

# Climate Change Draft Scoping Plan

## Economic Analysis Supplement

*Pursuant to AB 32  
The California Global Warming Solutions Act of 2006*

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the California Air Resources Board  
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# Economic Evaluation Supplement Climate Change Draft Scoping Plan Pursuant to AB 32 The California Global Warming Solutions Act of 2006

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# **Economic Evaluation Supplement Climate Change Draft Scoping Plan Pursuant to AB 32 The California Global Warming Solutions Act of 2006**

## **Executive Summary**

The California Air Resources Board (ARB) is the lead agency charged with implementation of AB 32, the Global Warming Solutions Act of 2006, which requires a statewide reduction of greenhouse gas emissions to 1990 levels by 2020. As the lead agency, ARB is required to develop and approve a Scoping Plan by January 1, 2009, that proposes a comprehensive set of actions designed to achieve the reductions. In furtherance of this requirement we released a draft Scoping Plan on June 26, 2008.

The draft Scoping Plan set out a Preliminary Recommendation for reducing California's greenhouse gas emissions and described a number of other measures also being analyzed. Key elements of the Preliminary Recommendation include the expansion and strengthening of energy efficiency programs, increasing the Renewable Portfolio Standard to 33 percent, development of a California cap-and-trade program that links with other Western Climate Initiative partner programs, and the implementation of both new and existing state laws and policies geared toward reducing greenhouse gas emissions from the transportation sector.

As required by AB 32, we have conducted an economic analysis of the draft Scoping Plan. This analysis is a thorough assessment of the economic impact of the recommended greenhouse gas emission reduction measures on California consistent with the plan's broad programmatic framework of measures and approaches. It supports our initial estimates that implementing the recommended measures will have a small overall positive impact on economic growth in California. We will analyze individual strategies and measures as they are further developed during the measure development and adoption process.

### **Choosing a Cleaner Path**

The draft Scoping Plan outlines an approach that will position California to move toward a more secure, sustainable future where we invest heavily in energy efficiency and clean technologies. This economic analysis indicates that implementation of that forward-looking approach also creates more jobs and saves individual households more money than if we stood by and pursued an unacceptable course of doing nothing at all to address our unbridled reliance on fossil fuels.

Continued economic growth is perhaps the clearest indicator of the fundamental health of California's economy. Under a business-as-usual case (i.e., without putting into effect any significant measures to reduce global warming emissions) economic growth is expected to total 43 percent between now and 2020, culminating in a Gross State Product of almost \$2.6 trillion. The analysis we have conducted indicates that if

California implements the comprehensive greenhouse gas reduction strategy, as recommended in the draft Scoping Plan, not only will the economy grow by a similar amount as we move toward 2020, but it will grow at a slightly higher rate. Increased economic growth is anticipated primarily because the investments motivated by several measures, such as the expansion and strengthening of existing energy efficiency programs and implementation of new and existing policies to reduce emissions from the transportation sector, result in substantial energy savings that more than pay back the cost of the investments at expected future energy prices. These results support the conclusion that the decision California made in 2006 to reduce its greenhouse gas emissions was not just a good environmental choice, it also will help sustain growth and enable the state to reap the full range of economic benefits that come with a transition to a more sustainable future.

## **Overall Impact on the Economy**

Our analysis relied upon the Environmental Dynamic Revenue Assessment Model (E-DRAM), a macroeconomic model that characterizes the flow of production, consumption, investment, and saving throughout the California economy in response to specified policies. ARB has previously used E-DRAM to assess the economic impacts of its regulations. In this analysis we also used the Berkeley Energy and Resources Model (BEAR) to confirm the E-DRAM results.

Macroeconomic models such as E-DRAM are best suited to analyzing the economy-wide impact of a set of recommended policy measures by taking into account their interaction and the shifting of economic activity across sectors. Such tools and related cost-estimation methods, however, tend to understate the benefits afforded by market-based policies because they cannot accurately model some important cost-saving features of market-based compliance mechanisms, such as those included in California's clean car standards (AB 1493, Chapter 200, Statutes of 2002, Pavley), those anticipated as part of the low carbon fuel standard, and in particular, a cap-and-trade program. This is largely the result of the inability of macroeconomic models to predict how firms might invest in cost-effective energy efficient technologies that will result in reduced greenhouse gas emissions and reduced energy-related expenditures. As a result of this limitation, our economic analysis likely understates the extent of the positive impact on the California economy from the full complement of measures in the Preliminary Recommendation.

With these caveats in mind, our modeling shows that implementation of the Preliminary Recommendation in the draft Scoping Plan will benefit California's economy above and beyond the business-as-usual projections, in 2020, by:

- ◆ Increasing production activity by \$27 billion
- ◆ Increasing overall Gross State Product by \$4 billion
- ◆ Increasing overall personal income by \$14 billion
- ◆ Increasing per capita income by \$200
- ◆ Increasing jobs by more than 100,000

## **Sector Specific Impacts**

In addition to assessing the overall economic impacts of the draft Scoping Plan, we also evaluated the impacts that implementing the Preliminary Recommendation would have on households, employment, businesses including small business, jobs and green technology. Overall economic impacts for each of these sectors are consistent with the other findings and are projected to be small, and for the most part positive, keeping in mind that the models tend to underestimate the benefits to the economy as a result of market mechanisms.

### Business Sectors

Compared to the business-as-usual case the implementation of the Preliminary Recommendations minimally alters current growth projections for most business sectors, and in fact enhances their growth in most cases. A potential decrease in output and employment is, however, projected for the utility and to a lesser extent for the retail sectors. The primary reason for these projections is that consumers are expected to purchase a decreasing amount of electric power, natural gas and gasoline – considered by the model to be a retail ‘product’ – as a result of the implementation of efficiency measures contained in the draft Scoping Plan.

### Low-Income Households

AB 32 recognizes the importance of ensuring that efforts to reduce greenhouse gases do not produce disproportionate impacts on low-income communities. To assess the impacts on low-income households, we analyzed how implementation of the Preliminary Recommendation in the plan would affect per capita income, household expenditures, and jobs. With the plan in effect the average income per capita changed very little for all income groups compared to the business-as-usual scenario. Further, our analysis indicates increased job opportunities for lower skilled workers (40,000 to 50,000 by 2020) and lower overall household expenditures driven by greater energy efficiency. As a result, the analysis concludes that the overall impacts of the Preliminary Recommendation will be positive for low-income households in California.

### Small Business

AB 32 also recognizes the key role that small businesses play in California’s economy. To assess the impacts that implementation of the draft Scoping Plan would have on small businesses in the state, we analyzed how changes in energy expenditures would affect the competitiveness and profitability of small business. To establish those impacts, we drew upon a recent study that demonstrates that implementing a set of policies similar to those recommended in the draft Scoping Plan would decrease the average electricity bill by 5 percent in 2020. Our analysis indicates that small businesses will experience a slight net economic benefit as a result of lower energy

expenditures along with a similar rise in the national competitiveness level of California businesses measured according to the percentage of revenue expended on electricity.

## **Green Technology Leadership**

The development of green technologies and a workforce trained to design, develop and deploy them will be key to the success of California's efforts to reduce greenhouse gas emissions. Our state is already benefitting from the influx of investment capital in green technology. In the second quarter of 2008 California dominated the world investment in clean technology venture capital, receiving \$800 million of the global total of \$2 billion . This places us well ahead of any other state, even though other states, such as Massachusetts and Florida, are now undertaking similar efforts to capture clean technology investment. Taking charge of our state's energy destiny provides California with a key opportunity to create and maintain a steady stream of 21<sup>st</sup> century jobs, and continue our lead ahead of other forward-looking states.

## **The Cost of Inaction**

This economic analysis deals only with the economic impacts of the implementation of the Preliminary Recommendation in the draft Scoping Plan. It does not address other potential costs to California that will directly result from inaction under the business-as-usual case. Doing nothing places California at economic risk from a variety of perspectives. We will continue to be at the mercy of foreign imports of petroleum and the vagaries of the international oil market. We could lose our competitive edge as the nation's technology leader and magnet for venture capital in the field of clean energy technology. And, by doing nothing, California will fail to do its part to help prevent the most severe impacts of climate change, such as reduced snowpack and disruption of water supplies, rising sea level and escalated coastal erosion, increased pollution in our cities, longer and more severe heat waves, and increased wildfire danger. It is important to keep the potential costs of adapting to such impacts in mind as a background and context for the measures and approaches analyzed here..

