U.N. Agenda 21 & The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006

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U.N. Agenda 21 & The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006
By Andrew Chang & Company, LLC for The California Manufacturers & Technology Association
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The California Manufacturers & Technology Association works to improve and enhance a strong business climate for California's 30,000 manufacturing, processing and technology based companies. Since 1918, CMTA has worked with state government to develop balanced laws, effective regulations and sound public policies to stimulate economic growth and create new jobs while safeguarding the state's environmental resources. CMTA represents 600 businesses from the entire manufacturing community – an economic sector that generates more than $200 billion every year and employs more than 1.2 million Californians.

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Acknowledgements:

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The Fiscal and Economic Impact of the
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The Fiscal and Economic Impact of the
California Global Warming Solutions Act (AB 32)
(Key Findings)

- In our optimistic case, AB 32 will cost consumers $135.8 billion cumulatively by 2020. This is equivalent to almost two-and-a-half times the annual spend on K-12 education.
- Annual AB 32 direct costs total $35.3 billion in 2020. This is equivalent to about 40 percent of California's General Fund revenues, and exceeds the General Fund collections for Sales and Use Tax, Corporation Tax, Motor Vehicle Fees, Insurance Tax, Estate Taxes, Liquor Tax and Tobacco Tax combined.
- 26 percent of emissions reductions will stem from the economic slowing caused by AB 32.
- AB 32 lowers California's 2020 GSP by $153.2 billion, amounting to a loss of 5.6 percent of GSP.
- California will have 262,000 fewer jobs in 2020 because of AB 32.
- By 2020, increased energy prices will increase household expenses for the average family by $2,500 per year.
- AB 32 will reduce state and local tax revenues by over $7.4 billion annually in 2020. $6.8 billion is lost from state revenues and $640 million from local revenues. The State losses are roughly equivalent to the amount that is needed to fund the Governor's entire Local Realignment initiative or more than a decade of funding Children's Medical Services program under the Department of Health Care Services.

The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006

Executive Summary

June 2012

EXECUTIVE SUMMARY

> ARB shall prepare and approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions from sources or categories of sources of greenhouse gases by 2020.
>
> California Public Codes
> Health and Safety Code (HSC) §38561

The Global Warming Solutions Act of 2006 (AB 32) propelled California to the forefront in the fight against global warming. Specifically, AB 32 directed the California Air Resources Board (ARB) to develop programs to reduce California's Greenhouse Gas (GHG) emissions to 1990 levels by the year 2020 while balancing the environmental objective with the goal of maximizing cost-effectiveness. ARB has completed two economic studies regarding its AB 32 Scoping Plan – an initial economic analysis completed in September 2008 and an updated economic analysis in March 2010. The result of ARB's most current study indicates that AB 32 will reduce California Gross State Product (GSP) by approximately 0.2 percent.

Since ARB's last economic study in 2010, new information about the potential cost of AB 32 programs has come to light, including the following:

- New information about the impact of Pavley II fuel efficiency rules on diesel trucks and the cost of local implementation of SB 375 (Vehicle Miles Traveled reduction);
- New data, particularly in regards to the strength of the California economy and the development speed and outlook for alternative fuel supply projections, such as low carbon intensity gasoline and diesel alternatives; and
- New independent studies that shed light on the cost and economic impact of AB 32 in California.

Andrew Chang & Company, LLC has been retained to provide policy makers with information as it pertains to AB 32 cost and economic impact utilizing the most current information available in a manner that is transparent and non-proprietary.

Direct Costs

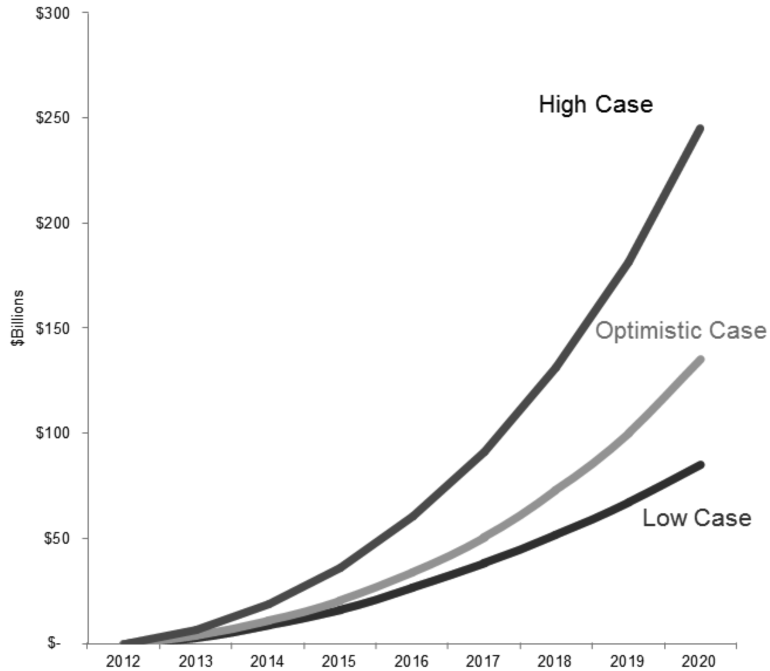
AB 32 consists of seven main policies. This includes the Low Carbon Fuel Standard (LCFS), Pavley II Fuel Efficiency Standards (Pavley II), SB 375 (VMT), the Renewable Portfolio Standard (RPS), Combined Heat & Power (CHP), Efficiency Measures and Cap-and-Trade (C&T). These policy levers impose direct costs on California in the form of higher commodity costs, the cost of required technological changes and the cost of Cap-and-Trade compliance credits and offsets as well as direct savings in the form of decreased demand for commodities. Because of the tremendous amount of uncertainty in the AB 32 program, our analysis is based on three scenarios as summarized in Table ES-1.

Table ES-1
Assumption by Case

	Low Case	Optimistic Case	High Case
Summary	This case is most comparable to ARB's base case scenario, with key cost drivers added.	This case includes realistic, but optimistic assumptions for key cost drivers	This case includes high, but realistic assumptions for key cost drivers
Base 2020 Credit Price	$25	$50	$100
Cellulosic Production (relative to OECD U.S. projection)	575% (50% to CA)	150% (50% to CA)	50% (50% to CA)
Brazilian Ethanol Cost Basis	Ample – Available at standard market rates plus import cost	Midpoint of Ample and Impacted	Impacted – Only available at a significant premium, the cost of replacement gasoline in Brazil
Biodiesel Premium	$2.00	$2.50	$3.00
Efficiency Growth	3% (2% standard + 1% from measures)	2.5% (2% standard + .5% from measures)	1% (2% standard – 1% due to preexisting technological penetration)
SB 375	Fully Implemented (4%)	Half Implemented (2%)	Half Implemented (2%) with increased transit need
Combined Heat and Power	CEC High Penetration	CEC Low Penetration	CEC Low Penetration

Our cumulative estimates of direct costs are shown in Figure ES-1 and ranges between $85.2 billion in the Low Case to $245.3 billion in the High Case. In the Optimistic Case, cumulative costs grow at an average rate of 70 percent per year and total $135.8 billion during the first eight years of implementation. This is equivalent to almost two-and-a-half times the current annual spend on K-12 education.

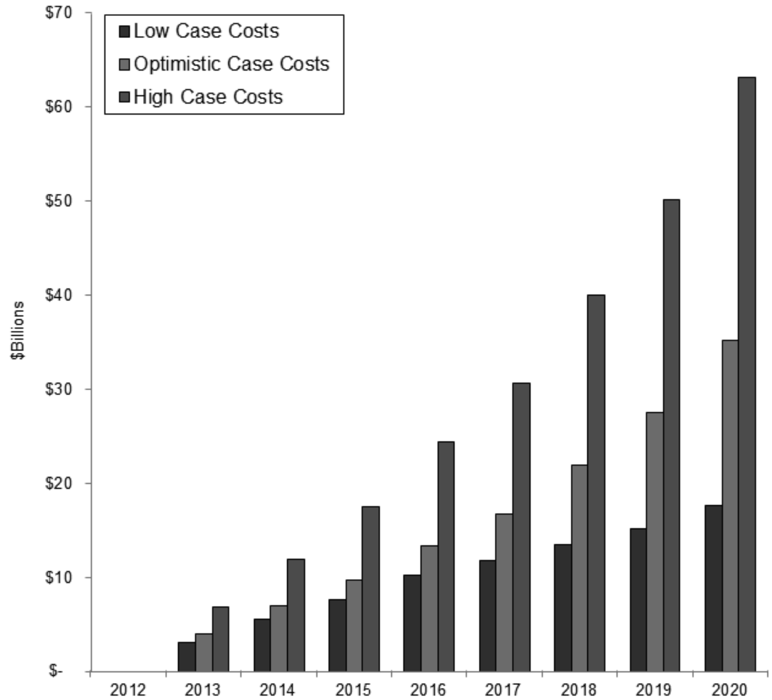
Figure ES-1
Cumulative Direct Costs by Case



SOURCE: Appendix C

Figure ES-2 exhibits the annual direct costs of AB 32. Annual direct costs in 2020 range from $17.7 billion to $63.3 billion. In the Optimistic Case, the direct annual cost of AB 32 grows at an average rate of 37 percent and amounts to $35.3 billion in 2020. This is equivalent to about 40 percent of California's General Fund revenues, and exceeds the General Fund collections for Sales and Use Tax, Corporation Tax, Motor Vehicle Fees, Insurance Tax, Estate Taxes, Liquor Tax and Tobacco Tax.

