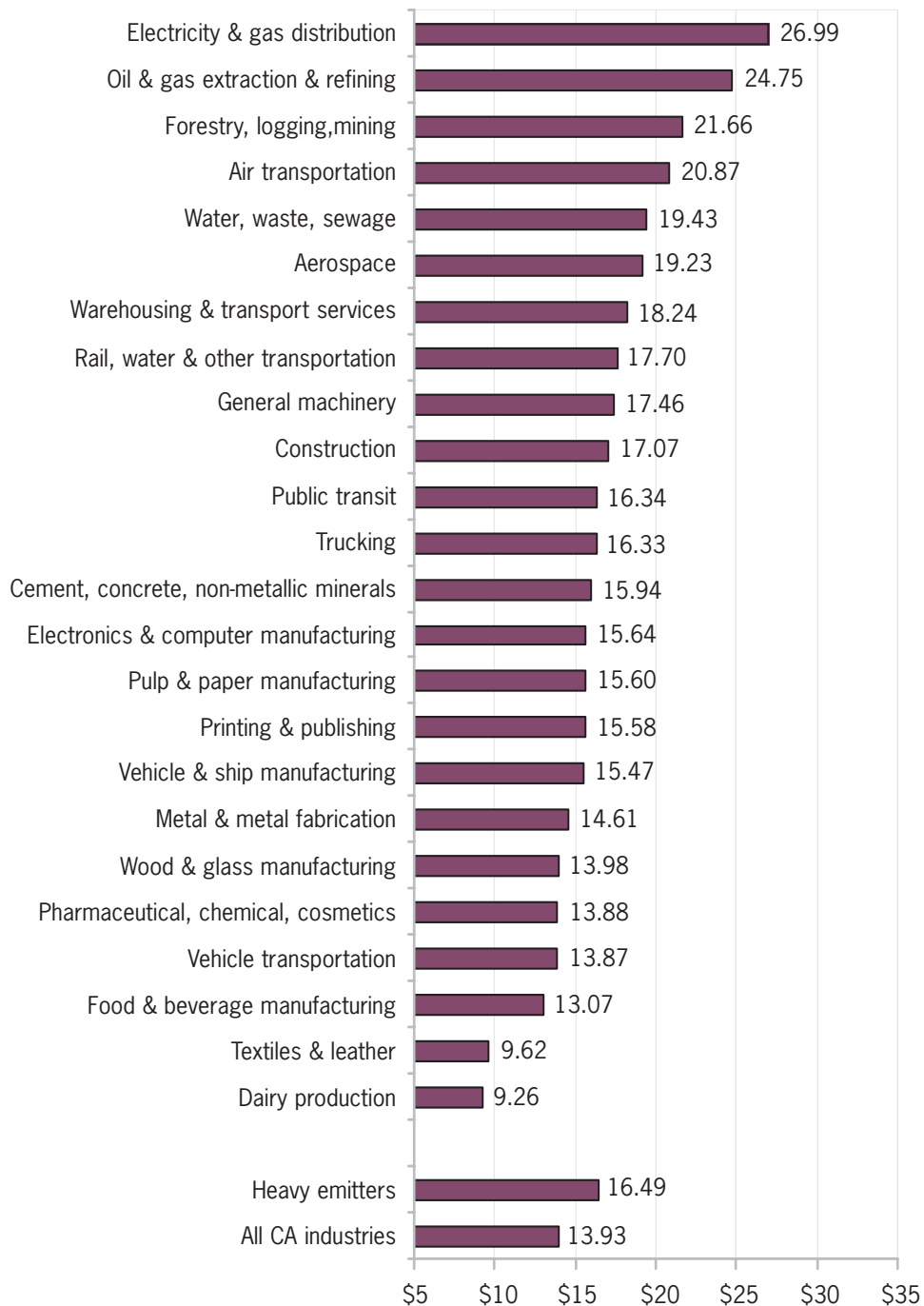
**Median wages for workers in heavy-emitting industries**



Source: Current Population Survey 2000-2008, wages as of May 2008

Graph 2

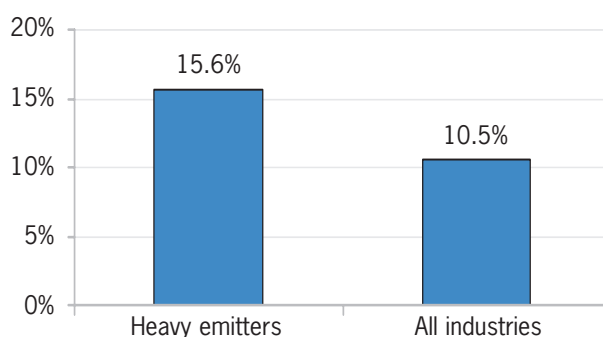
## Median wages for non-professional workers in heavy-emitting industries



Source: Current Population Survey 2000-2008, wages as of May 2008

---

**Graph 3**  
**Union density in private sector firms**



Source: Current Population Survey 2000-2008.