## **Peer Review and Next Steps**

As part of our effort to develop the most complete picture possible of the economic impacts of state greenhouse gas emission reduction policies, we will be submitting this analysis to an independent panel for peer review. In addition to the formal peer review the economic analysis and related ongoing work will also be reviewed by the Climate Action Team. We also will review any economic analyses of the draft Scoping Plan submitted by outside parties.

## **Conclusion**

The draft Scoping Plan Preliminary Recommendation contains a robust and effective mix of approaches and takes advantage of the strengths each approach offers. It calls

for the deployment of efficient technologies and strategies which will both reduce emissions and save consumers money. Performance standards with market mechanisms will further allow regulated businesses to meet those standards in the most efficient and profitable manner. A multi-sector cap-and-trade program will provide a strong financial incentive for both producers and consumers to search out and pursue the most cost-effective emissions reduction opportunities in ways that will achieve additional savings not fully captured within the model.

The economic impact to the state is not the only consideration when choosing which path to pursue; there are other aspects and benefits to consider. In this regard, the Preliminary Recommendation offers not only financial savings predicted within the model, but also assures that meaningful emission reductions will occur in *each* sector of the California economy. It creates a policy framework to maximize participation and benefits at every level of government including state, regional and local. The cap-and-trade program provides further environmental and leadership benefits including placing an absolute emission limit on capped sectors, expanding coverage of the program through the Western Climate Initiative, providing a model for future federal programs, and creating larger markets for California's clean technology industries.

Moving forward, ARB will continue to refine its economic analysis of the measures contained within the Scoping Plan, as well as evaluate the results of the peer review and other relevant modeling. While an important part of the process of developing the proposed plan, the results of the economic analysis will inform, but not wholly decide the full range of measures and approaches that will constitute the plan adopted by the Air Resources Board. Once the final Scoping Plan has been adopted, ARB will conduct further economic modeling for each of the measures pursued to inform the best design of those measures. The analysis presented here, therefore, represents the beginning, not the end, of what will be an ongoing evaluation of the best ways to achieve the goals of the overall program.

California has all of the ingredients to emerge as the vanguard of 21<sup>st</sup> century economies that are built upon clean, efficient and renewable energy sources. The state has a track record of successful and transformative innovation, a strong commitment to both public and private investment in new technologies, and a history of demonstrated success in designing environmental policies that also help to foster economic growth. The results of the economic analysis clearly show that California can achieve the goals of Global Warming Solutions Act and maintain and enhance its economic and environmental leadership.





# 1 INTRODUCTION

California strengthened its commitment to address and respond to climate change when Governor Schwarzenegger signed Assembly Bill 32, the Global Warming Solutions Act of 2006 (Núñez, Chapter 488, Statutes of 2006). As the lead agency for implementing AB 32, the Air Resources Board (ARB) is developing a Scoping Plan that will lay out a comprehensive set of actions designed to reduce greenhouse gas emissions in California, improve our environment, reduce our dependence on oil, diversify our energy sources, save energy, and enhance public health while creating new jobs and driving growth in California's economy.

The California Air Resources Board released the draft Scoping Plan on June 26, 2008. The Draft Plan provides a Preliminary Recommendation that includes a mix of strategies that combine market mechanisms, regulations, voluntary measures, fees, and other policies and programs to reduce greenhouse gas emissions. Key elements of ARB's Preliminary Recommendation for reducing California's greenhouse gas emission levels to 1990 levels by 2020 include:

- Expansion and strengthening of energy efficiency programs, and building and appliance standards;
- Expansion of the Renewables Portfolio Standard to 33 percent;
- Development of a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system;
- Implementation of existing state laws and policies, including California's clean car standards, goods movement measures, and the low-carbon fuel standard; and,
- Targeted fees to fund the state's long-term commitment to AB 32 administration.

Virtually every sector of California's economy will play a role in reducing greenhouse gas emissions. Implementation of the Scoping Plan will require our state's industrial, commercial and consumer sectors to invest in new, more efficient technologies and it will put California at the forefront of forward-looking economies that will be driven by clean, safe and secure energy sources.

This Economic Analysis Supplement summarizes our evaluation of the economic costs and benefits associated with the measures set out in the Preliminary Recommendation of the draft Scoping Plan. As is further discussed below, available models and related cost estimation methods tend to underestimate the important cost-saving features inherent to market-based policies such as the proposed cap-and-trade program and the market-based compliance mechanisms included in the clean car standards and the low carbon fuel standard. As a result we have had to adapt the available tools to approximate the Preliminary Recommendation, with the result that the likely costs of achieving the targeted reductions are likely to be overstated.

## Next Steps

We are requesting comments on this supplement as soon as possible, while recognizing that comments on this document will not be able to be reflected in the

October 3<sup>rd</sup> release of the proposed Scoping Plan. The October 3<sup>rd</sup> proposed Scoping Plan will contain an economic assessment of the final staff recommendation, and it will be available for additional public comment.

Comments received on this document (the economic analysis) will be considered along with all other comments about the measures and the economic analysis in the proposed Scoping Plan that will be presented to the Board for adoption at its November hearing.

Staff will provide an update at the November Board meeting, as needed, to respond to comments received on the economic analysis that is included with the October 3<sup>rd</sup> proposed Scoping Plan. The economic impact of the proposal will be one of a number of factors that the Board will weigh when it considers adoption of the proposed Plan at its November hearing.

Even after Board approval, the measures in the Scoping Plan will undergo additional development and refinement. All of the measures in the Scoping Plan must be adopted through the normal regulatory or other formal processes, with the necessary analysis and public input. Most of the measures included in the draft Scoping Plan do not have fully developed implementation details, so the information currently available regarding their costs and savings is necessarily preliminary. Further economic analysis will be conducted when ARB and other agencies move to adopt regulations or programs to implement the measures.

## **Structure of the Analysis**

The evaluation summarized here relied primarily on two macroeconomic models of California, using current estimates of the costs and savings of the various measures being analyzed. In addition to considering the macroeconomic impacts of the Preliminary Recommendation on California, other impacts are considered, including: preliminary evaluation of the potential effects on low-income households, other households, and businesses, particularly small businesses.

The following subsection summarizes the models we used to perform the analysis. Section 2 presents the results both from a macroeconomic perspective and in relation to certain sectors including households and small businesses. Section 3 presents an analysis of the “Greentech” sector and the role it will play in California’s greenhouse gas reduction efforts. Section 4 describes the peer review procedure that this Economic Analysis Supplement will undergo. Section 5 summarizes our overall findings and outlines the path forward.

### **1.1 Summary of Models**

This section outlines the modeling approach employed and the models used. (Full descriptions of the models and a summary of the costs and savings of the measures that were modeled are included in the appendices.) In large part, the results of any

macroeconomic analysis are driven by the input assumptions; our cost and savings estimates that constitute many of these inputs are based on the best information available to staff. As with all elements of this analysis, we welcome stakeholder comment on these estimates. In addition to the models and modeling analysis described in this supplement, we will also review any stakeholder analyses of the draft Scoping Plan policies. We believe that obtaining results from additional models and methodologies will help to further inform the assessment of potential impacts of the Scoping Plan policies on California's economy.

## **Macroeconomic Modeling**

The primary economic analysis was conducted using the Environmental Dynamic Revenue Assessment Model (E-DRAM). This is a 'general equilibrium macroeconomic model' of the California economy, meaning that it calculates changes in the prices of goods and services and factors of production in the economy in such a way that the total quantity demanded and supplied is kept in balance – in equilibrium. As a result it is possible to track the flow of money from one sector to another when a specific policy is set in place. E-DRAM was originally developed for use by the California Department of Finance and was subsequently refined to assess the impacts of environmental regulations.<sup>1</sup> ARB has used E-DRAM for several years for a variety of economic assessments, including evaluation of the potential economic impacts on California associated with the State Implementation Plan for the Clean Air Act and the greenhouse gas motor vehicle regulations developed in response to AB 1493. E-DRAM was also used for the macroeconomic analysis of the Climate Action Team (CAT) report. More background on E-DRAM and a full description of the modeling results can be found in Appendices I and II.

Professor David Roland-Holst of UC Berkeley also ran the Berkeley Energy and Resources Model (BEAR) for this analysis. The inputs and assumptions for E-DRAM and BEAR were made consistent for this effort. BEAR uses the same underlying data regarding industry linkages as E-DRAM and has also been used extensively to analyze the impacts of policies. The specific results from the BEAR model runs are generally consistent with the E-DRAM results and are not reported separately here. (Professor Roland-Holst's analysis appears in Appendix III.)