Figure ES-2
Annual Direct Costs by Case

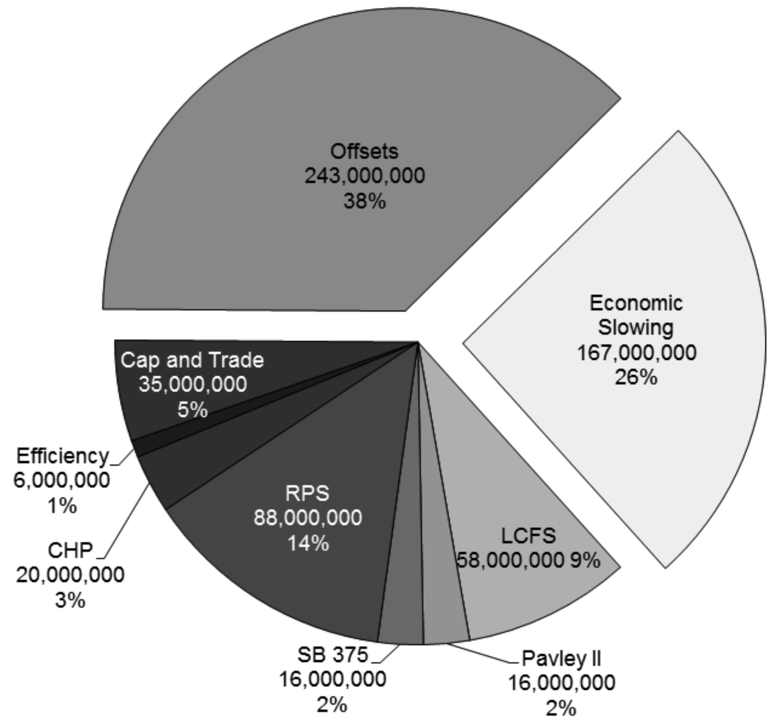


SOURCE: Appendix C

Economic Impact

Our analysis shows that AB 32 reductions in GHG will come at significant cost to the state's economy. The second largest share of emissions reductions will stem from the economic slowing caused by AB 32, while the larger share will be achieved by Cap-and-Trade, as exhibited in Figure ES-3.

Figure ES-3
GHG Reductions by Source
(Optimistic Case)

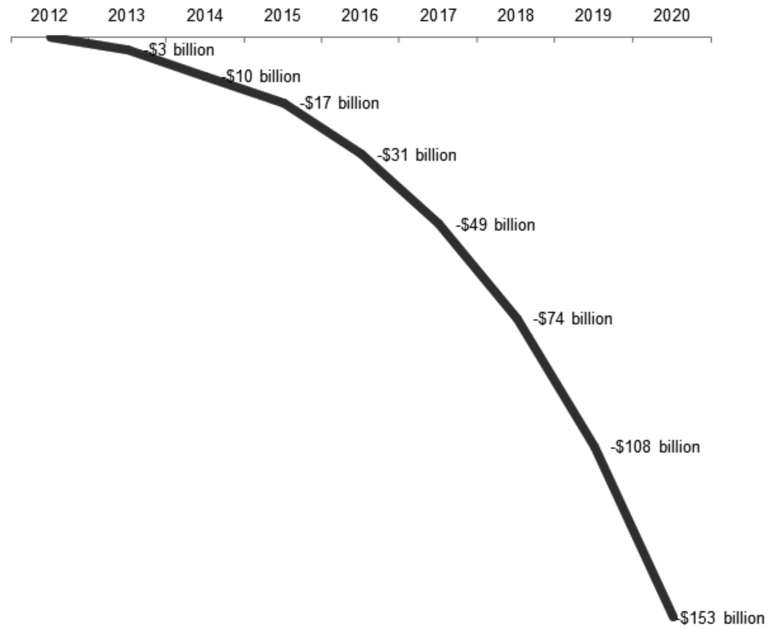


SOURCE: Appendix C

In the Optimistic Case, we find that AB 32 will cumulatively reduce 648 million tons of GHG through 2020. Purchased offsets under Cap-and-Trade account for the largest share with 243 million tons, with an additional 35 million tons of reductions made by capped entities. An additional 26 percent of the reduction, 167 million tons, will be due to economic slowdown resulting from AB 32 and the decrease in transportation fuel consumption due to increased costs and decreased earnings.

Figure ES-4 shows our estimate of AB 32's impact on GSP. AB 32 lowers the projected 2020 GSP from $2.722 trillion to only $2.569 trillion, a loss of $153.2 billion in 2020. This amounts to a loss of approximately 5.6 percent of GSP in the year 2020. This lost percentage of GSP is roughly equivalent to California's real GSP loss in the Great Recession from December 2007 to June 2009.

Figure ES-4
GSP Gains/(Losses) Resulting from AB 32
(Optimistic Case)

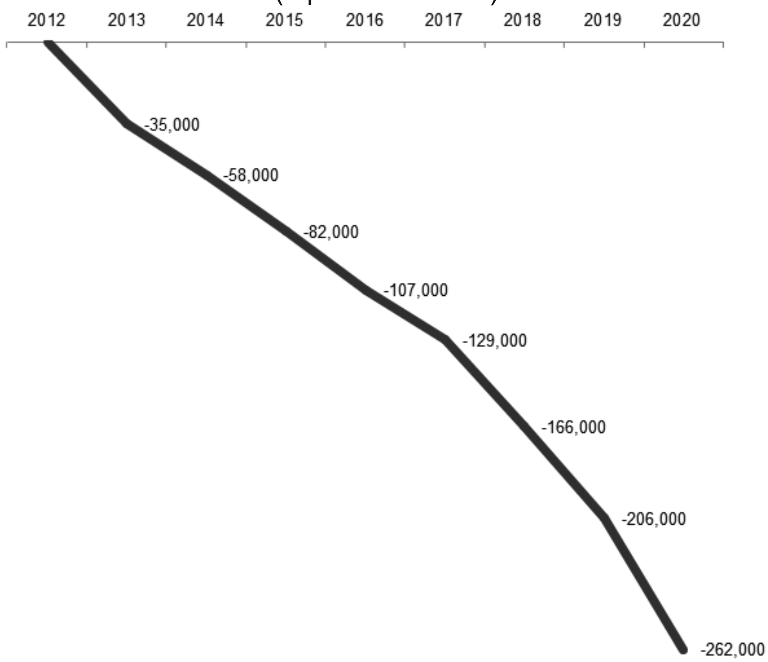


SOURCE: Appendix C

Figure ES-5 shows the impact of AB 32 on California's employment under our Optimistic Case. California's unemployment rate remains the third highest in the nation, making lost jobs a significant concern.[1] AB 32 will cause a reduction of 262,000 jobs in 2020.

[1] Bureau of Labor Statistics, Regional and State Employment and Unemployment Summary, April 2012

Figure ES-5
Job Gains/(Losses) Resulting from AB 32
(Optimistic Case)

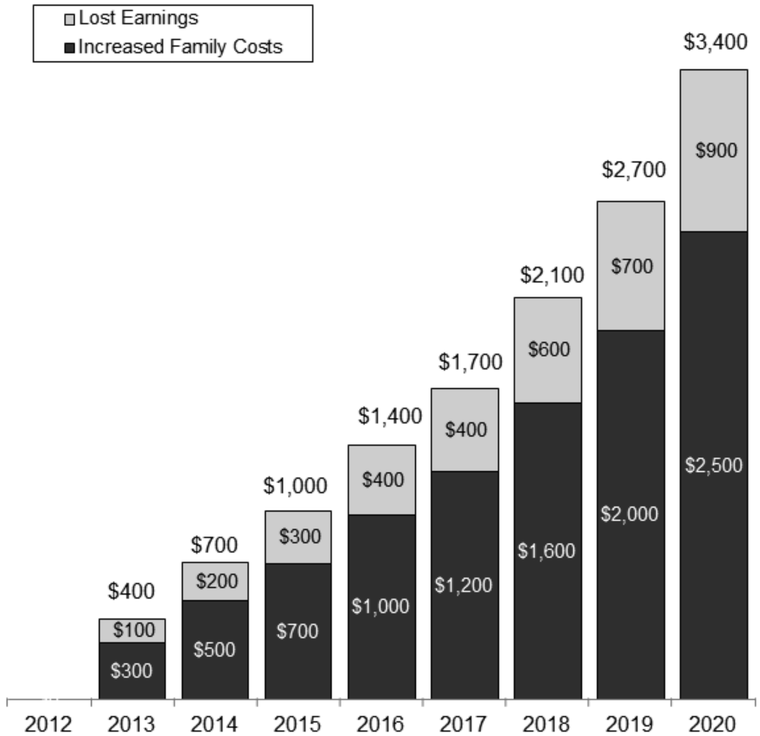


SOURCE: Appendix C

Family Impact

The combined effects of AB 32 will significantly impact the average California family. AB 32 will drive a combination of increased prices for commodities, goods and housing and lost earnings. By 2020, increased energy and transit prices will increase household expenses for the average family by $2,500 per year as shown in Figure ES-6. This is nearly two and a half times the monthly mortgage payment made by an average California family. When combined with the lost earnings, AB 32 will cost the average California family almost $3,400 per year.

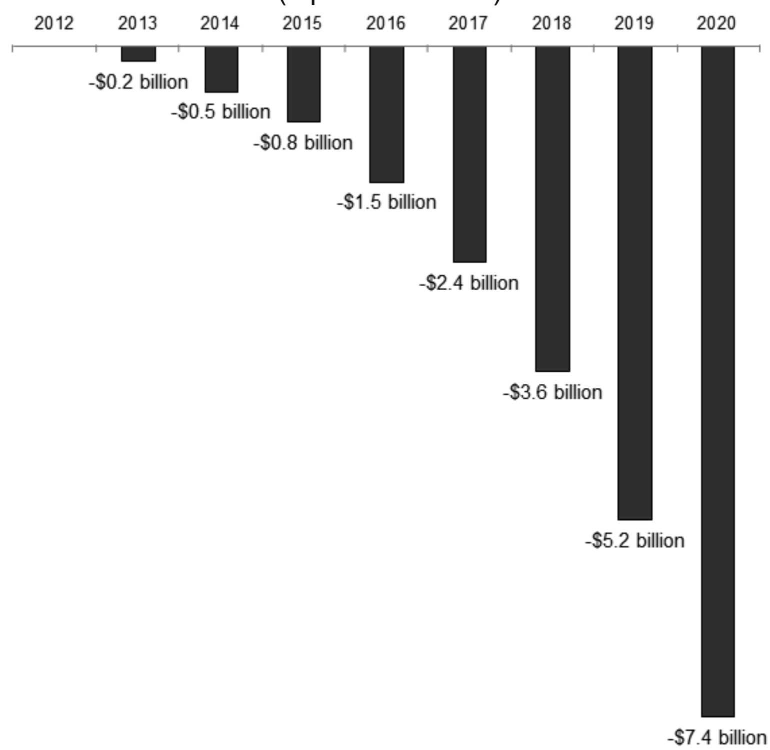
Figure ES-6
Impact on Households Resulting from AB 32
(Optimistic Case)



SOURCE: Appendix C

State and local government revenues were hit hard by the Great Recession. Budgets for education, social services, law enforcement, parks and infrastructure have had to be cut significantly. AB 32's impact on the economy will likewise impact state and local revenues as shown in Figure ES-7. AB 32 will reduce state and local tax revenues by over $7.4 billion annually by 2020. $6.8 billion is lost from state revenues and $640 million directly from local revenues. The State losses are roughly equivalent to the amount that is needed to fund the Governor's entire Local Realignment initiative or more than a decade of funding Children's Medical Services program under the Department of Health Care Services.