---

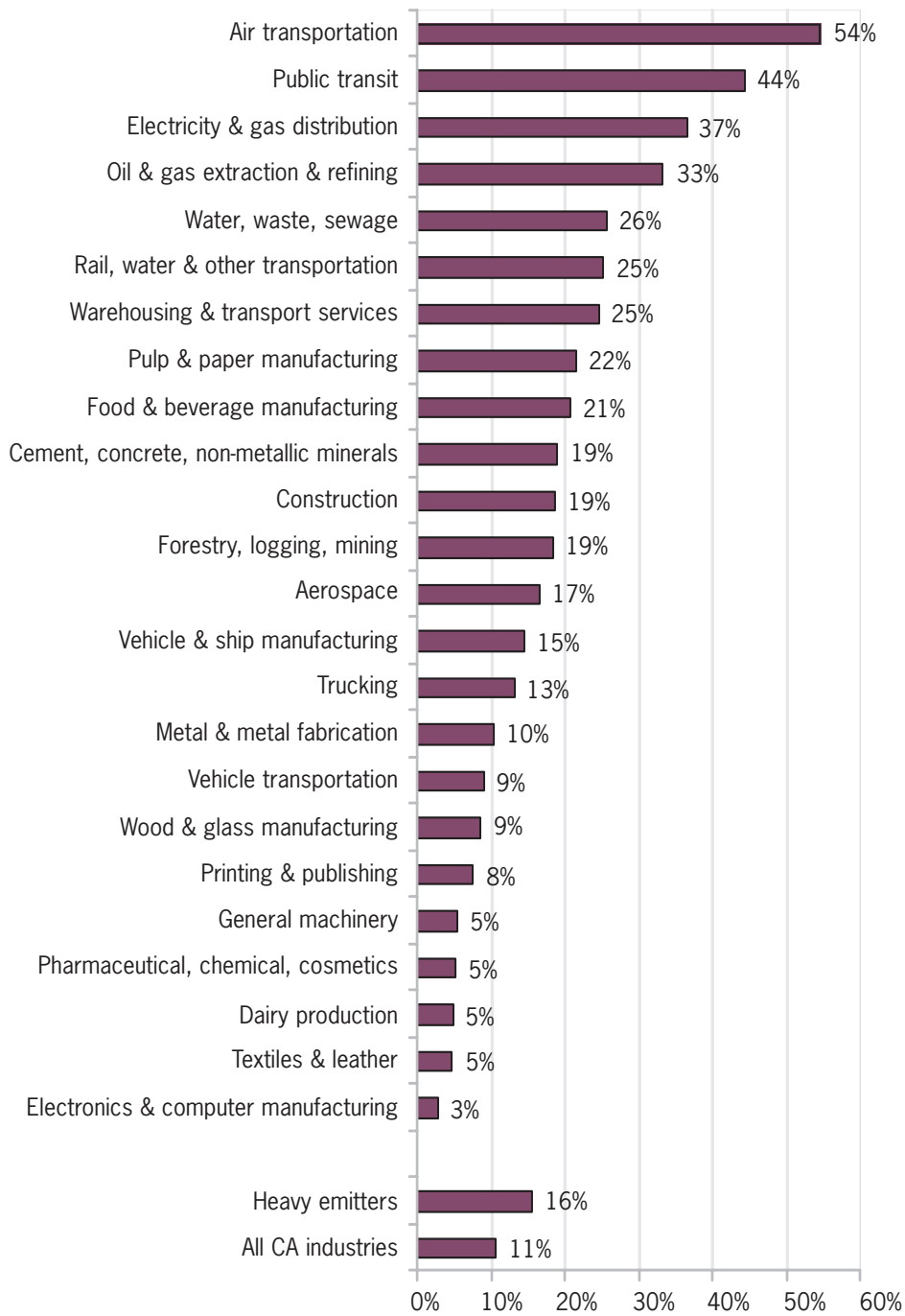
In summary, the heavy-emitting industries that will be subject to new emissions limits under AB 32 are in key manufacturing, construction, and energy industries in which well-paying, blue-collar jobs are concentrated. These industries have been an important path to the middle class for a significant portion of California's working class, particularly its male, Latino, and less educated workers.

These industries also have high union density, important not only because of the resulting high wages and good benefits, but also because unions are important institutions that can play a significant role in retooling their industries to reduce emissions. The apprenticeship infrastructure in California is a tremendous asset that can help the state respond quickly to changing skill needs in many of these industries. In addition to the job changes that may take place in the heavy-emitting industries, there is also the possibility of creating new jobs, especially in manufacturing, if renewable energy plants and their component parts manufacturing are encouraged to locate in the state. California has the opportunity to be a national headquarters of the new energy economy, fueled by the state's research and engineering infrastructure, strong apprenticeship infrastructure, and the emerging consensus among stakeholders, including organized labor, for the need for strong state action to promote the green transition.

This analysis also reveals that more industry-specific and occupational research is greatly needed. The available data on jobs in the heavy-emitting industries do not bring to light the kinds of re-skilling that may be necessary as these industries lower their emissions. For example, switching to cleaner trucks may not change truck driver jobs but will certainly require new skills in truck manufacturing and truck repair and maintenance. Detailed occupational analyses that provide a comprehensive picture of changing skills set requirements will be necessary to guide the state, unions, and training and educational institutions so that California workers can help create a strong green economy.

Graph 4

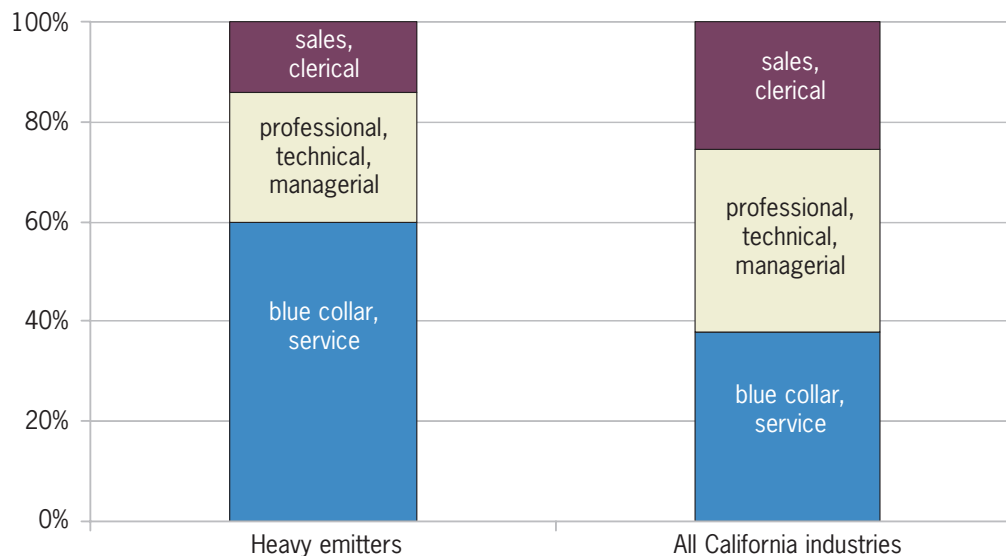
## Union density in private firms for heavy-emitting industries