Both E-DRAM and BEAR are macroeconomic models that characterize the flow of production, consumption, investments and savings throughout the economy in response to policies. In order to model the measures being evaluated, the estimated costs and savings must be mapped to the applicable sectors in the model. This is an important step because the relationship that sectors have with one another describes how dollars flow throughout the economy. The relationships on how dollars flow throughout the economy are defined in a Social Accounting Matrix discussed further in the appendices.

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<sup>1</sup> The Department of Finance itself does not generate long-term economic projections for the entire California economy; however, its demographic forecasts are used as inputs to E-DRAM.

The input assumptions for both E-DRAM and BEAR were based on cost and savings assumptions for the individual measures in the draft Scoping Plan developed by staff from the ARB and other state agencies. The costs and savings of each measure were analyzed using a standard ARB methodology to consider costs, savings, and cost-effectiveness of its proposed regulations for the past three decades. (Additional information on the development of these estimates is provided in Appendix I of this Supplement.)

The modeling results are highly sensitive to the input assumptions. As previously mentioned, the measure-by-measure cost estimates represent the best information currently available to the ARB. The level of detail on the costs and saving for the different measures included in the Scoping Plan vary widely. Some of the measures are in the later stages of regulatory development, and as a result, costs and savings estimates were readily available. For other measures that have yet to undergo the full regulatory process, costs and savings were specifically estimated for the draft Scoping Plan.

## **Energy Sector Modeling**

ARB has also been working with a third model, ENERGY 2020, developed by System Solutions Incorporated (SSI). In response to a competitive solicitation, ICF International and its subcontractor, SSI were selected to support a more detailed analysis of the economic impact of energy-related measures using the ENERGY 2020 model. This modeling analysis would provide another perspective to supplement the E-DRAM results.

ENERGY 2020 is intended to assess the interactions of the energy sector with the rest of California's economy. It is an integrated multi-region energy model that provides energy demand and supply sector simulations. The model includes a detailed representation of the end uses that determine fuel demand, including for electricity. The change in these end uses (appliances, equipment, buildings) is simulated explicitly, and the model reflects the gradual introduction of more efficient technologies over time. The ENERGY 2020 electricity sector modeling framework was also informed by the California Public Utility Commission modeling work done under contract with Energy and Environmental Economics, Inc. (E3).

However, at this time no results are available from ENERGY 2020 because the model has not yet been fully calibrated. The calibration effort consists of harmonizing the ENERGY 2020 model with a business-as-usual case consistent with California-specific projections for emissions as well as demand for energy sources (e.g., gasoline). The calibration effort has required several more months of work than anticipated and, as indicated, is still underway. ARB has also been working with the contractor to incorporate detailed California-specific measure descriptions into the model. Although the methodology to integrate ENERGY 2020 and E-DRAM has been developed (i.e., mapping ENERGY 2020 outputs to E-DRAM inputs so that the models can work together), the calibration of investment and fuel expenditures has not been completed.

Thus, ENERGY 2020 will not be used in the analysis of the Scoping Plan, but is expected help to inform the subsequent regulatory phase of the program. ARB continues to work with ICF International and its subcontractor, SSI, to further refine and calibrate the ENERGY 2020 model and prepare it for evaluation of future regulations and policy designs.

## 1.2 Challenges in Modeling Market-Based Approaches

The primary insight to be gained from our macroeconomic modeling is the combined net beneficial impact of the set of recommended policies and measures embodied in the Preliminary Recommendation on the California economy, taking into account their interaction and the shifting of economic activity across sectors. For the reasons outlined below, however, such models understate the benefits associated with market-based polices, and thus also likely understate the full range of the beneficial impacts.

### 1.2.1 Limitations of Available Models

Macroeconomic models such as E-DRAM are well suited to analyzing the economy-wide impact of a set of recommended policy measures, taking into account their interaction and the shifting of economic activity across sectors. As noted above, E-DRAM has been used in this fashion for a variety of past economic assessments.

Such models face several challenges in attempting to model market-based policies. First, the macroeconomic tools do not have the ability to predict how firms might invest in cost-effective energy efficient technologies that will result in reduced greenhouse gas emissions and reduced energy-related expenditures. Such cost-saving investments can only be reflected if they are specified in advance as inputs to the model. This can be done for specific investments and measures for which the costs and savings have been estimated.

But available models do not have a mechanism to properly determine the nature or costs of “unspecified reductions” that are anticipated due to the broad flexibility allowed by a cap-and-trade program. By their very nature, such reductions cannot be attributed in advance to any specific measures or even source type. In order to produce additional unspecified reductions the models simulate a more costly alternative. They adjust each sector’s output and resulting emissions by adjusting prices of products so that they reflect the cost of GHG emissions (based upon calculated allowance prices) until the required emissions reductions are achieved. Consequently, emissions reductions in the model occur in response to reduced demand induced by increased prices. This provides an inaccurate picture that overestimates the costs of how a cap-and-trade program would operate in practice, since it fails to account for new investment that could increase efficiency and produce emissions reductions either at a net savings or lower cost.

In addition, the macroeconomic models operate at the sector level and, therefore, do not have the ability to capture the heterogeneity of facility-level emission reduction opportunities, that is, the full range of options for reducing greenhouse gas emissions available at individual facilities throughout the state. One of the primary advantages of market-based policies is that they take advantage of this heterogeneity—both in terms of variety of existing options and range of ability to innovate—to minimize costs.

Such savings have been documented by empirical studies. As was noted by the Market Advisory Committee, “This potential for cost savings is not simply a theoretical proposition. Studies indicate substantial cost savings from existing cap-and-trade programs. The two major studies of cost savings for the SO<sub>2</sub> program<sup>2</sup> are in general agreement that savings under the trading program amounted to 43–55 percent of expected compliance costs under an alternative regulatory program that imposed a uniform emission standard. Carlson et al. cite savings of over 65 percent compared to a policy that might have forced post-combustion controls (scrubbers) to achieve the same level of emissions.”<sup>3</sup> However, the models and related cost estimation methodologies treat all facilities within a sector as similar and therefore do not capture the cost reducing benefits of market-based policies that these studies have demonstrated.

Moreover, the models do not fully capture how individual consumers can and will take steps to pursue lower cost options. This is being observed today as consumers change driving habits and make greater use of public transit, carpooling and biking in response to gasoline price increases. In addition, over time, market-based approaches provide an incentive to find innovative ways to reduce emissions beyond the level necessitated by an individual firm under a performance standard. Again, available models do not capture how such innovation can reduce cost.

Other modeling tools can provide a more detailed look at the cost reduction options available to facilities. For example, ENERGY 2020 and similar models allow for an investment in improved energy efficiency as a way to achieve emission reductions. These models also treat all facilities in a sector the same with the exception of the utility sector, which in some models is represented at the individual power plant level. In general they face the same inability to capture market-oriented cost savings resulting from facility-level decisions.

### **1.2.2 Approach Used to Address Limitations**

The Preliminary Recommendation in the draft Scoping Plan incorporates a regulatory-based cap-and-trade program that links with the Western Climate Initiative, as well as a number of more narrowly defined regulatory measures, many of which make extensive use of market mechanisms. Our assessment of the economic impact of the Preliminary

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<sup>2</sup> Carlson et al., 2000 and Ellerman, 2003

<sup>3</sup> Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California, Recommendations of the Market Advisory Committee to the California Air Resources Board, June 30, 2007, p. 7.

Recommendation is subject to the limitations of the models noted above with a resultant underestimation of benefits.

Given those limitations we have approximated the operation of the cap-and-trade program as well as the available modeling tools allow. For example, to capture how facilities might make technology changes to reduce emissions, the costs and savings of known efficiency measures were identified so that the cost- per ton for reductions from those measures could be compared to allowance prices under a cap-and-trade program. It is then assumed that facilities will choose to implement measures that cost less than anticipated allowance prices, to the extent they have been identified.

This approach provides a conservative approximation of how a portion of the reductions will be achieved by industry. This technique partially addresses the model's lack of an internal mechanism to identify efficiency measures, but cannot fully eliminate it. Further, the model does not allow for the impact of innovation on cost reduction, and does not reflect the variety of emission reduction opportunities at the individual facility level.

Keeping these limitations in mind, our estimate of the economic impact of the Preliminary Recommendation will understate the benefits of the market-based policies—including the cap-and-trade program—and therefore will understate the positive impact of the Preliminary Recommendation on the California economy. We nevertheless believe that the estimate provides useful information and is a reasonable application of the model.