Figure ES-7
State and Local Revenue Gains/(Losses) Resulting from AB 32
(Optimistic Case)



SOURCE: Appendix C

Conclusion

Our review using the most current resources available suggests that the cost and economic impact of AB 32 will likely be significantly higher than what was reported by ARB in its base case. Even under optimistic of circumstances, ARB's implementation of AB 32 will lower California's 2020 GSP by 5.6 percent when costs are fully accounted.

At this critical junction, policy makers should consider if there are more cost-effective solutions that may produce the same GHG reductions. As noted, AB 32 has a balanced mandate to produce cost-effective solutions. However, despite the considerable amount of research that has been produced or commissioned by ARB, no study has comprehensively assessed whether ARB's plan is indeed cost-effective. Because of the potential harms and benefits that could emerge, policy makers should explore this issue in greater detail.

The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006

Full Report

June 2012

1. Introduction

In 2006, Governor Arnold Schwarzenegger signed into law the Global Warming Solutions Act (AB 32). At the time, California had already been perceived as leading the nation in energy efficiency measures and environmental regulations as a whole with efforts such as fuel efficiency standards for vehicles, emission reductions at California ports and goods movement and regulation of diesel particulate matter. AB 32 now propelled California to the forefront in the fight against global warming. Specifically, AB 32 directed the California Air Resources Board (ARB) to develop programs to reduce California's Greenhouse Gas (GHG) emissions to 1990 levels by the year 2020. Because of the potential to significantly harm the economy, the Act further directed ARB to achieve reductions while minimizing costs. Specifically, the Act read, "ARB shall prepare and approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions in greenhouse gas emissions from sources or categories of sources of greenhouse gases by 2020."[2]

Over the past five years ARB established a number of programs to meet its charge to reduce GHG. Some of ARB's programs promote existing technologies and best practices, such as cogeneration of electricity and enhanced city and regional planning to reduce commuting. Other ARB programs depend on the private sector's ability to accelerate innovation and develop new fuels in a cost effective manner. Yet another ARB program creates one-of-a-kind, new markets to reduce carbon. Collectively, these programs will impact every major GHG source in the state and the day-to-day activities of virtually every Californian.

To date, ARB has completed two comprehensive economic studies regarding its AB 32 programs – an initial economic analysis completed in September 2008 and an updated economic analysis in March 2010. ARB has not completed a cost effectiveness study. The result of its most current study indicates that AB 32 will reduce California Gross State Product (GSP) by approximately 0.2 percent.

[2] California Public Codes, Health and Safety Code (HSC) §38561

Since the publication of ARB's March 2010 study, new information about the potential cost of AB 32 programs has come to light, including the following:

- New information about the impact of Pavley II fuel efficiency rules on diesel trucks, the cost of local implementation of SB 375 (Vehicle Miles Traveled reduction) and the efficacy of Cap-and-Trade;
- New data, particularly in regards to the strength of the California economy and the development speed and outlook for alternative fuels with supply projections, such as low carbon intensity gasoline and diesel alternatives; and
- New independent studies that shed light on the cost and economic impact of AB 32 in California, such as the recent Boston Consulting Group report on LCFS.

Andrew Chang & Company, LLC has been retained to provide policy makers with information as it pertains to AB 32 cost and economic impact. Specifically, we are charged with answering the following questions:

- What does the current literature say about the cost and economic impact of GHG reduction programs? How does ARB's analysis of AB 32 compare with other similar studies?
- Does ARB's most current analysis adequately reflect the current program and market situation? What should be addressed to provide a more current appraisal of AB 32 costs? How would this change the assessment of AB 32's impact on the California economy?
- Can ARB's AB 32 programs collectively be construed to be the lowest cost program?

This report is broken out into 8 sections. This section frames the report for the reader. Section 2 provides an overview of the study approach and methodology. Section 3 provides a summary of GHG regulations nationally and internationally. The fourth section provides an overview of existing literature and research to better understand how ARB's analysis compares to other research. In section 5 we review ARB's analysis, with a focus on how their results and assumptions compare to the literature and how current technology, policy and economic outlooks might shift those assumptions. The sixth section gives an overview of the results of our independent analysis of the costs, economic impact and cost-effectiveness of ARB's outlined program. The seventh section discusses the policy implications of these results. Section 8 consists of technical appendices which are referenced in the main body of the report.

2. Approach

Our study was conducted in four phases as shown in Figure 2.1 below.

Figure 2.1
Model Architecture

	Phase I: Literature & Model Review	Phase II: Collect Data for Model	Phase III: Construct Impact Models	Phase IV: SME Review
Duration:	▪ 2/15 – 3/9	▪ 3/10 – 5/11	▪ 4/14 – 5/11	▪ 5/12 – 6/26
Goals:	▪ Ensure that consultants and staff understand roles and finalize protocols ▪ Benchmark and set data targets	▪ Review data on costs and implementation ▪ Understand and determine direct costs of AB 32 policy implementation	▪ Establish total impacts to state and local economy ▪ Establish total impacts to public sector in costs and lost revenue	▪ Receive subject-matter expert feedback ▪ Finalize all reports in conjunction with client ▪ Establish total impacts to business and industry
Key Activities:	▪ Collect, review, and summarize current literature from internet, Lexis-Nexis, testimony, and scholarly sources ▪ Draft literature review of AB 32 policy levers ▪ Review ARB and other models and provide critical assessment as necessary ▪ Make necessary edits and finalize	▪ Collect, review, and catalog data from public and private agencies ▪ Analyze varying forecasts ▪ Establish electricity mix forecasts for baseline and AB 32 levers ▪ Develop models for electricity, water, natural gas, and transportation fuel costs ▪ Establish AB 32 impacts on per-unit costs	▪ Construct market impact sub-models ▪ Construct economic impact sub-models ▪ Construct state and local government impact sub-models ▪ Construct state and local government revenue impact sub-models ▪ Construct private sector and all other impacts	▪ Draft final study ▪ Engage selected peer reviewers ▪ Validate model findings, troubleshoot as necessary ▪ Review and finalize AB 32 report with Project Manager
Deliverables:	▪ Project kickoff documents ▪ Review with Project Manager	▪ Draft models of selected AB 32 policy levers ▪ Summary description of all data	▪ Review of market impacts with Project Manager ▪ Initial report for review	▪ Review of government impacts with Project Manager ▪ Final Report

The first half of Phase I focused on reviewing the current literature surrounding AB 32 specifically and GHG reductions in general. We reviewed academic research, government reports and expert testimony provided to the ARB. During the second half of Phase I, we reviewed the data and the available information regarding ARB's fiscal and economic impact models. Our focus on Phase I was to develop insights into the strengths and opportunities for improvement to ARB's analysis. We specifically leveraged existing literature and testimony to identify cost and benefits categories that were not included in ARB's 2010 analysis to make the model more robust and more inclusive of all AB 32 costs and benefits. Moreover, we also identified relevant data sources that may not have been available when ARB conducted its study in 2010.

Phase II focused on developing an understanding of data sources pertaining to the AB 32 program and its fiscal and economic impact. We identified the most credible sources of data currently available and relied exclusively on publicly available data, primarily from government sources.

During Phase III, we constructed the fiscal and economic models used to provide our independent assessment of AB 32. Our model consists of 24 interacting models that measure the combined impacts of AB 32. While most studies consider AB 32 policies in isolation, our analysis shows the combined effects of the various policies interacting together with the California economy as a whole.

Phase IV of our study consists of a subject matter expert review of our approach, methodology and estimation model. We were benefitted from input provided by key subject matter experts from industry, the academic community and consulting community to help us improve our models for which we are grateful. We provided complete documentation to each of our reviewers, which is included in the appendix. Our model documentation is comprehensive and transparent. The assumptions, data and calculations are documented to provide readers the ability to recreate the model to verify results or modify the model to test the impacts of shifts in policies or assumptions.

3. AB 32 and Greenhouse Gas Regulations in North America

Under AB 32, ARB is charged with establishing the major milestones and programs to achieve the GHG reduction goals. The various programs and regulations that ARB has developed as a part of AB 32 implementation are collectively known as the AB 32 Scoping Plan. The Scoping Plan contains the main policy levers ARB will use to reduce the GHG emissions. Additionally, the Scoping Plan includes an official assessment of the costs and economic impacts of the adopted programs. The Scoping Plan has seven GHG reduction policy levers that ARB is relying upon to achieve the targeted GHG reductions. Table 3.1 summarizes the policy levers established by ARB.

Table 3.1
AB 32 Policy Levers

Policy Lever	Description
Low Carbon Fuel Standard (LCFS)	The LCFS calls for a reduction of at least 10 percent in the carbon intensity of California's transportation fuels by 2020.
Pavley II Fuel Standards (Pavley II)	The Pavley II Fuel Standards would establish a vehicle fleet efficiency of 42.5 miles per gallon by the year 2020 and reduce total GHG emissions by 45 percent, or 31.7 MMT of CO2 and account for over 18 percent of the 2020 emissions goal.
Vehicle Miles Traveled (VMT)	SB 375 requires local and regional planning bodies to consider GHG emissions when making planning decisions. Within this scope, it directs ARB to establish regional GHG reduction targets.
Renewable Portfolio Standard (RPS)	The RPS would mandate a minimum of 33 percent of all energy used in California must come from a renewable resource, defined as wind, biomass/biogas, geothermal, solar thermal, small hydroelectric and distributed renewables.
Combined Heat & Power (CHP)	CHP systems, also referred to as cogeneration, generate electricity and useful thermal energy in an integrated system. ARB's Climate Change Scoping Plan targets 4,000 MW of capacity, 30,000 GWh and 6.7 MMT of CO2 emissions reduction from CHP by 2020.
Efficiency Measures	ARB assumes current and potential efficiency programs can be expanded to achieve a specified GHG emission reduction above and beyond current Federal requirements.
Cap-and-Trade (C&T)	As a core component of AB 32, ARB established a Cap-and-Trade system, which places a cap on the electrical, transportation fuel, natural gas and large industry sectors. Emission credits are issued primarily through an auction and may be traded among parties. The cap tightens annually, intending to reduce emissions to 1990 levels by 2020.