Source: Current Population Survey 2000-2008, wages as of May 2008

Graph 5

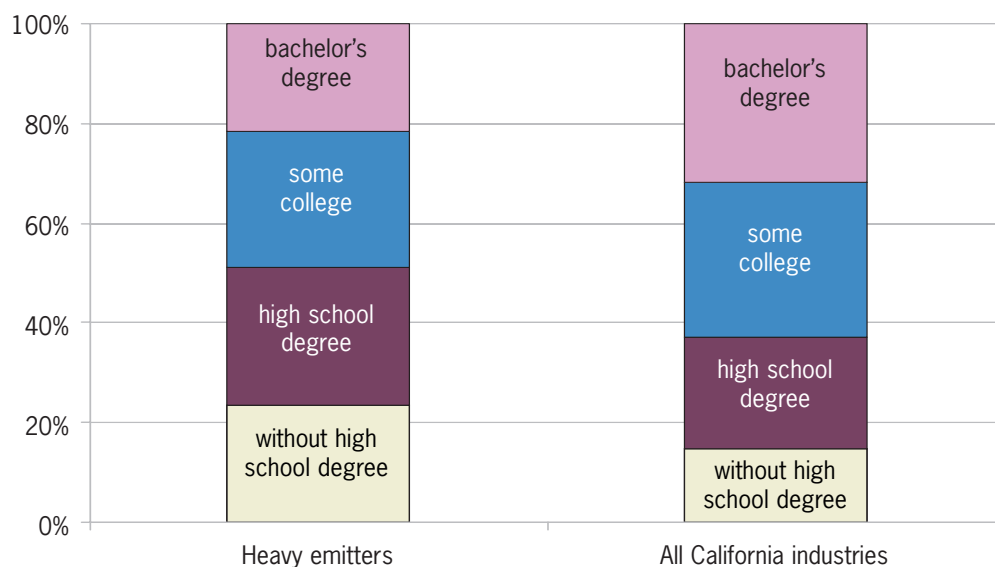
### Occupational type of workers in heavy-emitting industries v. all CA jobs



Source: Current Population Survey, 2000–2008

Graph 6

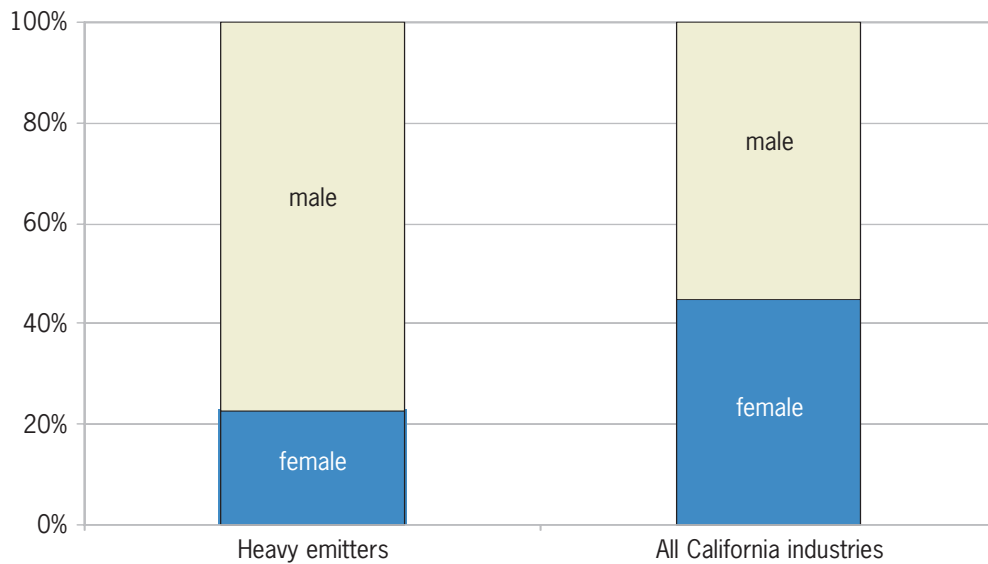
### Educational degrees of workers in heavy-emitting industries v. all CA jobs