### **1.2.3 Valid Comparison of Approaches Not Possible**

The limitations of the available modeling tools noted above prevent a comparison between market-based approaches and alternative strategies, such as one that relies only on direct regulation. It is worth noting that, to our knowledge, no previous work has made such a comparison in any rigorous way that incorporates the costs and savings of specific reduction measures. Other studies have either only modeled variations on one approach – typically one that includes market-based measures – or have used a broad-brush surrogate for a regulatory approach, such as uniform percentage reductions employed at the sector level, rather than incorporating the detailed cost and savings information from individual measures.

It is important to understand, as well as possible, the potential impacts of the various options available, and we devoted considerable time and effort to analyze alternatives to the preliminary recommendation. We have ultimately concluded that tools are not available to make a valid comparison of one approach to the others, in great part because of the inability of the model to capture the benefits of the market mechanism measures. Therefore, it is inappropriate and misleading to provide the results in the form of a direct comparison, and we do not report results in that fashion in this document. We are providing Appendices II and III which document for E-DRAM and

BEAR, respectively, the results from our initial effort to evaluate the economic impact of using alternative approaches to reduce emissions to the 2020 goal, including an option that relies entirely on direct regulation.

### 1.3 Western Climate Initiative Modeling Activity

The draft Scoping Plan recommends that California develop a cap-and-trade program that links to the broader regional market being developed by the Western Climate Initiative (WCI). The partners of the Western Climate Initiative are conducting economic modeling and analysis to evaluate the implications of cap-and-trade program design options. The analysis is designed to examine a range of program design issues, including:

- Program scope: the sectors, sources, and GHGs included in the cap-and-trade program, including potential phasing in of sectors;
- Allowance allocation: auction, free distribution (using a range of methods) and hybrid approaches; and,
- Flexible compliance mechanisms: emission offsets, banking, and borrowing.

The analysis focuses on assessing outcomes at the regional level, including:

- Economy-wide costs and savings.
- Cap-and-trade program outcomes, including allowance price, offsets used, and allowances banked.
- Emissions impacts, including emission reductions under the cap-and-trade program and reductions in the sectors outside the scope of the cap-and-trade program.

The WCI partners are using ENERGY 2020 to conduct this analysis. The WCI work, as is appropriate for a multi-state analysis, is analyzing broad greenhouse gas reduction policies applied uniformly across the region rather than incorporating state by state specific implementation details.

The WCI website ([http://www.westernclimateinitiative.org/Economic\\_Analysis.cfm](http://www.westernclimateinitiative.org/Economic_Analysis.cfm)) contains an overview of the modeling and analysis. As of August 2008, the analysis is covering the area of the Western Electric Coordinating Council (WECC). This includes eight of the 11 WCI partners: Arizona, British Columbia, California, Montana, New Mexico, Oregon, Utah, and Washington. The main inputs to ENERGY 2020 are presented in the Assumptions Book for ENERGY 2020, which is being updated as the analysis proceeds, and is also posted on the WCI website. The inputs include:

- Historical energy consumption data by sector;
- Forecasts of fuel prices through 2020;
- Population forecasts by state and province through 2020; and,
- Forecast of economic growth by sector by state and province through 2020.



The WCI partners' analysis incorporated a set of policy assumptions into the reference case against which the cap-and-trade programs would be evaluated. These policy assumptions include:

- Energy efficiency, fuel standards, and automobile fuel efficiency (CAFE) standards from the Energy Independence and Security Act; and,
- Existing renewable portfolio standards adopted in the WECC states and provinces.

Additionally, the reference case incorporates assumptions regarding the availability and cost of various electric generating technologies and emission control technologies, including: fossil fuel-fired generation (oil, gas, and coal) and wind, solar, biomass and geothermal generation.

The status of the WCI partners' modeling work was presented at a July 29, 2008, stakeholder workshop in San Diego, California. At this time, the WCI partners' modeling team is continuing to specify the model and results are not yet available.

The WCI modeling work will not be directly comparable to the results reported here. It relies on a more aggregated set of GHG emission reduction measures rather than the specific individual policies recommended in the draft Scoping Plan; it uses somewhat different assumptions regarding what measures are included in the "business-as-usual" case, and it is modeling the entire WECC rather than California. Nevertheless, the results of the WCI modeling, when available, will provide further insight into the economic impact of greenhouse gas emission reduction policies. ARB staff are closely following the WCI work and will incorporate results as they become available.

## **2 SUMMARY OF ARB MACROECONOMIC ANALYSIS RESULTS**

To evaluate the economic impacts of the draft Scoping Plan, we compare estimated economic activity under a business-as usual (BAU) case to the results obtained when the policies in the Preliminary Recommendation are implemented. The BAU case and the Preliminary Recommendation are briefly described below and discussed in greater detail later in this section. The estimated costs and savings used as model inputs for individual measures are outlined in Appendix I. Additional detail for all of the individual measures contained in the draft Scoping Plan can be found in Appendix C of that plan. All monetary estimates are in 2007 dollars.

Under the business-as-usual (BAU) case described below, Gross State Product (GSP) in California is projected to increase from \$1.8 trillion in 2007 to around \$2.6 trillion in 2020. The results of our economic analysis indicate that the Preliminary Recommendation in the draft Scoping Plan will have an overall positive, but relatively small, net economic benefit for the state. Positive impacts are anticipated primarily because the investments motivated by several measures result in substantial energy savings that more than pay back the cost of the investments at expected future energy prices.

**Business-as-Usual (BAU) Reference Case:** The business-as-usual case is a representation of what the state of the California economy will be in the year 2020, assuming that none of the measures included in the draft Scoping Plan are implemented. While a number of the measures in the plan will be implemented as the result of existing federal or state policies and do not require additional regulatory action resulting from the implementation of AB 32, we do not include them in the BAU case to ensure that the economic impacts of all of the measures in the draft Scoping Plan are fully assessed.

The BAU case is not generated by the E-DRAM or BEAR models. Rather, the BAU case is constructed using several forecasts from other sources. Additional information about these sources can be found in Appendix II. Aspects of the BAU case are subject to uncertainty, for example to the possibility that future energy prices could deviate from those that are included in the BAU case. Sensitivity analysis is warranted to assess potential variations in the BAU case, and how those variations affect the economic impacts of the Scoping Plan.

**Preliminary Recommendation:** The Preliminary Recommendation in the draft Scoping Plan includes measures related to energy efficiency, alternative fuels and high global warming potential gases, and a regulatory-based cap-and-trade program that together reduce emissions by 169 MMTCO<sub>2</sub>e to meet the 2020 total emission target of 427 MMTCO<sub>2</sub>e. The key measures providing the reductions include:

- Implementation of existing state laws and policies, including California's clean car standards (AB 1493), goods movement measures, and the low-carbon fuel standard;
- Expansion of the Renewables Portfolio Standard to 33 percent;
- Expansion and strengthening of existing energy efficiency programs, and building and appliance standards;
- Development of a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system;
- Regional targets to reduce emissions associated with land use, along with other local government action; and,
- Reduction of high GWP gases (e.g., hydrofluorocarbons or HFCs).

## 2.1 Impact of the Draft Scoping Plan on California's Economy

Table 1 summarizes the modeling results. Several economic indicators are shown for 2007 and for the 2020 model results from the business-as-usual (BAU) case and the Preliminary Recommendation. Though the model results include other metrics, Gross State Product, personal income and employment have historically been determined to be most useful for evaluating the macroeconomic impacts of policies and economic well-being. Under the BAU case, Gross State Product increases by \$775 billion between 2007 and 2020, personal income grows by 2.8 percent per year from \$1.5

trillion in 2007 to \$2.1 trillion in 2020, and employment grows by 0.9 percent per year from 16.4 million jobs in 2007 to 18.4 million jobs in 2020.

As noted above, macroeconomic models will understate the benefits of market-based policies, including the cap-and-trade program. Consequently, our estimate of the economic impact of the Preliminary Recommendation understates the positive impact on the California economy. Nonetheless, using the current best estimates of the costs and savings of the measures, the models demonstrate that the Preliminary Recommendation has a positive effect on Gross State Product, personal income and employment. For example, Gross State Product and personal income are projected to increase slightly more than they would in the BAU case, by about 0.15 and 0.6 percent, respectively, and employment is also projected to experience an increase of 0.6 percent. The modeling results indicate that California can meet the ambitious AB 32 target while maintaining and enhancing economic growth.