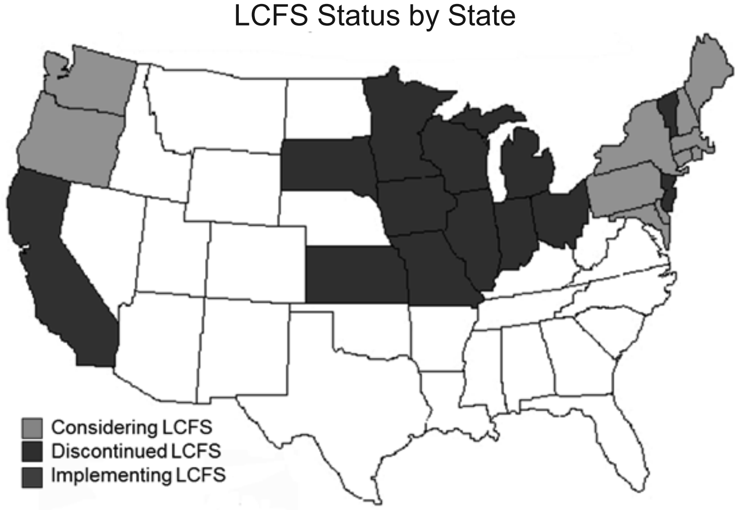
SOURCE: ARB Scoping Plan

Low Carbon Fuel Standard

The goal of LCFS is to reduce the carbon intensity of transportation fuels by at least ten percent by 2020 as called for by Governor Arnold Schwarzenegger in Executive Order S-01-07. In the initial scoping plan, ARB accounts for a 15 MMTCO2E (Million Metric Tonnes of Carbon Dioxide Emissions) reduction from this policy alone.

LCFS is developing on a regional basis in the United States, as shown in Figure 3.1 below. California, once again, leads the effort in adopting LCFS and remains the only state with a low carbon fuel standard.[3] Of those states that considered developing an LCFS, eleven states are currently in the process of developing an LCFS and the remaining twelve have abandoned developing a standard citing high costs.[4]

Figure 3.1
LCFS Status by State



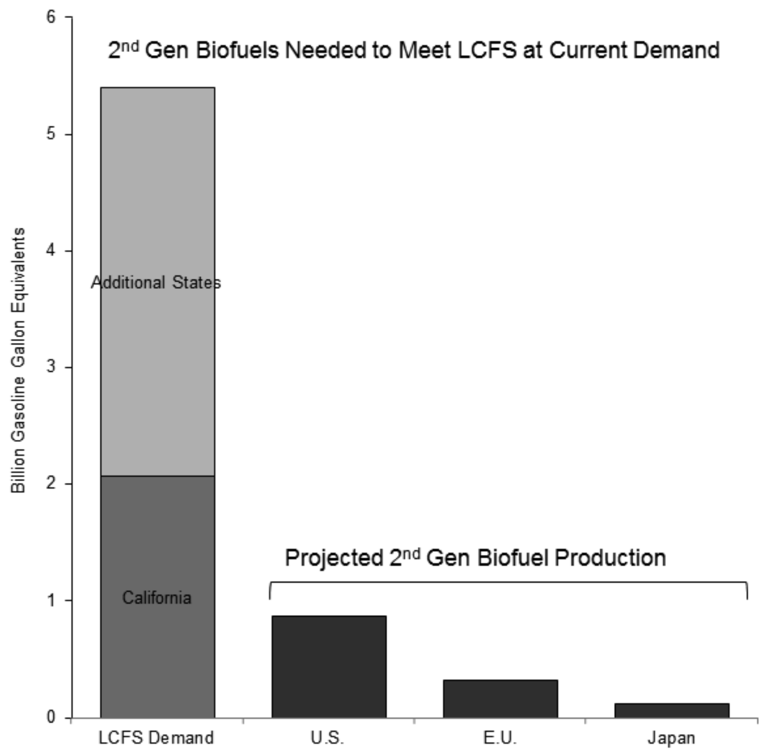
Source: Pew Center for Climate and Energy Solutions

As noted in Figure 3.2 below, California's demand for 2nd generation biofuel exceeds U.S. production by more than 100 percent. In addition, even if European and Japanese 2nd generation biofuel production are accounted for, California's demand alone still exceeds combined production by almost 20 percent. The availability of 2nd generation biofuels will become more problematic if and/or when other states adopt a low carbon fuel standard, as

[3] "Low Carbon Fuel Standard," Pew Center for Climate and Energy Solutions, October 31, 2011
[4] *ibid.*

the U.S. combined demand for biofuels would exceed domestic supply by more than 400 percent. This does not include standards that may be implemented in Canada or the EU, which would further increase the demand for limited availability low carbon fuels.

Figure 3.2
2nd Gen Biofuel Demand and Projected Production



SOURCE: U.S. Energy Information Administration, "State Energy Data System: 2010 Estimates," U.S. Department of Energy, June 2012, OECD-FAO Agricultural Outlook 2011. Based on current annual demand and California’s 2020 LCFS

Pavley II

In 2002, AB 1493 was passed into law and directed ARB to adopt vehicle standards that lowered GHG emissions to the maximum extent technologically feasible, beginning with the 2009 model year. These regulations, which are now known as “Pavley I” fuel standards, were adopted in 2004 and incorporate both performance standards and market-based compliance mechanisms. As part of the AB 32 Scoping Plan, ARB adopted a second phase of the Pavley regulations, known as “Pavley II” to increase fuel efficiency to 42.5 miles per gallon by 2020.

Vehicle Miles Traveled

SB 375 (Steinberg) was signed into law in September 2008 and established mechanisms for the development of regional targets for reducing passenger vehicle GHG emissions. The legislation sets out goals for regions to integrate development patterns and transportation network in a way that the reduction of GHG emissions reductions while meeting housing needs and other regional planning objectives.

The legislation also required ARB to develop, in consultation with metropolitan planning organizations, passenger vehicle GHG emissions reduction targets for 2020 and 2035 by September 2010. It also provides incentives, such as relief from certain California Environmental Quality Act (CEQA) requirements for development projects that are consistent with regional plans that achieve the targets.

Renewable Portfolio Standard

The policy began in 2002 when California established a Renewables Portfolio Standard (RPS) Program with the goal of 20 percent of the state's retail sales of electricity coming from renewable energy by 2017. The success of that effort led to further legislation that increased the targets of the program. Renewable energy includes (but is not limited to) wind, solar, geothermal, small hydroelectric, biomass, anaerobic digestion and landfill gas. The AB 32 Scoping Plan anticipated that California would have 33 percent of its electricity provided by renewable resources by 2020.

Combined Heat and Power

Combined heat and power (CHP), also referred to as cogeneration, produces electricity and thermal energy in an integrated system on development sites. The purpose of this policy is to reduce the need to expand or build new power plants and reduce the cost of transmission. The target for the program is to provide an additional 4,000 megawatts of installed CHP capacity by 2020. To encourage deployment, the state has considered incentives or mandates where appropriate, such as utility-provided incentive payments, the creation of a CHP portfolio standard, transmission and distribution support payments and the use of feed-in tariffs.

Efficiency Measures

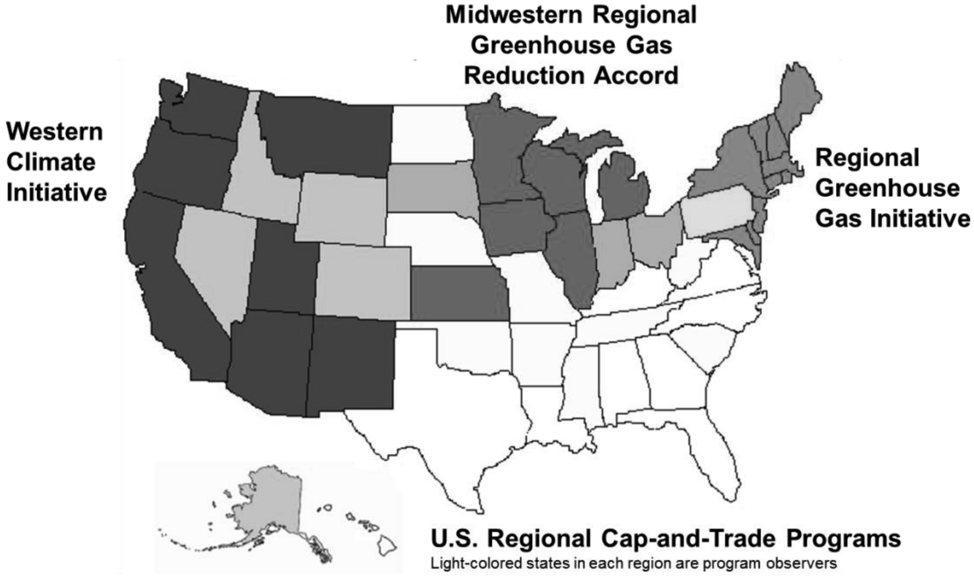
Efficiency measures refer to a series of strategies to reduce GHG emissions through improved energy usage, technological advancement and strategic building and utility standards targeted at the industrial, agricultural, commercial and residential end-use sectors.

Key energy efficiency strategies include "zero net energy" buildings, more stringent building codes and appliance efficiency standards, broader standards for new types of appliances and for water efficiency, voluntary and mandatory whole-building retrofits for existing buildings, more aggressive utility programs to achieve long-term savings, local government programs to tap into local authority over planning, development and code compliance and additional industrial and agricultural efficiency initiatives.