Source: Current Population Survey, 2000–2008

**Graph 7**

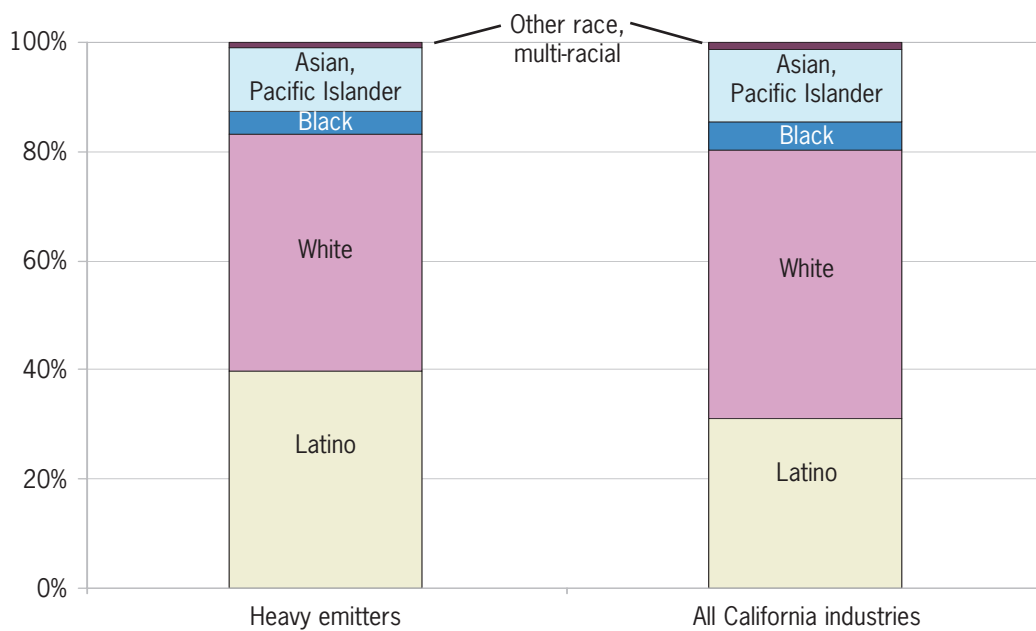
**Gender of workers in heavy-emitting industries v. all CA jobs**



Source: Current Population Survey, 2000–2008

**Graph 8**

**Race and ethnicity of workers in heavy emitting industries v. all CA jobs**



Source: Current Population Survey, 2000–2008

## Green Technology Job Growth

The third job impact analysis summarizes what we know about jobs resulting from green technology businesses, using a narrow definition of green jobs in firms that sell a product or service that has a positive impact on the environment.<sup>5</sup> Though the growth of green jobs, narrowly defined, has received a large amount of attention from policymakers and the media, it represents a tiny fraction of the overall jobs that are affected by climate change policy, at least in the short run.

The jobs we focus on here are in the industries and businesses that are growing in response to new market opportunities associated not just with AB 32 or other mitigation policies, but also with consumer preference changes, energy price changes, innovation, and other market opportunities. Emerging green businesses and green jobs are related to AB 32, because particular measures that are implemented to meet the AB 32 GHG reduction goals may spur the growth of certain green businesses and green jobs. For example, ARB proposes increasing the renewables portfolio standard (RPS) to 33 percent, a policy that will spur the creation of more businesses and jobs in renewable energy generation like solar energy. ARB is also proposing new energy efficiency standards for residential and commercial construction, which will likely lead to the creation of new “green” construction jobs.

Many analysts of green jobs focus only on these new green jobs, which, as we will see, account for far fewer jobs than the larger set of industries that will change as a result of AB 32 regulations and policies. While still a very small portion of jobs in California, these jobs are clearly growing here—and around the world. Venture capital is increasingly directed toward investments in clean tech companies. According to the Cleantech Group, LLC, “clean tech” venture capital investments in California reached more than \$1.7 billion in 2007.

There is strong evidence that clean energy production, including solar, wind, and biomass, is much more labor-intensive than the fossil fuel-based energy sector per unit of energy delivered (*Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* 2004; *Renewable Energy Demand: A Case Study of California*, 2006). A recent report by the Center for Energy Efficiency and Renewable Technology reports that, under every methodology examined, development of the state’s abundant renewable energy resources—solar, wind, geothermal, and biomass—would create more than six times as many jobs as continued reliance on fossil fuels like coal and natural gas (*Harvesting California’s Renewable Energy Resources: A Green Jobs Business Plan*, 2008).

Energy efficiency measures are thought to be even more labor-intensive (Ehrhardt-Martinez and Laitner, 2008). A study by the Center on Wisconsin Strategy, Workforce Alliance, and Apollo Alliance (*Greener Pathways: Jobs and Workforce Development in the Clean Energy Economy*, 2008) estimates that eight to eleven direct jobs are created per \$1 million invested in retrofitting buildings for energy efficiency. The energy efficiency measures that are part of AB 32’s scoping plan could end up creating many new jobs in the emerging green economy.

One of the most comprehensive study to date that quantifies how many green jobs currently exist in California and in which industries those jobs are located is *Clean Technology and the Green Economy*:

---

<sup>5</sup> There is of course some overlap between the jobs discussed here and those in the previous section, but since green jobs have not been assigned an industry code, this is unavoidable.

*Growing Products, Services, Businesses and Jobs in California's Value Network*, which was published by the California Economic Strategy Panel in March 2008. In the study, the authors identify and compile a list of green businesses in California by using green business association documents, the National Establishment Time Series (NETS) database, and other resources. They then match these businesses with other information on the industries they are in and derive an estimate of the number of jobs these green tech businesses account for, and where they are located. The study defines a green business as one that lowers performance costs, reduces or eliminates negative ecological impact, and improves the productive and responsible use of natural resources. It looks not only at green “products” but also at the products' associated chains of suppliers, distributors, and service providers.

The study finds that there are 43,746 jobs in 3,085 green businesses in California, about one-quarter of 1 percent of California jobs in 2006. The study identifies the following green industry segments: energy generation, energy efficiency, transportation, green building, energy storage, environmental consulting, water and wastewater, finance/investment, environmental remediation, air and environment, business services, research and alliances, agriculture, recycling and waste, materials, and manufacturing/industrial.