**Table 1: Summary of Economic Impact Modeling of the Draft Scoping Plan Using E-DRAM**

<b>Economic Indicator</b>	<b>2007</b>	<b>Business-as-Usual<sup>1</sup></b>	<b>Preliminary Recommendation<sup>2</sup></b>
Real Output (\$Billion)	2,535	3,597	3,624
Gross State Product (\$Billion)	1,811	2,586	2,590
Personal Income (\$Billion)	1,464	2,093	2,106
Income Per Capita (\$Thousand)	38.6	47.56	47.72
Employment (Million Jobs)	16.41	18.41	18.51
Emissions (MMTCO <sub>2</sub> e)	500 <sup>3</sup>	596	427
Carbon Prices (Dollars)	-	-	9.75

<sup>1</sup> Business-as-usual is a forecast of the California economy in 2020 without implementation of any of the measures identified in the draft Scoping Plan.

<sup>2</sup> Includes all measures in the Preliminary Recommendation in the draft Scoping Plan, plus additional emission reduction options expected to be undertaken because they are estimated to have a cost-per-ton lower than the market price.

<sup>3</sup> Approximate value. ARB is currently estimating GHG emissions for 2007.

The economic impacts of the draft Scoping Plan are expressed as changes from a business-as-usual estimate of California’s economic growth. As noted, the BAU case assumes that none of the measures included in the draft Scoping Plan are implemented. As Table 2 below indicates, in the BAU case Gross State Product is projected to grow by about 2.7 percent annually to a value of nearly \$2.6 trillion by

2020. Personal income is projected to grow by approximately 2.8 percent annually and job growth is also expected to continue as we move toward 2020.

**Table 2: Business-as-usual Case for California Economy**

Economic Indicator	2007	2020	Change	Average Annual Growth (%)
Real CA Output (\$Billions)	2,535	3,597	1,062	2.7%
Gross State Product (\$Billions)	1,811	2,586	775	2.7%
California Personal Income (\$Billions)	1,464	2,093	628	2.8%
Income Per Capita (\$1000)	38.6	47.6	9	2.8%
Employment (Millions)	16.4	18.41	2	1.6%
Emissions (MMTCO <sub>2</sub> e)	500 <sup>1</sup>	596	96*	1.4 <sup>1</sup>

<sup>1</sup> Approximate value. ARB is currently estimating the GHG emissions for 2007.

Table 3 shows how implementation of the Preliminary Recommendation would impact California’s economy relative to a business-as-usual growth trajectory between now and 2020. As indicated in the table, the effects on output, personal income and employment are small but positive. Total output, which represents production activity in the state, increases by 0.8 percent over BAU. This translates into an increase of approximately \$27 billion in 2020, which is a relatively minor increase when evaluated in the context of a \$2.6 trillion economy, but still positive nonetheless. Also represented in Table 3 are the impacts of the Preliminary Recommendation on Gross State Product, personal income, income per capita, and employment. In each case, the modeling shows a similar positive, but small, impact.

**Table 3: E-DRAM Estimates of Economic Impacts of the Draft Scoping Plan Preliminary Recommendation**

Economic Indicator	BAU Case	Preliminary Recommendation	Change	% Change
Real Output (\$Billions)	3,597	3,624	27	0.8%
Gross State Product (\$Billions)	2,586	2,590	4	0.2%
Personal Income (\$Billions)	2,093	2,106	14	0.6%
Income Per Capita (\$1000)	47.56	47.72	0.2	0.3%
Employment (Millions)	18.41	18.51	0.1	0.6%
Emissions (MMTCO <sub>2</sub> e)	596	427	169	-28%
Carbon Price (Dollars)	NA	9.75	NA	NA

The positive impacts are largely attributable to savings that result from reductions in expenditures on energy. These savings translate into increased consumer spending on goods and services other than energy. Many of the measures entail more efficient use of energy in the economy, with savings that exceed their costs. In this way, investment in energy efficiency results in money pumped back into local economies. Table 4 summarizes the energy savings that are projected from implementation of the

Preliminary Recommendation in the draft Scoping Plan. These savings are estimated to exceed \$20 billion annually by 2020.

**Table 4: Fuels and Electricity Saved in 2020 from Implementation of Preliminary Recommendation**

	<b>Gasoline</b>	<b>Diesel</b>	<b>Electricity</b>	<b>Natural Gas</b>
<b>Use Avoided</b>	4,100 million gallons	340 million gallons	46,000 GWh	2,200 million therms
<b>Value of Avoided Fuel Use (Million \$2007)</b>	\$15,000	\$1,300	\$4,000 <sup>1</sup>	\$1,700
<b>Percent Reduction from BAU</b>	22%	7%	14% <sup>2</sup>	18%

<sup>1</sup> Based on estimated avoided cost based on average base-load electricity, including generation, transmission and distribution.

<sup>2</sup> This is as a percentage of BAU total California electricity consumption in 2020.

All told, the specified reduction measures in the draft Scoping Plan's Preliminary Recommendation (not including additional unspecified reductions from cap and trade) are expected to reduce emissions of approximately 169 MMTCO<sub>2</sub>e at a net savings of about \$14 billion, providing a positive stimulus to the economy.

When modeling the Preliminary Recommendation, the model should reflect the fact that facilities will pursue emission reduction options that have a cost per ton that is lower than the market price. In the absence of complete information on what those options might be, we included in the model runs the technical options that have been identified as part of the additional measures under consideration that cost less than the allowance price (other than feebates, because of the regulatory structure that would be necessary to implement that measure). Thus, this approach provides a rough approximation of how a portion of the reductions from the market approach would be achieved. This produces, however, an incomplete list of choices since the model does not have the capability to adequately reflect the full set of options that are available to covered sectors under cap and trade. This approach resulted in measures that provided an additional 21 MMTCO<sub>2</sub>e in reductions included in the model run of the Preliminary Recommendation. Reductions for the remaining 14 MMTCO<sub>2</sub>e were then modeled using an approach that represented pricing mechanisms that moderated consumer demand. Appendix I provides a complete list of the measures, included in this modeling run.

As a result, the modeling results presented for the cap-and-trade program of the Preliminary Recommendation reflect a carbon price of slightly less than \$10 per ton. It is important to note that the \$10 per-ton figure does not reflect the average cost of reductions; rather, it is the *maximum* price at which reductions to achieve the cap are pursued. We will continue to evaluate these results and anticipate that modeling efforts

currently underway in the Western Climate Initiative will provide useful additional information.

## 2.2 Impact on Specific Business Sectors

In addition to evaluating the projected statewide macroeconomic impacts of implementation of the draft Scoping Plan, we also modeled how implementation will affect specific sectors. E-DRAM is capable of generating information at a general level of detail that describes how specific sectors of the California economy will be affected. Additional discussion regarding how E-DRAM models sector specific impacts and the various types of industries that comprise each sector can be found in Appendices II and IV.

As indicated in Table 5, the effects of the plan are not uniform across sectors. Implementation of the Preliminary Recommendation in the draft Scoping Plan would have the strongest positive impact on output and employment for the agriculture, forestry and fishing sector; the finance, insurance and real estate sector; and the mining sector. Similar to the statewide economic impacts projected by the model, these results also indicate that impacts due to implementation of the plan, compared to the business-as-usual case, are still positive, and alter the current growth projections for most sectors by only very small amounts.

Table 5 also shows that for several sectors a decrease in output and employment is projected. In the utility sector, the modeling indicates that implementation of the Preliminary Recommendation would significantly reduce the need for additional power generation and natural gas consumption which subsequently reduces the growth in output for this sector. This results in a reduction from business-as-usual for both economic output and employment of approximately 16 and 14 percent, respectively, in 2020. The primary reason for these projections is the implementation of efficiency measures and programs for both consumers and producers as described in the draft Scoping Plan.

The retail trade sector, which is projected to grow by nearly 50 percent in both the business-as-usual and the Preliminary Recommendation case, is also projected to experience a slight net decline in output relative to business-as-usual. Since gasoline is considered a consumer retail purchase under this model, the reduced growth is mostly due to the decrease of approximately \$16 billion in retail transportation fuel purchases, which is largely offset by the \$12 billion increase in spending at other retail enterprises.