Cap-and-Trade

Twenty-two states have, at one time or another, joined regional GHG Cap-and-Trade markets. Moreover, 11 other states have considered joining regional markets. Several Mexican states and Canadian provinces have also considering joining Cap-and-Trade markets. Figure 3.3 shows the three major regions that have been involved in developing Cap-and-Trade markets.

Figure 3.3
Regional Cap-and-Trade Programs



SOURCE: World Resources Institute

The Western Climate Initiative was founded by Arizona, California, New Mexico, Oregon and Washington in 2007. By 2010, the Initiative grew to include Utah and Montana as well as four Canadian provinces as members; six additional states, one province and six Mexican states joined the Initiative as formal observers. However, by the end of 2011, California was the sole remaining U.S. state, the other states dropping due to costs and concerns about Cap-and-Trade implementation. Today, California and Quebec are the only entities that are actively participating in the Western Climate Initiative.

Illinois, Iowa, Kansas, Minnesota, Michigan and the Canadian province of Manitoba formed the Midwestern Regional Greenhouse Gas Reduction Accord in 2007. Indiana, Ohio, South Dakota and the province of Ontario joined as observers. Although implementation was envisioned to begin in 2010, no action has been taken to date. Accord members cite that they have not gone further because the Federal government has signaled that it may develop a program. However, no Federal program is imminent and no member states are currently actively pursuing Cap-and-Trade.

The Regional Greenhouse Gas Initiative (RGGI) was founded by nine Northeast and Mid-Atlantic states. Pennsylvania and three Canadian provinces are observers and New Jersey removed itself in 2011. RGGI implemented a limited GHG Cap-and-Trade system for power plants only, with the revenues primarily directed to efficiency programs.

4. Literature Review

Of the more than 120 academic sources reviewed, only 3 studies comprehensively assess AB 32's costs and economic impacts. The vast majority of studies were limited to specific AB 32 policy levers. It should be noted that SB 375, Pavley II and Efficiency Measures have only been analyzed by ARB and Berkeley/Roland-Holst, which reportedly share some architectural similarities. The range of impacts the studies reviewed are summarized in Table 4.1 below.

Table 4.1
Literature Projections by Program

Policy	Low	Median	High
LCFS	$0 [a]	$7.9 Billion [b]	$19.4 Billion [c]
Pavley II	($1.6 Billion) [d]	($1.3 Billion)	($1.1 Billion) [a]
VMT (SB 375)	($9.6 Billion) [d]	($4.8 Billion)	$0 [a]
RPS	$1.7 Billion [a]	$3.8 Billion [e]	$6.1 Billion [d]
CHP	($1.4 Billion) [a]	$0.2 Billion [f]	$1.5 Billion [d]
Efficiency	($4.0 Billion) [d]	($2.3 Billion)	($0.6 Billion) [a]
C&T	$7.3 Billion [g]	$18.7 Billion	$73.0 Billion [g]
Total	($7.6 Billion)	$22.2 Billion	$98.3 Billion

NOTE: All figures are in 2012 dollars.
SOURCE: a) Roland-Holst, David, "Energy Prices & California's Economic Security Prepared," Next 10, October 2009; b) Canes, M. and Murphy, E., "Economics of a National Low Carbon Fuel Standard," Marshall Institute, 2009; c) Bernstein, P.M., et al, "Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach", Electric Power Research Institute/Charles River Associates, June 2007; d) Air Resources Board, "Updated Economic Analysis of California's Climate Change Scoping Plan," March 2010; e) California Public Utilities Commission, "33 Percent RPS Calculator," July 2009; f) Norwood, Zack, et. al., "Assessment Of Combined Heat And Power System 'Premium Power' Applications In California," Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, June 1, 2010; g) Tanton, T., "An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California," AB 32 Implementation Group/T2 & Associates, March 2010;

In aggregate, the costs for AB 32 programs range from saving $7.6 billion to costing consumers $98.3 billion, representing over a $100 billion discrepancy in estimates. 74 percent of the total cost discrepancy stem from disagreements on Cap-and-Trade costs. The greatest consensus on program costs relate to Pavley II. However, as noted above, estimates of Pavley II costs are limited in number.

Low Carbon Fuel Standard

The literature surrounding LCFS is robust and generally demonstrates a consensus that LCFS as mandated by ARB will be expensive to implement.[5] The development of LCFS is highly dependent on the creation of a new low carbon intensity fuel market that does not exist at scale today. In a subsequent study, ARB found that a sustainable LCFS program is dependent on a "complete technology shift future."[6] Additionally, the National Research Council found that an LCFS market would not be met without substantial technological advances. The study also noted that even with technological advances, biofuels are not economically competitive with gasoline.[7]

Studies assessing a national LCFS program similarly conclude that there are significant issues with implementing LCFS. One study found that a national LCFS would cost $65.5 billion annually.[8] Another study found that a nationwide LCFS would result in 2.3 - 4.5 million jobs lost by 2025 and a 2 - 3 percent decline in GDP.[9] Studies also point out that LCFS may not effectively reduce overall GHG emissions because GHG emission reductions from LCFS use would be offset by increased emission elsewhere. In order for real reductions to be achieved, gasoline that is not consumed in California due to the LCFS would have to also not be

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[5] National Research Council, "Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy," Committee on Economic and Environmental Impacts of Increasing Biofuels Production, 2011; Schremp, G. "Low Carbon Fuel Standard (LCFS) Analysis & Compliance Costs: Role of Alternative Fuels in California's Transportation Energy Future," California Energy Commission, November 24, 2011; Lyons, J. and Daly, A., "Preliminary Review of the ARB Staff Analysis of 'Illustrative' Low Carbon Fuel Standard (LCFS) Compliance Scenarios - Draft," Sierra Research Inc, December 2011; Farrell, A.E. and Sperling, D., "A Low Carbon Fuel Standard for California: Part 1: Technical Analysis," California Energy Commission, August 2007

[6] Air Resources Board, "Low Carbon Fuel Standard 2011 Program Review Report," December 2011

[7] National Research Council, "Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy," Committee on Economic and Environmental Impacts of Increasing Biofuels Production, 2011

[8] Canes, M. and Murphy, E., "Economics of a National Low Carbon Fuel Standard," Marshall Institute, 2009

[9] Montgomery, D., et al, "Economic and Energy Impacts Resulting from a National Low Carbon Fuel Standard," Consumer Energy Alliance/Charles River Associates, June 2010

consumed elsewhere. A number of studies found that this is unlikely which would result in no net change in GHG emissions.[10]

Pavley II

Literature on Pavley II passenger standards is abundant. Since Pavley II mandates improved fuel efficiency, every study found that it will result in significant savings from decreased fuel consumption by passenger vehicles. The National Bureau of Economic Research estimated that Pavley II would save 162 million gallons of gasoline.[11] A U.C. Berkeley study found that it would result in $11 billion in fuel savings.[12] A Next 10 study found more modest results of $1.6 billion.[13]

In addition to the savings, there will likely be costs to design and manufacture the more efficient vehicles. ARB's Economic and Allocation Advisory Committee cautioned that ARB failed to provide an analysis to justify its assessment of costs and that their results are likely overly optimistic.[14] Next 10 estimated a cost of $2,010 per vehicle.[15] The National Bureau of Economic Research estimated that these costs would amount to $9.67 per gallon of fuel

[10] Canes, M. and Murphy, E., "Economics of a National Low Carbon Fuel Standard," Marshall Institute, 2009; Holland, S.P., et al, "Greenhouse Gas under Low Carbon Fuel Standards?" American Economic Journal: Economics Policy, 2009; National Research Council, "Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy," Committee on Economic and Environmental Impacts of Increasing Biofuels Production, 2011

[11] Goulder, Lawrence H., Mark R. Jacobsen and Arthur A. van Benthem. "Unintended Consequences From Nested State & Federal Regulations: The Case of the Pavley Greenhouse-Gas-Per-Mile Limits." National Bureau Of Economic Research, September 2009

[12] Zabin, Carol and Andrea Buffa. "Addressing The Employment Impacts Of AB 32, California's Global Warming Solutions Act." UC Berkeley Center for Labor Research and Education, February 2009

[13] Roland-Holst, David. "Energy Prices & California's Economic Security Prepared." Next 10, October 2009

[14] "Comments on the ARB's Updated Economic Impacts Analysis." Economic and Allocation Advisory Committee, California Environmental Protection Agency, April 18, 2010

[15] Roland-Holst, David. "Energy Prices & California's Economic Security Prepared." Next 10, October 2009

saved.[16] The National Highway Transportation Safety Administration estimated additional costs starting at $151 per vehicle in 2017 increasing to $820 by 2020.[17]

Though the literature on Pavley II passenger standards is readily available, literature concerning the Pavley II commercial diesel standards is limited. We have only obtained a study by the National Highway Traffic Safety Administration regarding this issue. That study estimates that Pavley II commercial diesel standards will result in costs amounting to $6,000 and $7,000 per vehicle. [18]

Vehicle Miles Traveled (SB 375)

Literature on the viability of SB 375 is currently very limited. SB 375 program details are currently being crafted by local governments, which make it difficult to determine levels of effectives and to estimate cost. However, despite the CARB's current assessment that SB 375 will be cost-free and yield substantial savings, localities have noted that potentially significant costs for infrastructure and public transport development are needed to effectuate SB 375.[19]

Renewable Portfolio Standard

The literature suggests that consensus is limited regarding the costs and the economic impact of RPS. Some studies show that it could offer significant savings, while others show that it will bring significant costs. The Union of Concerned Scientists estimates that it will yield $14.9 billion in new capital investment in renewable energy and create an additional $631 million in property tax revenue. In total it will lead to $1.85 billion in lower electricity and natural gas bills by 2020 (growing to $3.82 billion by 2030) and create 16,000 new jobs from renewable energy

[16] Goulder, Lawrence H., Mark R. Jacobsen and Arthur A. van Benthem. "Unintended Consequences From Nested State & Federal Regulations: The Case of the Pavley Greenhouse-Gas-Per-Mile Limits." National Bureau Of Economic Research, September 2009

[17] National Highway Traffic Safety Administration, "Corporate Average Fuel Economy for MY 2017-MY 2025 Passenger Cars and Light Trucks: Preliminary Regulatory Impact Analysis," 2011