By green industry segment, the study finds that California's green businesses are primarily in energy generation and energy efficiency. The energy generation sector accounts for 43 percent of California's green businesses. Energy generation includes businesses with primary activities in manufacturing, design, installation, system management, and consulting, as well as various business services and associations focused on energy generation or specific forms such as solar or wind. Within the energy generation sector, solar energy generation comprises 64 percent of the businesses and 53 percent of employment.

The energy efficiency sector makes up 31 percent of green business in California. Within the energy efficiency sector, 40 percent of businesses are in energy conservation consulting. The bulk of employment within the energy efficiency sector is in the manufacturing, design, and sales of low-wattage or zero-wattage lighting products.

The study also looks at how California's green businesses and jobs are distributed across industry sectors according to the North American Industry Classification System (NAICS). It finds that 36 percent of California's green businesses are in professional, scientific, and technical services; 19 percent are in construction; and 15 percent are in manufacturing.

By region, the majority of green businesses and green jobs are found in the San Francisco Bay Area and Southern California regions. Green building and green finance/investment businesses are more numerous in the Bay Area region. Energy efficiency and energy storage businesses are more numerous in the Southern California region. Transportation is equally distributed across the two regions with some activity also taking place in the Southern Border region.

Another study with California-wide data looks at green jobs in the metropolitan regions of California and other states. Using a similar but not identical definition of green jobs, it estimates that there are approximately 73,000 green jobs in 26 large and small metropolitan areas in California (*Current and Potential Green Jobs in the U.S. Economy*, 2008).



A number of regional or industry-specific studies tell similar stories. A study of Los Angeles by the Economic Roundtable (*Jobs in L.A.'s Green Technology Sector*, 2006) found that the most common industry classifications for green technology jobs were professional, scientific, and tech services; construction, including solar power; and manufacturing. A study of Berkeley, California (in the Bay Area region) (*Green Collar Jobs: An Analysis of the Capacity of Green Businesses to Provide High Quality Jobs for Men and Women with Barriers to Employment*, 2007) identified specific positions for which green businesses expressed a need, including skilled carpenters and finishers, certified solar electric installers, and journeyman electricians, and concluded that many of the jobs could be accessible to individuals with barriers to employment. The Environmental Defense Fund's *Green Jobs Guidebook* (EDF, 2008) documents over 200 green occupations, detailing the pay, skill and education requirements. The Centers of Excellence, which are part of California's community college system, have also carried out a number of green jobs studies, looking at the solar industry in California (*California's Solar Industry Workforce, Preview of Key Findings*, 2008), green construction in L.A. County (*Green Construction*, 2007), green jobs in the Central Valley (*Green Economy Workforce Study, Central Valley Region*, 2008), and energy efficiency occupations in the San Francisco Bay Area (*Energy Efficiency Occupations At A Glance*, 2007). All of these studies found that job growth is expected in these industries. These studies all contribute to our growing understanding of green jobs in California, but each defines green jobs differently, and most use a narrow definition of green jobs that excludes the jobs in the heavy-emitting industries that will be transformed due to climate mitigation policy.

Recently, a number of studies have also estimated the impact of economic stimulus packages on the creation of green jobs. A recent study by Pollin, Garrett-Peltier, Heintz and Scharber estimates that a \$100 billion federal investment in a national "green recovery program" would produce about 235,000 jobs in California. Their analysis assumes that California would receive \$12.7 billion in funds for retrofitting buildings, investing in mass transit and freight rail, building a smart grid, and investing in solar, wind, and biofuels.

In the final analysis, AB 32 will, over time, significantly impact jobs in California. It will create opportunities for job growth in the construction trades, including in retrofitting and building new buildings, in building the infrastructure for renewable energy, and in efficiency improvements in manufacturing. Job loss is predicted to be small or may not occur, and dislocations can be managed with targeted assistance programs. Much further research is needed to determine the specific industries and businesses where energy efficiency measures will change jobs significantly, resulting in the need for private and public investment in retraining and new skill development. The workforce and economic changes that will come with AB 32 create tremendous opportunities for policymakers to shape the green transition so that it reduces emissions *and* benefits working families.

## CONCLUSION AND RECOMMENDATIONS: TOWARD AN EQUITABLE TRANSITION

California is on the brink of a major economic transition as it confronts the real need for reducing GHG emissions. The specter of coastal flooding, ongoing drought, and increasingly uncontrollable wildfires in California has led to a consensus that the cost of unchecked climate change is much greater than the cost of reducing emissions. California also suffers from an economic structure characterized by the growth of low-wage jobs and inequality. The state's landmark global warming

legislation, AB 32, will reshape not only the energy industry, but the whole California economy, offering an opportunity to redirect the state's future economic development. California's leadership in reducing GHG emissions positions the state to create a new engine of growth through reinvestment in California industries and promotion of exports to the rest of the country and the world.

The preliminary jobs analysis presented in this briefing paper points to the necessity of specific actions that ARB, other government agencies and California elected officials should take to address the job impact opportunities and challenges that will emerge as climate change mitigation strategies are implemented.

This report supports ARB's overall policy recommendations but urges greater emphasis on the need to prepare California's workforce for the coming job transitions, thereby enabling successful implementation of low-emitting technologies and processes. In addition, ARB and other California agencies and elected officials should more explicitly consider the needs of workers and their families, and ensure that the costs and benefits of the transition are both equitable and transparent. California policymakers should promote policies to ensure that as new jobs replace old jobs, wage and benefit standards are not eroded. An emphasis should be placed on public investment strategies, which can be funded in part or wholly from cap-and-trade revenues, provided the cap-and-trade program is designed with appropriate safeguards.