**Table 5: E-DRAM Estimates of Sector Specific Economic Impacts  
of the Preliminary Recommendation**

Sector	Output (\$Billions)				Employment (thousands)			
	2007	BAU	Prelim Rec	Percent Change from BAU	2007	BAU	Prelim Rec	Percent Change from BAU
Agriculture, Forestry and Fishing	76	109	113	3.7%	398	449	464	3.4%
Mining	26.6	28.7	30	4.5%	26	26	26	0.4%
Utilities	51	72	61	-15.9%	60	67	58	-13.8%
Construction	114	164	166	1.5%	825	929	933	0.5%
Manufacturing	673	943	947	0.4%	1,821	2,046	2,055	0.4%
Wholesale Trade	120	171	173	0.8%	703	791	792	0.0%
Retail Trade	207	296	291	-1.5%	1,688	1,901	1,915	0.7%
Transportation and Warehousing	76	109	110	1.0%	447	503	506	0.5%
Information	164	235	238	1.0%	398	448	450	0.4%
Finance, Insurance and Real Estate	391	559	571	2.1%	911	1,026	1,044	1.8%
Services	636	910	925	1.7%	5,975	6,729	6,769	0.6%
Government	-	-	-	-	3,100	3,491	3,503	0.3%
<b>Total</b>	<b>2,535</b>	<b>3,597</b>	<b>3,624</b>	<b>0.8%</b>	<b>16,352</b>	<b>18,405</b>	<b>18,514</b>	<b>0.6%</b>

## 2.3 Household Impacts

Our analysis also included an evaluation of how households in California would be affected by the implementation of AB 32, particularly low- and middle-income households. The results indicate that both low- and middle-income households will realize savings on the order of a few hundred dollars per year in 2020, compared to the business-as-usual case, primarily as a result of increased energy efficiencies.

### 2.3.1 Low-Income Households

Based on current U.S. Department of Health and Human Services poverty guidelines, we evaluated the projected impacts of the plan on households with earnings at or below both 100 and 200 percent of the poverty guidelines. For the typical household of three members, an income of \$17,600 corresponds to 100 percent of the poverty level and an income of \$35,200 corresponds to 200 percent of the poverty level.<sup>4</sup> For all households, including those with incomes at 100 percent and 200 percent of the poverty level, implementation of the Preliminary Recommendation produces a slight increase in household income relative to the business-as-usual case.

At the same time, the modeling projects a small increase in the number of jobs available for lower-income workers<sup>5</sup> relative to business-as-usual as a result of implementing the plan.

<sup>4</sup> Source: Federal Register, Vol. 73, No. 15, January 23, 2008, pp. 3971-3972.

<sup>5</sup> Hourly wage below \$15 per hour.

For example, implementation of the Preliminary Recommendation produces between 40,000 and 50,000 more such jobs in 2020 than there would otherwise be. The largest employment gains come in the retail, food service, agriculture, and health care fields. A decline in such jobs is projected in the retail gasoline sector due to the overall projected decrease in output from this sector. This decline is more than offset by the increases experienced in other areas, and the vast majority of workers displaced in the retail gasoline sector would not likely require any additional training or experience to transition into a new field of employment.

Another important factor to consider when analyzing the impact of the raft Scoping Plan on households is how it will affect household expenditures. As indicated in Table 6, analysis based on the modeling projections estimates a savings (i.e., reduced expenditures) of around \$400 per household in 2020 for low-income households under both federal poverty guideline definitions. These savings are driven primarily by the implementation of the clean car standards and energy efficiency measures in the draft Scoping Plan that over time are projected to outweigh potential increases in electricity and natural gas prices that may occur. As the measures in the Scoping Plan are implemented, we will work to ensure that the program is structured so that low income households can fully participate in and benefit from the full range of energy efficiency measures. Additional information regarding the data in Table 6 can be found in Appendix V.

**Table 6: Impact of Implementation of Draft Scoping Plan on Total Estimated Household Savings in 2020 (2007 \$)**

	Income at 100% of Poverty Guideline	Income at 200% of Poverty Guideline	Middle Income <sup>1</sup>	High Income <sup>2</sup>	All Households <sup>3</sup>
Preliminary Recommendation	\$400	\$400	\$500	\$500	\$400

<sup>1</sup> All households between 200 percent and 400 percent of the poverty guidelines.

<sup>2</sup> All households above 400 percent of the poverty guidelines.

<sup>3</sup> Average of households of all income levels.

The modeling indicates that implementation of the draft Scoping Plan is likely to result in small savings for most Californians, with little difference across income levels. Largely due to increased efficiencies, low-income households are projected to be slightly better off from an economic perspective in 2020 as a result of implementing AB 32.

### **2.3.2 Middle-Income Households**

In addition to looking at how low-income households would be affected, we also analyzed what the projected impacts of the plan would be for a middle-income California household. For purposes of our analysis we define "middle-income" households as



those earning between 200 percent and 400 percent of the federal poverty guidelines. For the average-size household in California, this equates to an annual income between \$35,000 and \$70,000.

As previously discussed, the modeling indicates that implementation of the plan produces a small increase in per capita income across all income levels, including middle-income households relative to the business-as-usual case. In terms of how jobs<sup>6</sup> for middle-income households would be impacted, the modeling indicates a slight overall increase of between 30,000 and 40,000 in 2020.

As shown in Table 6, the modeling projects a net-savings in annual household expenditures of about \$500 in 2020 for middle-income households. These savings are driven by the emergence of greater energy efficiencies that will be implemented as a result of the plan.

The results of our analysis show that implementation of the Scoping Plan will have a small, but overall positive, impact on middle-income California households. These findings are consistent with the projected impacts of the plan on low-income households and with the economy-wide modeling results as well.

## 2.4 Small Business Impacts

Small businesses in general will not be directly affected by the measures recommended in the draft Scoping Plan. Any impacts will primarily come in the form of changes in the costs of goods and services that they procure, and in particular, changes in energy expenditures. Therefore in this analysis we focus on how implementation of the Preliminary Recommendation would affect the percentage of revenue small businesses spend on energy, and how this could impact their profitability and overall economic competitiveness. Additional detail regarding the methodology we used is in Appendix V.

Recent analysis from Energy and Environmental Economics, Inc.<sup>7</sup> (E3) forecasts that a package of greenhouse gas emission reduction measures similar to those contained in the draft Scoping Plan would deliver a 5 percent decrease in electricity expenditures for the average California electricity customer relative to business-as-usual in 2020. Changes to individual entities will deviate from the average and the E3 analysis does not predict how these savings will be distributed among customers. This projection is based on the assumption that increases in electricity prices will be more than offset by the continued expansion of energy efficiency measures and that more efficient technologies will be developed and implemented<sup>8</sup>. We also make a conservative assumption that expenditures on natural gas remain the same, balancing the projected

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<sup>6</sup> Hourly wage between \$15 and \$30 per hour.

<sup>7</sup> Based on their GHG calculator, CPUC/CEC GHG Docket (CPUC Rulemaking.06.04.009, CEC Docket 07-OIIP-01), available at [http://www.ethree.com/cpuc\\_ghg\\_model.html](http://www.ethree.com/cpuc_ghg_model.html).

<sup>8</sup> The E3 analysis focuses on direct programmatic measures and does not include the incremental price impact of the cap and trade program, which will depend upon allowance price, allocation strategy, the capped sector industry response and other program design decisions.

18 percent decrease in natural gas consumption in California with the model's projected natural gas price increase of 7.8 percent.

Based on this assessment, our analysis indicates that implementation of the Preliminary Recommendation in the draft Scoping Plan will likely have minor but positive impacts on small businesses in the state. These benefits are attributable primarily to the measures in the plan that will deliver significantly greater energy and fuel efficiencies. Even when higher per-unit energy prices are taken into account, these efficiencies will decrease overall energy expenditures for small businesses. Additionally, as previously described, the California economy is projected to experience robust economic growth between now and 2020 as AB 32 is implemented. Small businesses will experience many of the benefits associated with this growth in the form of more jobs, greater production activity, and rising personal income.

The projected decrease in electricity expenditures is especially important for small businesses since they typically spend more on energy as a percentage of revenue compared to larger enterprises. For example, firms with a single employee spend approximately 3.3 percent of each sales dollar on electricity while businesses with between 10 and 49 employees spend around 1.2 percent. As a result, smaller businesses are likely to experience a greater relative benefit from decreased energy expenditures relative to their larger counterparts.

From the broader economic perspective, these changes will make California more competitive as a location for small business, moving it from 7<sup>th</sup> highest to 19<sup>th</sup> among all states in terms of the percentage of revenue that businesses expend on electricity<sup>9</sup>. As was noted above for low-income households, care must be taken to ensure that the program is structured to allow small businesses to participate in and benefit from the energy efficiency measures.