[18] National Highway Traffic Safety Administration, "Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards For Medium and Heavy-Duty Engines and Vehicles; Regulatory Impact Analysis," 2011

[19] Elkind, E., "The Myth of SB 375," Legal Planet, September 2010; Shigley, P., "Bureaucratic Compliance With SB 375 May Not Reduce Driving," California Planning and Development Report, July 2009

development, $704 million in state income and $539 million in GSP.[20] Conversely, Resources for the Future found that an RPS could cost consumers $3.3 billion, while reducing emissions by 89 million tons. Other studies generally rest between the two extremes.[21]

Combined Heat and Power

Literature on the impact of Combined Heat and Power is limited. The literature suggests that ARB's assumptions were overly optimistic and that penetration to the point they anticipated is not readily feasible.[22] ARB agrees with this assessment and did not model full CHP penetration in the Updated Economic Analysis.[23] The California Energy Commission found that penetration would likely range between 12,317 GWh and 42,228 GWh by 2030 at a cost of between $3.1 and $7.2 billion in 2012 dollars.[24]

Efficiency Measures

Literature on Efficiency Measures is also limited. McKinsey & Company's Abatement Curve shows that there are 4.5 Gigatons of potential abatement in North America due to technological innovations. They estimate that this would cost approximately $35 per ton per year to achieve these reductions.[25] It should be noted that a previous McKinsey report, focusing on the United States found that the western region has far less abatement potential than the nation overall

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[20] "Cashing In on Clean Energy." Union of Concerned Scientists. July 2007

[21] Energy and Environmental Economics, Inc., Aspen Environmental Group. "33% Renewables Portfolio Standard: Implementation Analysis Preliminary Results." California Public Utilities Commission, June 2009; Mahone, A., C.K. Woo, J. Williams, I. Horowitz. "Renewable portfolio standards and cost-effective energy efficiency investment." Energy Policy, Volume 37, Issue 3, March 2009, Pages 774–777

[22] ICF International. "CHP Market Assessment." Integrated Energy Policy Report Committee Combined Heat and Power Workshop, California Energy Commission, July 23, 2009; Stadler, Michael. "The CO2 Reduction Potential of Combined Heat and Power in California's Commercial Buildings." Clean Tech Law & Business journal, 2010

[23] California Air Resources Board, "Updated Economic Analysis of California's Climate Change Scoping Plan," March 2010

[24] CEC, "Combined Heat And Power: Policy Analysis And 2011 – 2030 Market Assessment," February 2012

[25] McKinsey & Company, "Impact of the financial crisis on carbon economics: Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve," 2010

and that this potential is concentrated in the electricity generation sector, which is separate from these measures.[26]

Cap-and-Trade

A number of forecasts exist for national Cap-and-Trade models, while a smaller number have been produced for California specifically. California GSP impacts range from +.2 percent to -2.2 percent in 2020,[27] while national GDP impacts range as high as a loss of 3.8 percent.[28] Projected credit prices range from $20 to $214 per ton.[29]

Studies show a wide variety of potential price points for carbon offsets. The ARB study shows a projected range between $20 and $162/ton in 2020[30] and The Brattle Group assumes

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[26] McKinsey and Company, “Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?” U.S. Greenhouse Gas Abatement Mapping Initiative, December 2007

[27] California Air Resources Board, “Updated Economic Analysis of California’s Climate Change Scoping Plan,” March 2010; Roland-Holst, D., “Energy efficiency, innovation and job creation in California,” Center for Energy, Resources and Economic Sustainability, October 2008; Bernstein, P.M., et al, “Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach”, Electric Power Research Institute/Charles River Associates, June 2007; Tanton, T., “An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California,” AB 32 Implementation Group/T2 & Associates, March 2010

[28] U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Low Carbon Economy Act of 2007,” January 2008; U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Lieberman-Warner Climate Security Act of 2008,” March 2008 Congressional Budget Office, “The Economic Effects of Legislation to Reduce Green-House Gas Emissions,” September 2009; Congressional Budget Office, “The Economic Effects of Legislation to Reduce Green-House Gas Emissions,” September 2009

[29] California Air Resources Board, “Updated Economic Analysis of California’s Climate Change Scoping Plan,” March 2010; Roland-Holst, D., “Energy efficiency, innovation and job creation in California,” Center for Energy, Resources and Economic Sustainability, October 2008; Bernstein, P.M., et al, “Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach”, Electric Power Research Institute/Charles River Associates, June 2007; Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses,” Union of Concerned Scientists/The Brattle Group, December 2009; Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses: An Update,” Union of Concerned Scientists/The Brattle Group, October 2010; Tanton, T., “An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California,” AB 32 Implementation Group/T2 & Associates, March 2010; U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Low Carbon Economy Act of 2007,” January 2008; U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Lieberman-Warner Climate Security Act of 2008,” March 2008; Congressional Budget Office, “The Economic Effects of Legislation to Reduce Green-House Gas Emissions,” September 2009; Johnston, L., et al, “2011 Carbon Dioxide Price Forecast,” Synapse Energy Economics, Inc, February 2011; Economic and Allocation Advisory Committee, “Allocation Emissions Allowances Under a California Cap-and-Trade Program,” Recommendations to the California Air Resource Board and California Environmental Protection Agency, March 2010

[30] Air Resources Board, “Updated Economic Analysis of California’s Climate Change Scoping Plan,” March 2010

a range between $42 and $100/ton in 2020[31] in its AB 32 specific analyses. Synapse projects a range between $27 and $71/ton in 2020[32], the EIA and EPA project levelized costs of between $15 and $90/ton.[33] Another study projects possible prices as high as $214.[34] Every analysis makes clear that the price can vary greatly based on specific policy maker decisions, economic impacts and varying levels of technological development.[35] Key drivers of price include the amount of offsets available, a factor particularly driven by the allowance of international offsets and command and control measures in addition to cap and trade.[36] The CBO found that offsets

[31] Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses: An Update,” Union of Concerned Scientists/The Brattle Group, October 2010

[32] Johnston, L., et al, “2011 Carbon Dioxide Price Forecast,” Synapse Energy Economics, Inc, February 2011

[33] U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Low Carbon Economy Act of 2007,” January 2008; U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Lieberman-Warner Climate Security Act of 2008,” March 2008

[34] Economic and Allocation Advisory Committee, "Comments on the ARB’s Updated Economic Impacts Analysis," California Environmental Protection Agency, April 18, 2010

[35] California Air Resources Board, “Updated Economic Analysis of California’s Climate Change Scoping Plan,” March 2010; Roland-Holst, D., “Energy efficiency, innovation and job creation in California,” Center for Energy, Resources and Economic Sustainability, October 2008; Bernstein, P.M., et al, “Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach”, Electric Power Research Institute/Charles River Associates, June 2007; Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses,” Union of Concerned Scientists/The Brattle Group, December 2009; Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses: An Update,” Union of Concerned Scientists/The Brattle Group, October 2010; Tanton, T., “An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California,” AB 32 Implementation Group/T2 & Associates, March 2010; U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Low Carbon Economy Act of 2007,” January 2008; U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Lieberman-Warner Climate Security Act of 2008,” March 2008; Johnston, L., et al, “2011 Carbon Dioxide Price Forecast,” Synapse Energy Economics, Inc, February 2011; Taylor, M., “Evaluating the Policy Trade-Offs in ARB’s Cap-and-Trade Program,” Legislative Analyst’s Office, February 2012; Economic and Allocation Advisory Committee, “Allocation Emissions Allowances Under a California Cap-and-Trade Program,” Recommendations to the California Air Resource Board and California Environmental Protection Agency, March 2010

[36] California Air Resources Board, “Updated Economic Analysis of California’s Climate Change Scoping Plan,” March 2010; Roland-Holst, D., “Energy efficiency, innovation and job creation in California,” Center for Energy, Resources and Economic Sustainability, October 2008; Bernstein, P.M., et al, “Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach”, Electric Power Research Institute/Charles River Associates, June 2007; Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses,” Union of Concerned Scientists/The Brattle Group, December 2009; Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses: An Update,” Union of Concerned Scientists/The Brattle Group, October 2010; Tanton, T., “An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California,” AB 32 Implementation Group/T2 & Associates, March 2010; U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Low Carbon Economy Act of 2007,” January 2008; U.S.

could reduce costs by 70 percent,[37] while another comment stated that the most cost efficient renewable energy sources have already been developed.[38]

Regulations will impact certain industries far more than others. Energy intensive industries, such as refining and commercial transportation will likely be the hardest hit and many small businesses, such as laundry and dry cleaning, are also particularly energy intensive.[39] Several studies found that a price safety valve or similar policy could stabilize the market and limit potential harm.[40]

Contract or resource shuffling could make California's imports appear to be cleaner, but provide no net difference in emissions as higher emission power is sold in locations without emission regulations. Leakage is a significant risk. Reports state that it would not only

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Environmental Protection Agency, Office of Atmospheric Programs, "EPA Analysis of the Lieberman-Warner Climate Security Act of 2008," March 2008; Johnston, L., et al, "2011 Carbon Dioxide Price Forecast," Synapse Energy Economics, Inc, February 2011; Taylor, M., "Evaluating the Policy Trade-Offs in ARB's Cap-and-Trade Program," Legislative Analyst's Office, February 2012; Economic and Allocation Advisory Committee, "Allocation Emissions Allowances Under a California Cap-and-Trade Program," Recommendations to the California Air Resource Board and California Environmental Protection Agency, March 2010; Rothrock, D. and Burgat, M., "AB 32 Implementation Group's letter to CARB regarding its Cap-and-Trade preliminary draft regulation," AB 32 Implementation Group, January 2010; AB 32 Implementation Group, "Backgrounder: AB 32's Economic Analysis Tens of Billions in Hidden Costs," September 2008; Cutter, B., et al, "Rules of the Game: Examining Market Manipulation, Gaming and Enforcement in California's Cap-and-Trade Program," Emmett Center on Climate Change and the Environment, August 2011; Tansey, J., "Re: ARB Cap and Trade 'Alternatives'," Comments on the Supplement to the AB 32 Scoping Plan FED, July 2011; Coleman, B.M., "CalChamber's Comments on the Supplement to the AB 32 Scoping Plan Functional Equivalent Document as Released June 13, 2011," California Chamber of Commerce, July 2011