## Recommendations

### Job Impact Analysis

ARB should analyze the impact of its proposed measures on jobs and workers. Thus far, ARB has not invested sufficient resources in research on job impacts. The macroeconomic models being used by ARB to analyze the California labor market are not currently adequate to address the fundamental questions about job growth, job loss, and job transformation. ARB should improve the job and worker impact analysis in the macroeconomic models, and should commission sector-specific studies of the key sectors that will be affected by scoping plan measures—particularly energy, construction, transportation, and some of the heavy-emitting industries such as cement. ARB should also commission studies to help guide the state in workforce preparedness as AB 32 transforms California's industries and businesses. Since the impact on jobs in California is dependent on the Western Climate Initiative negotiations and how California integrates with the WCI, ARB should also work with the WCI to improve its analysis of employment and job impacts in the WCI region.

### Cap and Trade

ARB's scoping plan proposes a multi-industry cap-and-trade program, to be developed over the next several years in conjunction with the development of the Western Climate Initiative's cap-and-trade program. Many details of the structure and implementation of the cap-and-trade policy will be developed by ARB during a rule-making process over the next two years.

Cap-and-trade programs are a major thrust of climate change mitigation strategies in the U.S. and elsewhere, but are still relatively untested, and, where tested, have had mixed results. To ensure a successful cap-and-trade program that has economic benefits as well as environmental benefits, we

recommend that the following safeguards be included to maximize the benefits to workers and their communities.

- ▶ **Cap and auction:** Within a cap-and-trade policy, one of the most important decisions to be made is whether the government gives carbon allowances away for free to firms already emitting GHGs, whether it auctions the allowances for a fee to the highest bidder, or whether it uses some mix of the two approaches. This report recommends that California have a goal of 100 percent auction of the carbon allowances, to be reached after a short adjustment period for some key enterprises. Auctioning the carbon allowances will prevent windfall profits from accruing to private companies. And, more importantly, the auction proceeds will be needed for a variety of programs that will smooth the transition to a green economy for workers, low-income consumers, and businesses in California. (See Public Investment section, below.)
- ▶ **Leakage:** Leakage refers to a situation in which jobs and carbon emissions leave California if production relocates to other states—or countries—that have less stringent GHG emissions regulations. In order to ensure that leakage does not occur, ARB should explore various policies to prevent leakage and its potential to undermine both environmental and economic goals. This report does not recommend one particular policy to address this problem, but urges ARB and others to study such policies as output-based rebates and border adjustments, among others.
- ▶ **Offsets:** Offsets allow a company to invest in an emissions reduction project outside the capped sectors—such as a reforestation project that can capture carbon—instead of reducing emissions itself. One of the main policy choices is whether offsets should be limited to the geographical area of the cap-and-trade program. For example, should companies be allowed to invest in a biofuel company in Brazil as part of a cap-and-trade program seeking to reduce emissions in California?

This report recommends that offsets be limited to a small portion of covered entities' compliance obligations and that offset projects located in California be given preference. This geographical preference on offsets would keep jobs and investment in California. Offset projects should also meet job quality standards and environmental justice criteria to ensure the maximum co-benefits to the people of California. Offsets must be additional, verifiable, and enforceable by a state agency.

## Renewables Portfolio Standard

ARB's scoping plan proposes that California's Renewables Portfolio Standard (RPS) be increased to 33 percent by 2020. The RPS requires that California utilities generate a certain amount of electricity from renewable resources. Renewable resources include wind, solar, geothermal, small hydroelectric, biomass, and biogas.

The California legislature will need to vote to codify the new RPS. In doing so, it has the opportunity to make sure the RPS is as beneficial as possible for California workers. Possible strategies are requiring that a certain amount of the renewable energy be produced in-state and attaching wage and training standards to jobs associated with renewable energy providers. (See section on Attaching Job and Training Quality Standards to Public Investment and Incentives, below.)

## Public Investment

The transition to a carbon-constrained economy will require both private and public investment. A cap-and-trade program under which the carbon allowances are auctioned by the state can help defray many of the public investment expenses. Even a modest cap-and-auction program can generate several billion dollars annually in revenues that can help businesses, workers, and households change their practices. ARB should create a clear process to set priorities for the use of these new revenues. There is consensus that they should be used to develop and disseminate new technologies that lower carbon emissions and for investments in permanent emissions reductions by emitters. This report also recommends the following investments and investment strategies:

- ▶ *Workforce development:* The transition to an economy that limits GHG emissions will require a significant restructuring of many of California's key industries as they adopt cleaner technologies. Retooling California's workforce training and education infrastructure is clearly important to ensure an adequate supply of trained (and retrained) workers for new and restructuring industries. The analysis presented in this report shows that a large portion of job growth in the green economy will occur in mid-skilled occupations where vocational, community college, and work-based training programs are essential.

New investment in workforce development should build on and complement the existing workforce development system—particularly the union apprenticeship infrastructure—rather than substitute for it. Many of the state's most successful workforce development programs are union apprenticeship programs or other high-road labor-management training partnerships. These represent a tremendous asset for the green transition, particularly because of the key role of construction occupations in new green building, energy efficiency building retrofits, solar energy installation, and construction of renewable energy plants. Apprenticeship programs, in addition to high school and community college vocational educational programs, should be the focus of the state's workforce development strategy for the green transition.

- ▶ *Worker adjustment assistance:* Overall, job loss resulting from AB 32 is expected to be quite small in California, mostly because California's economy is less based on fossil fuels and dirty manufacturing than are the economies of many other states. Job losses in fossil fuel and other industries can be addressed by generous transition programs that will be affordable because of their small scale. Just as the Trade Adjustment Assistance Program was set up to help workers whose jobs were eliminated by increased imports after trade agreements like NAFTA went into effect, so there should be a climate adjustment assistance program to support and provide retraining for displaced workers.