### **3 GREEN TECHNOLOGY LEADERSHIP**

The development of green technologies and a trained workforce equipped to design, develop and deploy them will be key to the success of California's long-term efforts to combat global warming. This section outlines a variety of ways in which the state's greenhouse gas emission reduction policies will support and foster green technology.

#### **3.1 Green Technology Attracts Capital**

Bold, long-range environmental policies help drive innovation and investment in emission-reducing products and services in part by attracting private capital. Typically, the private sector under-invests in research and development for products that yield public benefits. When environmental policy is properly designed and sufficiently robust

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<sup>9</sup> Although our natural gas data is less specific, we expect a similar scenario where increased prices are typically offset by greater efficiencies for most small businesses.

to support a market for such products, private capital is attracted to green technology development as it is to any strategic growth opportunity.

In addition to well-designed environmental policy, other factors are also important in attracting private resources to invest in technological innovation. These include the presence of adequate innovation infrastructure in the form of established centers of research and development, a physical and cultural environment that attracts the most innovative human resources, and a large-scale local market for innovative products. Where all of these other factors are present – as they are in California – state policies can have an extremely important positive impact.

California's leadership in environmental and energy efficiency policy has helped attract an increasing share of venture capital investment in green technologies. According to statistics from PricewaterhouseCoopers and the National Venture Capital Association, California's share of U.S. venture capital investment in innovative energy technologies increased dramatically from 1995 to 2007 (see Figure 3 below).<sup>10</sup> The same period saw a stream of pioneering environmental policy initiatives, including energy efficiency codes for buildings and appliances, a renewable portfolio standard for energy, climate change emission standards for light duty automobiles and, most recently, AB 32. Flows of venture capital into California are escalating as a direct result of the focus on greenhouse gas reduction. According to Cleantech Network, LLC, an industry group that tracks cleantech financial trends, California captured the largest single portion of global venture capital investment (\$800 million out a total of \$2 billion dollars) during the second quarter of 2008.<sup>11</sup>

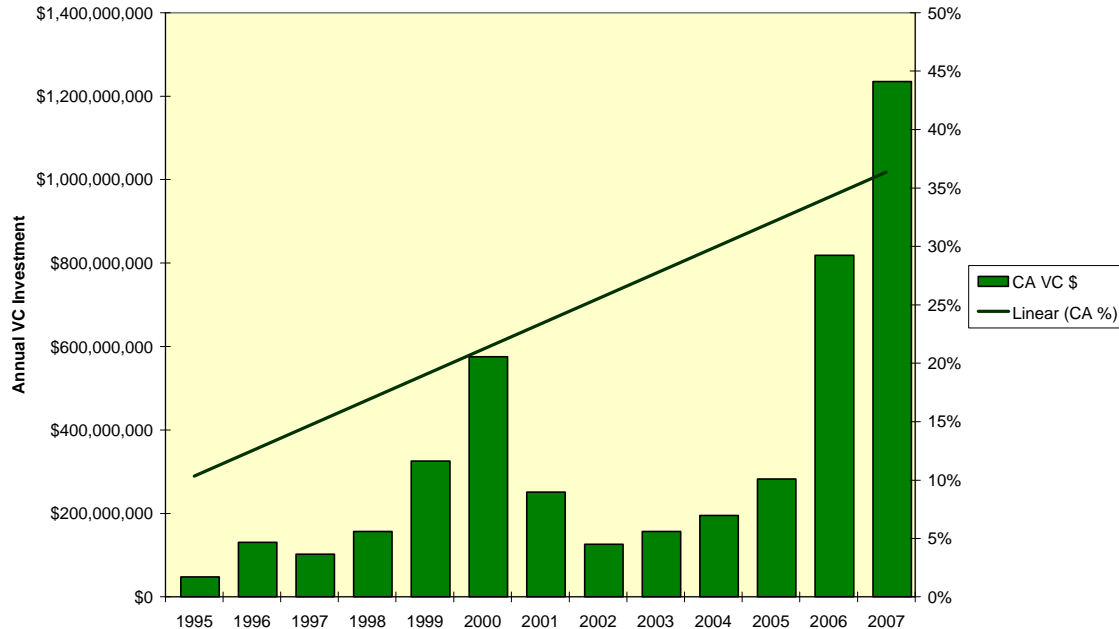
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<sup>10</sup> PricewaterhouseCoopers MoneyTree Report, available at: <https://www.pwcmoneytree.com>.

<sup>11</sup> 1: "Cleantech Venture Investment Reaches Record of \$2 Billion in 2Q08", Cleantech Network, LLC, July 08, 2008.

**Figure 3**

**California's Growing Share of Venture Capital Investment  
in Energy Innovation, 1995-2007 (current \$, % share)**



A survey of clean technology investors by Global Insight and the National Venture Capital Association found that public policy influences where venture capitalists invest.<sup>12</sup> And investments in green technology solutions produce jobs at a higher rate than investments in comparable conventional technologies.<sup>13</sup> Venture Capitalists estimate that each \$100 million in venture capital funding helps create 2,700 jobs, \$500 million in annual revenues for two decades, and many indirect jobs.<sup>14</sup>

Access to capital controlled by institutional investors is also enhanced by policies that encourage early adoption of green technologies. When California-based corporations use green technologies to reduce their exposure to climate change risk, institutional investors reward them by facilitating their access to capital. The Investor Network on Climate Risk -- including institutional investors with more than \$8 trillion of assets under management -- endorsed an action plan in 2008 that calls for:

- Requiring asset managers to consider climate risks and opportunities when investing;

<sup>12</sup> Clean Tech Entrepreneurs & Cleantech Venture Network LLC, "Creating Cleantech Clusters: 2006 Update" 2006, p.43.

<sup>13</sup> Kammen, D, Kapadia, K. & Fripp, M. "Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?" Energy and Resources Group/Goldman School of Public Policy at University of California, Berkeley, 2004.

<sup>14</sup> Global Insight, National Venture Capital Association, "Venture Impact 2004: Venture Capital Benefits to the U.S. Economy" 2004.

- Investing in companies that develop and deploy clean technologies; and,
- Expanding climate risk scrutiny by investors and analysts.<sup>15</sup>

Additional capital for green technologies helps drive increased employment, both indirectly, as energy savings are plowed back into other sectors of the economy; and directly, as new green products are successfully commercialized.

### 3.2 Green Job Creation

The increasing emphasis on making a transition toward safer and more secure energy sources has spurred a steady rise in demand for energy efficiency and renewable energy products and services. Mainstream capital markets have started to actively seek out and embrace green business opportunities. Now an accepted investment category in capital markets, green technology portfolios routinely outperform broader market indices such as the Standard & Poor's 500 and the Dow Jones Industrial Average.<sup>16</sup> Alternative energy is no longer an alternative investment.

McKinsey & Company projects average annual returns of 17 percent on global investments in energy productivity, and sizes the global investment opportunity at \$170 billion annually through 2020.<sup>17</sup> Meanwhile, global investment in energy efficiency and renewable energy has grown from \$33 billion to more than \$148 billion in the last four years. Beyond 2020, green technologies are expected to attract investment of more than \$600 billion annually.<sup>18</sup> In short, green technology is now a *bona fide* global growth industry.

Today, green technology businesses directly employ at least 43,000 Californians, primarily in energy efficiency and energy generation, according to a 2008 study from the California Economic Strategy Panel. Green jobs are concentrated in manufacturing (41 percent), and professional, scientific and technical services (28 percent), with median annual earnings of \$35,725 and \$56,754, respectively.<sup>19</sup> By 2030, under a moderate growth scenario, green businesses nationwide are expected to generate revenues of \$2.4 trillion, (2006 dollars), and employ 21 million Americans.<sup>20</sup>

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<sup>15</sup> Final Report, 2008 Investor Summit on Climate Risk, The Investor Network on Climate Risk

<sup>16</sup> "Cleantech Venture Capital: How Public Policy Has Stimulated Private Investment" James Stack, UC Berkeley Goldman School of Public Policy, E2 Environmental Entrepreneurs, and Cleantech Venture Network, LLC, May 2007, pages.8-9

<sup>17</sup> McKinsey Global Institute, "The Case for Investing in Energy Productivity" McKinsey & Company, February, 2008, p.8.

<sup>18</sup> United Nations Environment Programme-New Energy Finance Ltd., "Global Trends in Sustainable Energy Investment 2008: Analysis of Trends and Issues in the Financing of Renewable Energy and Energy Efficiency", 2008, p.12.