[37] Congressional Budget Office, "The Economic Effects of Legislation to Reduce Green-House Gas Emissions," September 2009

[38] Busterud, J.W., "Re: PG&E's Comments on the California Air Resources Board's 11/16/09 Workshop on AB 32 Economic Analysis," PG&E, December 2009

[39] California Air Resources Board, "Updated Economic Analysis of California's Climate Change Scoping Plan," March 2010; Roland-Holst, D., "Energy efficiency, innovation and job creation in California," Center for Energy, Resources and Economic Sustainability, October 2008; Bernstein, P.M., et al, "Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach", Electric Power Research Institute/Charles River Associates, June 2007; Weiss, J. and Sarro, M., "The Economic Impact of AB 32 on California Small Businesses," Union of Concerned Scientists/The Brattle Group, December 2009; Weiss, J. and Sarro, M., "The Economic Impact of AB 32 on California Small Businesses: An Update," Union of Concerned Scientists/The Brattle Group, October 2010; Tanton, T., "An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California," AB 32 Implementation Group/T2 & Associates, March 2010

[40] Bernstein, P.M., et al, "Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach", Electric Power Research Institute/Charles River Associates, June 2007; Aldy, J.E. and Stavins, R.N., "The Promise and Problems of Pricing Carbon: Theory and Experience", Faculty Research Working Paper Series, October 2011; Taylor, M., "Letter to Assembly Member Logue," Legislative Analyst's Office, June 2010

undermine California's economy, but would also undermine the emissions reduction goals of AB 32 when emitting industries simply move their facilities to unregulated states or countries.[41]

[41] California Air Resources Board, "Updated Economic Analysis of California's Climate Change Scoping Plan," March 2010; Bernstein, P.M., et al, "Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach", Electric Power Research Institute/Charles River Associates, June 2007; Tanton, T., "An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California," AB32 Implementation Group/T2 & Associates, March 2010; Taylor, M., "Evaluating the Policy Trade-Offs in ARB's Cap-and-Trade Program," Legislative Analyst's Office, February 2012; Economic and Allocation Advisory Committee, "Allocation Emissions Allowances Under a California Cap-and-Trade Program," Recommendations to the California Air Resource Board and California Environmental Protection Agency, March 2010; Rothrock, D. and Burgat, M., "AB 32 Implementation Group's letter to CARB regarding its Cap-and-Trade preliminary draft regulation," AB 32 Implementation Group, January 2010; LaVenture, R., "Re: Regulation to Implement CA Scoping Plan and Transportation Fuels," United Steel Workers, July 2011

5. Review of ARB's Updated Economic Analysis

A number of stakeholders provided feedback on ARB's Updated Economic Analysis though ARB did not facilitate an official review. (It should be noted that though ARB's initial Economic Analysis was subject to formal comments, the Updated Economic Analysis was not.[42]) The feedback ranged from comments on ARB's modeling method approach in general to specific comments regarding particular program assumptions and estimation methods. These comments include:

- Problems in the baseline and reference case including:
  - Overly optimistic economic forecasting
  - Assigning non-AB 32 policies to AB 32 implementation
- A lack of sensitivity analysis for critical assumptions, including:
  - Economic growth
  - Weather patterns
  - Technology development
  - Driving patterns
- Questionably optimistic assumptions regarding vehicle miles traveled (VMT)
- The savings from VMT account for all savings projected by ARB
- Fails to measure leakage, a key potential harm based on AB 32
- Does not adequately account for additional costs of operation, such as transmission and backup generation costs

ARB's AB 32 Reductions and Business As Usual Projections

As shown in Figure 5.1, ARB projects that it will achieve the required GHG emissions reductions through a combination of policies. Cap-and-Trade emission reductions make up about half of total reductions. Additional reductions are assumed to come from other complementary policies. If these policies fail to meet their projected GHG reductions, ARB has

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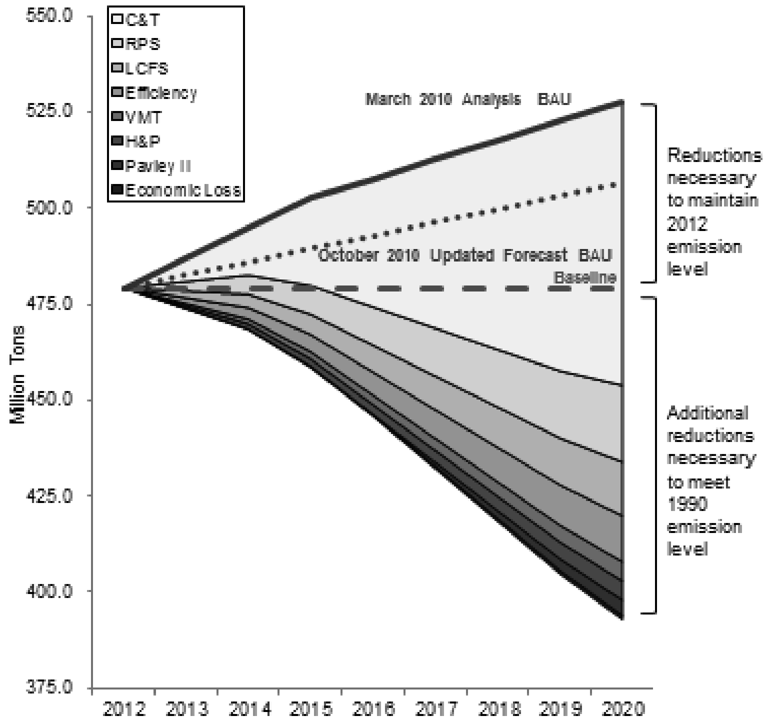
[42] California Air Resources Board, "Peer Review of the Economic Supplement to the AB 32 Draft Scoping Plan: Major Peer Review Comments and Air Resources Board Staff Responses", November 2008

indicated that it would seek the necessary additional reductions through its Cap-and-Trade program.

Figure 5.1
ARB Projected AB 32 Reductions

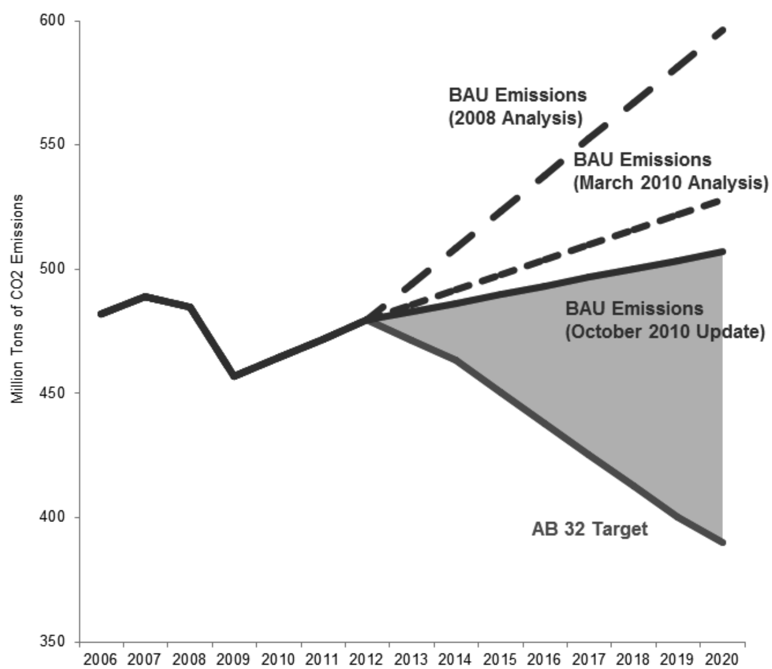


SOURCE: ARB 2010 Updated Economic Analysis Data for targets and complementary results, attributing remaining reductions to Cap-and-Trade and calculating straight-line growth/reductions for interim years with data not reported; ARB Greenhouse Gas Inventory - 2020 Emissions Forecast

It should be noted that 38 percent of emissions reductions under AB 32 are required to maintain the 2012 baseline. AB 32's requirement is a 20 percent reduction relative to the 2012 baseline, so in addition to that 20 percent, ARB needs to prevent increased emissions due to economic growth and other factors.

Program cost estimates are extremely sensitive to ARB's business-as-usual (BAU) forecast. Though full documentation regarding ARB's methodology was not readily available, it is our understanding that the BAU forecast is itself dependent on a number of factors, including economic growth, which complicates the forecasting process. Figure 5.2 highlights the potential uncertainty involved in estimating the BAU. As shown in the diagram, ARB has reduced its BAU estimate twice and twice has lowered its initial projections, totaling 43 percent since its initial projection in 2008. In 2008, ARB projected that BAU GHG emissions would total 596 million tons by 2020; under the original BAU, required GHG inventory reductions totaled 206 million tons. In March 2010, ARB decreased its BAU to 528 million tons by 2020; in order to meet AB 32 targets under the restated BAU, GHG inventory reductions were projected to total 138 million tons, amounting to a reduction of 33 percent from its 2008 inventory projection. In October 2010 (the most current forecast), ARB decreased the BAU again to 507 million tons, equating to an inventory reduction of 117 million tons. This amounts to a 43 percent reduction from its 2008 inventory of necessary GHG emissions reductions.