The AFL-CIO developed strong worker protection language for national cap-and-trade policy proposals that are expected to be revived under the new administration in 2009. This language included income and training supports for workers as well as bridges to retirement for workers near retirement. A similar policy should be adopted as part of the AB 32 regulations.

- ▶ *Equity programs:* Without adequate protections, low-income consumers and communities may end up bearing the brunt of increased energy costs that result from the implementation of AB 32. ARB should prioritize equity programs that would protect low-income consumers from the impacts of higher energy prices. Such programs might include income-based rebates, similar to the earned income tax credit, that compensate low-income families for high energy costs while

maintaining the price incentive to economize on energy consumption. They might also include home and building weatherization and energy efficiency retrofits, mass transit, urban infill, innovative financing, and other strategies that can lower households' energy use and vehicle miles traveled, while promoting good jobs.

These policies will benefit low-income consumers who otherwise may be unable to lower their energy use because they are unable to make the up-front investments (for example, by buying a more fuel-efficient car or retrofitting a home). Though many of these interventions depend on actions at the local level, ARB should set robust goals for local community action and provide incentives that can be financed by revenues from a cap-and-auction program.

Another equity consideration is the potential of a cap-and-trade system to exacerbate “hot spots,” which occur when pollutants co-produced with GHGs are concentrated in specific low-income communities. Under a cap-and-trade system, companies may choose to buy carbon allowances rather than reducing their emissions at sites that are expensive to abate. The AB 32 regulations should provide incentives for companies to clean up their emissions in low-income communities, thereby supporting environmental justice while at the same time creating employment in those communities.

- ▶ *Attaching job and training quality standards to public investment and incentives:* Public investment in green infrastructure and green training should include standards for wages and benefits as well as for training programs. A set of policy tools exists to ensure that investments in public infrastructure are carried out by skilled workers and provide some floor for wages and benefits. These include prevailing wages, state-approved apprenticeship job training standards, project labor agreements, and best value contracting. They also include criteria for structuring public investment to prioritize industry projects that include labor-management partnerships, as was part of the national Green Jobs Act language.

In sum, AB 32 will help slow global warming and at the same time generate enormous opportunities for California and its working families. California's initiative in GHG reduction has the potential to create a green economic engine by fostering leading-edge technologies, processes, and products that can be exported to the rest of the world.

Policymakers and ARB must consider the important contribution to this endeavor that workers will make by putting these new technologies and processes into use. As a state, we must invest in our workforce as well as in our technology. We must also make sure that the costs and benefits of the green economy are distributed equitably so that as a community we can move forward to solve the problem of global warming.

## REFERENCES

Asmus, Peter. 2008. *Harvesting California's Renewable Energy Resources: A Green Jobs Business Plan*. Center for Energy Efficiency and Renewable Technologies. [http://www.cleanpower.org/reports\\_pdf/Harvesting\\_California\\_Renewable\\_Energy\\_Resources\\_080815\\_FINAL\\_1st\\_Ed.pdf](http://www.cleanpower.org/reports_pdf/Harvesting_California_Renewable_Energy_Resources_080815_FINAL_1st_Ed.pdf)

Barrett, James P., J. Andrew Hoerner, Steve Bernow, and Bill Dougherty. 2002. *Clean Energy and Jobs: A Comprehensive Approach to Climate Change and Energy Policy*. Economic Policy Institute and Center for a Sustainable Economy. <http://www.epi.org/studies/cleanenergyandjobs.pdf>

Burns, Patrick and Daniel Flaming. January 2006. *Jobs in L.A.'s Green Technology Sector*. Economic Roundtable. <http://www.economicrt.org/download/form.html>

California Air Resources Board. October 2008. *Climate Change Proposed Scoping Plan: A Framework for Change* (AB 32 Scoping Plan). <http://www.arb.ca.gov/cc/scopingplan/document/psp.pdf>

*California Global Warming Solutions Act of 2006, Assembly Bill 32*. <http://www.arb.ca.gov/cc/docs/ab32text.pdf>

Center of Excellence, Economic and Workforce Development, California Community Colleges. March 2008. *California's Solar Industry Workforce, Preview of Key Findings*. <http://ccewd.net/industryscans>

Center of Excellence, Los Angeles Community College District. November 2007. *Green Building: Environmental Scan Report Los Angeles County*. <http://ccewd.net/files/resources/Green%20Building%20and%20Construction-Los%20Angeles%20County.pdf>

Center of Excellence, City College of San Francisco. September 2007. *Energy Efficiency Occupations At A Glance*. [http://ccewd.net/files/resources/Energy\\_Efficiency\\_Occupations-Bay\\_Area.pdf](http://ccewd.net/files/resources/Energy_Efficiency_Occupations-Bay_Area.pdf)

Center of Excellence, Central Valley Region. December 2008. *Green Economy Workforce Study, Central Valley Region*. [http://www.coecc.net/Environmental\\_Scans/GreenEcon\\_Scan\\_CV\\_08.pdf](http://www.coecc.net/Environmental_Scans/GreenEcon_Scan_CV_08.pdf)

Ehrhardt-Martinez, Karen and John A. "Skip" Laitner. 2008. *The Size of the U.S. Energy Efficiency Market: Generating a More Complete Picture*. American Council for an Energy-Efficient Economy. <http://www.aceee.org/pubs/e083.htm>

Global Insight. 2008. *Current and Potential Green Jobs in the U.S. Economy*. U.S. Conference of Mayors. <http://www.usmayors.org/pressreleases/uploads/GreenJobsReport.pdf>