<sup>19</sup> "Clean Technology and the Green Economy," California Economic Strategy Panel with Collaborative Economics, March 2008, pages 14-15

<sup>20</sup> Renewable Energy and Energy Efficiency, The American Solar Energy Society, 2007, p.39.

### 3.3 Energy Efficiency Jobs

As a leader in green technology development and use, California has already realized substantial economic benefits from the adoption of energy efficiency policies. State energy efficiency measures have saved enough energy over the past 30 years to avoid construction of 24 500-megawatt power plants. Today, California's per capita electricity consumption is 40 percent below the national average, and the carbon intensity of California's economy is among the lowest in the nation.<sup>21</sup>

Household consumption accounts for over 70 percent of Gross State Product, and household energy savings are a key driver of both employment and economic growth. As energy-efficient households shift spending from the capital intensive supply chain of the energy industry to the more labor-intensive supply chains of other products and services, more new jobs are created. As a result, net employment impacts of energy efficiency for California are strongly positive.

Building and appliance efficiency standards have saved California households more than \$56 billion in electricity and natural gas costs since 1978, and increased the growth of Gross State Product by 3 percent (\$31 billion) over the same period. California's Title 24 building standards are expected to produce another \$23 billion in household energy savings by 2013, while California's appliance standards are projected to deliver another \$25 billion in energy savings through 2020.<sup>22</sup>

### 3.4 Renewable Energy Jobs

Renewable energy—solar, wind, biomass, geothermal—will also bring new employment opportunities to Californians while spurring economic growth. Compared to other states, California enjoys significant advantages for renewable energy development. These include: concentrated innovation resources; a large potential customer base; key natural resources such as reliable insolation and wind; and supportive regulatory programs, including the California Renewable Portfolio Standard, the Million Solar Roofs Initiative, the California Global Warming Solutions Act of 2006, and the Solar Water Heating and Efficiency Act of 2007.

Other researchers have estimated that under a national scenario with 15 percent renewables penetration by 2020, California will experience a net gain in direct employment of 140,000 jobs by 2020.<sup>23</sup> Because investments in green technologies produce jobs at a higher rate than investments in conventional technologies, jobs losses

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<sup>21</sup> California Energy Commission, . 2007. 2007 Integrated Energy Policy Report. CEC-100-2007-008-CMF, p. 3.

<sup>22</sup> California Energy Commission, 2007. 2007 Integrated Energy Policy Report. CEC-100-2007-008-CMF, p. 3.

<sup>23</sup> Clean Energy: Jobs for America's Future, Tellus Institute and MRG Associates, cited in Kammen, Kapadia and Fripp, Putting Renewables to Work: "How Many Jobs Can the Clean Energy Industry Generate?", Energy and Resources Group, Goldman School of Public Policy.

that occur in traditional fossil fuel industries will be more than compensated for by gains in the clean energy sector.

Furthermore, if California's renewable energy suppliers field products that are sufficiently competitive to penetrate the export market, employment and earnings dividends for the state will also increase. California renewable energy industries servicing the export market can generate up to 16 times more employment than those that only manufacture for domestic consumption, according to a study by the Research and Policy Center of Environment California.<sup>24</sup>

## **4 PEER REVIEW OF THE DRAFT SCOPING PLAN ECONOMIC ANALYSIS**

ARB believes that the economic modeling presented in this supplement would benefit from an independent peer review and is therefore taking steps, through an established independent process conducted by CalEPA, to establish a peer review panel. Submission of the economic analysis for peer review can strengthen the economic assessment as well as the findings presented in the draft Scoping Plan. The purpose of the review is for the peer reviewers to make a determination as to whether the economic analysis is based upon sound scientific knowledge, methods, and practices. In short, the purpose of the peer review is to ensure that the scientific underpinnings of the economic analysis are based on the best science. In an effort to establish the peer review panel, the ARB has requested the University of California, Berkeley to initiate the process of selecting experts to review the economic analysis presented in this document. During its selection and review the panel will remain anonymous to the ARB and only be identified after submitting its comments.

The Economic Analysis Supplement will be provided to the peer reviewers through the University of California, Berkeley. The reviewers will be selected by the Berkeley Institute of the Environment based on their professional experience, having distinguished themselves as experts in the field of economics with a particular focus in areas including economic modeling, market mechanisms and the economics of climate change mitigation. As part of its review the panel will:

- Assess the theoretical basis of the models;
- Assess the appropriateness of the models to support the evaluation of the policy scenarios to reduce emissions of GHGs;
- Assess the key data sets (e.g., energy consumption forecasts) upon which one or more of the models rely;
- Examine the assumptions for their validity and practicality;
- Assess the key variables to which the model is most sensitive and a qualitative assessment of how alternative assumptions could impact the results;

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<sup>24</sup> "Renewable Energy and Jobs. Employment Impacts of Developing Markets for Renewables in California", Environment California Research and Policy Center, 2003 cited in Kammen, Kapadia and Fripp (see above).

- Assess the economic analysis of the proposed Scoping Plan including the associated inputs and assumptions;
- Comment on the reasonableness of the models' results as well as their interpretation as presented in the analysis;
- Comment on additional analyses that ARB should consider incorporating during the implementation of the Scoping Plan; and,
- Comment on additional modeling approaches that others have done/may do in response to the Scoping Plan.

The Economic Supplement will be provided to the peer reviewers concurrent with its public release. ARB will consider the results of this peer review when it is provided and will respond as appropriate.

In addition to the formal peer review the economic analysis and related ongoing work will also be reviewed by the Climate Action Team.

## **5 CONCLUSION**

California has boldly accepted the challenge to address climate change by developing a comprehensive program to reduce greenhouse gases. As this Economic Analysis Supplement indicates, the Preliminary Recommendations also presents us with a tremendous economic opportunity. We can implement AB 32 in a way that not only protects, but actually enhances economic growth and creates thousands of new jobs. We can grow our economy while also making it cleaner, more efficient and more secure. There are many economic benefits that will accompany the implementation of a comprehensive emission reduction strategy as outlined in the draft Scoping Plan. Our analysis concludes that:

- California can reach its emission reduction target in a manner that is beneficial to the economy by increasing the Gross State Product, jobs and income;
- On average, consumers are expected to be better off because of the savings due to the implementation of increased energy efficiency measures in the draft Scoping Plan;
- All households, including low-income households, are projected to experience net economic savings due to the implementation of the plan;
- Business impacts of the draft Scoping Plan are in the positive direction. Several measures in the plan encourage, require or promote energy efficiency that is likely to reduce energy costs for businesses of all sizes over time; and,
- Implementation of the plan will drive California-based technologies to the forefront of the growing global market in green technology, providing jobs and income to many Californians.

The Preliminary Recommendation contains an effective mix of approaches for reducing greenhouse gases and takes advantage of the strengths of each. It calls for the deployment of efficient technologies and strategies which will both reduce emissions and save consumers money. Performance standards with market mechanisms will further allow regulated businesses to meet those standards in the most efficient and



profitable manner. A multi-sector cap-and-trade program will provide a strong financial incentive for both producers and consumers to search out and pursue the most cost-effective emissions reduction opportunities in ways that will achieve additional savings not fully captured within the model.

These positive economic impacts to the state are not the only consideration when choosing which path to pursue. In addition to the financial savings predicted within the model, the Preliminary Recommendation also assures meaningful reductions will occur in each sector of the California economy. It creates a policy framework to maximize participation and benefits at every level of government including state, regional and local. The cap-and-trade program provides further environmental and leadership benefits including placing an absolute emission limit on capped sectors, expanding coverage of the program through the Western Climate Initiative, providing a model for future Federal programs and creating larger markets for California's clean technology industries.

Moving forward, ARB will continue to refine its economic analysis of the measures contained within the Scoping Plan as well as review the results of the peer review and other relevant modeling. Once the Final Scoping Plan has been adopted, ARB will conduct further economic modeling for each of the measures pursued to inform the best design of those measures. This analysis represents the beginning, not the end, of what will be an ongoing evaluation of the best ways to achieve the goals of the program.

California has all of the ingredients to emerge at the vanguard of 21<sup>st</sup> century economies that are built upon clean, efficient and renewable energy sources. The state has a track record of successful and transformative innovation, a strong commitment to both public and private investment in new technologies, and a history of demonstrated success in designing environmental policies that also help to foster economic growth. The results of the economic analysis clearly show that California can achieve the goals of the Global Warming Solutions Act of 2006 and enhance its economic and environmental leadership.