Gordon, Kate, Jeremy Hays, Jason Walsh, Bracken Hendricks, and Sarah White. 2008. *Green-Collar Jobs in America's Cities: Building Pathways Out of Poverty and Careers in the Clean Energy Economy*. Apollo Alliance and Green For All with Center for American Progress and Center on Wisconsin Strategy. <http://www.greenforall.org/resources/green-collar-jobs-in-america2019s-cities>

Henton, Doug, John Melville, Tracey Grose, and Gabrielle Maor. March 2008. *Clean Technology and the Green Economy: Growing Products, Services, Businesses and Jobs in California's Value Network*. California Economic Strategy Panel. [http://www.labor.ca.gov/panel/pdf/DRAFT\\_Green\\_Economy\\_031708.pdf](http://www.labor.ca.gov/panel/pdf/DRAFT_Green_Economy_031708.pdf)

- Henton, Doug, John Melville, Tracey Grose, Gabrielle Maor, and Bridget Gibbons. 2008. *California Green Innovation Index, Inaugural Issue*. Next 10.  
[http://www.next10.org/pdf/GII/Next10\\_FullFindings\\_EN.pdf](http://www.next10.org/pdf/GII/Next10_FullFindings_EN.pdf)
- Hoerner, J. Andrew. January 31, 2006. *A Golden Opportunity: Strengthening California's Economy through Climate Policy. Redefining Progress*.  
<http://www.rprogress.org/publications/2006/goldenopp0106.pdf>
- Intergovernmental Panel on Climate Change. November 2007. *Climate Change 2007 Synthesis Report; An Assessment of the Intergovernmental Panel on Climate Change*.  
[http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf)
- Kammen, Daniel M., Kamal Kapadia, and Matthias Fripp. April 13, 2004 (corrected 1/31/06). *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* Energy and Resources Group, Goldman School of Public Policy, UC Berkeley.  
<http://rael.berkeley.edu/files/2004/Kammen-Renewable-Jobs-2004.pdf>
- Legislative Analyst's Office. November 2008. *LAO's Critique of the AB 32 Scoping Plan Economic Analysis*. [http://www.lao.ca.gov/2008/rsrc/ab32/AB32\\_scoping\\_plan\\_112108.pdf](http://www.lao.ca.gov/2008/rsrc/ab32/AB32_scoping_plan_112108.pdf)
- O'Connor, Tim. 2008. *Green Jobs Guidebook*. Environmental Defense Fund.  
<http://www.edf.org/cagreenjobs>
- Pollin, R., H. Garrentt-Peltier, J. Heintz, and H. Scharber. 2008. *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy*. Political Economy Research Institute (PERI). University of Massachusetts, Amherst.  
[http://www.peri.umass.edu/fileadmin/pdf/other\\_publication\\_types/peri\\_report.pdf](http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/peri_report.pdf)
- Rivera Pinderhughes, Raquel. 2007. *Green Collar Jobs: An Analysis of the Capacity of Green Businesses to Provide High Quality Jobs for Men and Women with Barriers to Employment*. San Francisco State University. <http://bss.sfsu.edu/raquelrp/documents/v12OctoberFullReport.pdf>
- Roland-Holst, David. 2008. *Economic Evaluation Supplement, Climate Change Draft Scoping Plan Pursuant to AB 32, the California Global Warming Solutions Act of 2006*. Appendix III. Economic Analysis of California Climate Policy Initiatives using the Berkeley Energy and Resources (BEAR) Model. [http://www.arb.ca.gov/cc/scopingplan/document/economic\\_appendix3.pdf](http://www.arb.ca.gov/cc/scopingplan/document/economic_appendix3.pdf)
- Roland-Holst, David. August 2006. *Economic Growth and Greenhouse Gas Mitigation in California*. UC Berkeley. [http://calclimate.berkeley.edu/Growth\\_Strategies\\_Full\\_Report.pdf](http://calclimate.berkeley.edu/Growth_Strategies_Full_Report.pdf)
- Sterzinger, George and Jerry Stevens. 2006. *Renewable Energy Demand: A Case Study of California*. Renewable Energy Policy Project. [http://www.apollochallenge.org/CA\\_JOBS\\_REPP.pdf](http://www.apollochallenge.org/CA_JOBS_REPP.pdf)
- White, Sarah and Jason Walsh. 2008. *Greener Pathways: Jobs and Workforce Development in the Clean Energy Economy*. Center on Wisconsin Strategy, Workforce Alliance, and Apollo Alliance.  
<http://www.cows.org/pdf/rp-greenerpathways.pdf>

# UC Berkeley Center for Labor Research and Education

Institute for Research on Labor and Employment  
University of California–Berkeley  
2521 Channing Way  
Berkeley, CA 94720-5555  
(510) 642-6432  
<http://laborcenter.berkeley.edu>

*An affiliate of the University of California  
Miguel Contreras Labor Program*

The Center for Labor Research and Education (Labor Center) is a public service project of the UC Berkeley Institute for Research on Labor and Employment that links academic resources with working people. Since 1964, the Labor Center has produced research, trainings and curricula that deepen understanding of employment conditions and develop diverse new generations of leaders.

## Acknowledgments

Special thanks to Martha Bader, Peter Berck, Cheryl Brown, Barbara Byrd, Peter Cooper, Carla Din, Rich Ferguson, Kate Gordon, Dave Graham-Squire, Jay Hansen, Andrew Hoerner, Lisa Hoyos, Holmes Hummel, Ken Jacobs, Jill Kubit, Jenifer MacGillvary, Manuel Pastor, Tim Rainey, David Roland-Holst, Lucas Ronconi, and Jennifer Tran.

*The views expressed in this policy brief are those of the authors and do not necessarily represent the Regents of the University of California or the UC Berkeley Institute for Research on Labor and Employment.*