Figure 5.2
ARB Projected GHG Emissions Forecasts



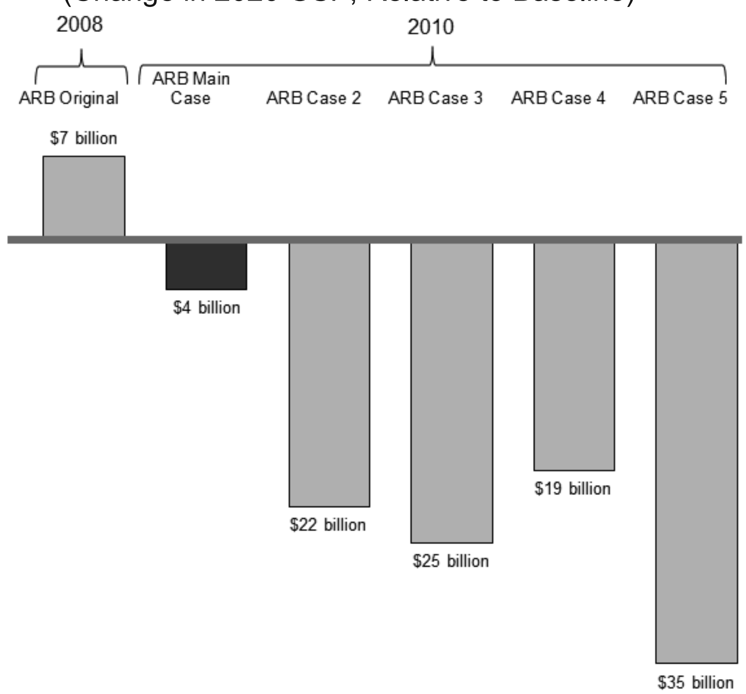
SOURCE: Historical emissions: ARB Greenhouse Gas Inventory Data - 2000 to 2009, BAU Emissions: ARB Greenhouse Gas Inventory - 2020 Emissions Forecast; AB 32 Target: ARB Updated AB 32 Scoping Plan Economic Analysis

The BAU forecast is key to determining the amount of reductions necessary to comply with AB 32 and the economic impact of AB 32. Inaccurate BAU's present significant programmatic risk. If the BAU is too low, reductions in the early years will be inadequate and will dramatically increase the costs of reductions in the later years. If the BAU is too high, it will needlessly impose significant costs on the California economy.

ARB Estimates of Economic Impacts

ARB released an initial study in 2008, which reported that AB 32 would generate $7 billion in economic activity for the state. As a result of feedback from its public review, ARB updated its analysis in 2010. Figure 5.3 summarizes the results of ARB's most current complete analysis.

Figure 5.3
ARB Study/Case Comparison
(Change in 2020 GSP, Relative to Baseline)



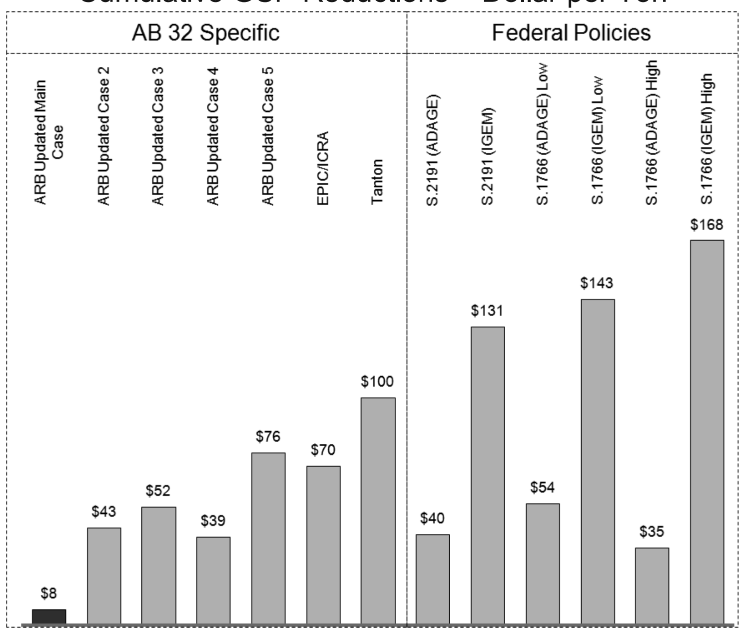
SOURCE: ARB 2010 Updated Analysis

ARB's latest study estimates that AB 32 will reduce GSP between $4 billion to $35 billion. The focus of their analysis and commentary, though, has focused entirely on the most optimistic case. The other four cases show four to seven times more economic damage than the most optimistic ARB projection.

As noted in the literature review section, the number of studies specifically pertaining to AB 32 is limited and in many cases lacks the detail necessary to make comparisons to other studies. ARB conducted their initial Economic Analysis in 2008 and updated this report in 2010. Studies comparable to ARB's Updated Economic Analysis were conducted by U.C. Berkeley/Next10[43], Charles River Associates[44], Varshney and Tootelian[45], Brattle[46] and Tanton[47]. In addition, the US EPA conducted studies on proposed Federal GHG reduction policies that shed light on the impact of AB 32.

Figure 5.4 below demonstrates the variation in per ton cost estimate of GHG reductions.

Figure 5.4
Cumulative GSP Reductions – Dollar per Ton



NOTES: EPIC/ICRA and Tanton did not disclose key data. To translate their results, we assumed 500 million tons of reductions achieved and a business as usual 2020 GSP of $2.5 trillion, consistent with ARB

[43] Roland-Holst, David, "Energy Prices & California's Economic Security Prepared," Next 10, October 2009; It should be noted that U.C. Berkeley/Next 10's produced similar results to ARB because there analysis is based on the same model and similar assumptions as the 2008 ARB Economic Analysis
[44] Bernstein, P.M., et al, "Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach", Electric Power Research Institute/Charles River Associates, June 2007
[45] Varshney, Sanjay B. and Dennis H. Tootelian, "Cost Of AB 32 On California Small Businesses - Summary Report of Findings," Varshney & Associates, June 2009
[46] Weiss, J. and Sarro, M., "The Economic Impact of AB 32 on California Small Businesses," Union of Concerned Scientists/The Brattle Group, December 2009
[47] Tanton, T., "An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California," AB 32 Implementation Group/T2 & Associates, March 2010

The available research suggests that there is considerable disagreement and uncertainty pertaining to the economic impact of AB 32. Estimated impacts to GSP/GDP per ton of reductions vary widely, from a low of $8, in ARB's main case to $168 in the EPA's analysis of Senate Bill 1766. Even ARB's own analysis reflects a great deal of uncertainty varying by more than nine fold between its high and low cases.

It should also be noted that ARB's main case is significantly lower than other reference studies. ARB's main case scenario reflects a reduction of GSP amounting to $8/ton and reflects an implicit direct cost of $5/ton, which is significantly out of line with other reports. A look at analysis of federal legislation suggests that currently available estimates for AB 32 costs may be conservative. While there are similarities, the federal proposals cited are generally less restrictive than AB 32 and, thus, would be expected to be less costly. Additionally, California has already implemented many environmental reforms that other states have not and has already consumed the "low hanging fruit." The cost of further GHG reductions in California will likely be more expensive than for the nation as a whole.

Omitted Costs and Analysis Adjustments

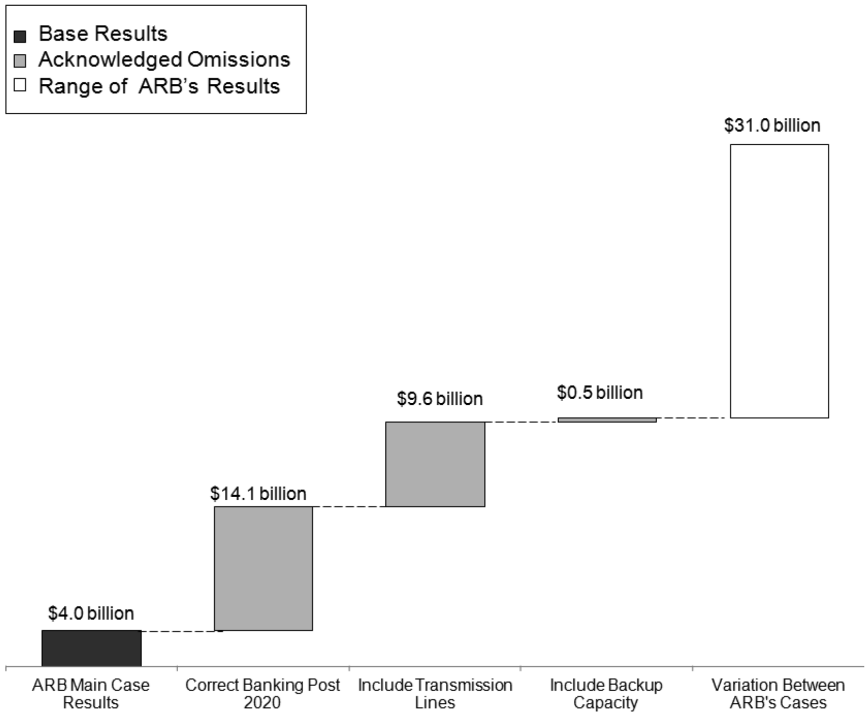
There are a number of specific ways that ARB's analysis could be strengthened. This includes incorporating key costs that have been omitted, assuming firms will meet Cap-and-Trade requirements in a sustainable manner and better acounting for leakage. ARB acknowledges a number of these issues, including failing to account for transmission line and backup capacity costs and the need for ongoing Cap-and-Trade compliance. These issues include:

- Transmission Lines: ARB's most current analysis does not account for additional transmission lines needed to transmit energy from remote renewable sources. ARB acknowledges that this is an issue. We calculate, based on CPUC estimates, that accounting for this cost would reduce GSP by $10 billion.

- Backup Capacity: ARB's most current analysis does not account for backup capacity needed to ensure continuous generation in all weather conditions. Using ARB's base case assumptions and assuming 10 percent backup capacity is needed, we calculate that this would reduce GSP by $0.5 billion.
- Ongoing Cap-and-Trade compliance: ARB assumed firms would meet their Cap-and-Trade obligations by making reductions early, banking the savings and spending them down in later years. This practice is only possible if Cap-and-Trade is assumed to expire after 2020. ARB discussed this issue in the Updated Economic Analysis and included adjusted credit costs to account for this issue. ARB estimated that credit prices would increase to $43 if these compliance issues are addressed. Based on ARB credit estimates, we estimate that adjusting for this would reduce GSP by $14 billion.
- SB 375 Costs: ARB does not model any costs for implementing SB 375 to achieve the vehicle miles traveled reductions they anticipate. The local and regional governments responsible for implementing SB 375 have made clear that substantial additional spending will be necessary for expanded public transit, development incentives, infrastructure and program implementation costs. Additional analysis is necessary to better understand the costs of this program.

Figure 5.5 below exhibits our adjustments to ARB's updated base case estimate factoring in the first three adjustments described above. Factoring in these corrections could raise costs by more than $24 billion in year 2020 alone. When coupled with the other scenarios developed by ARB, the combined impact of AB 32 could reduce California's GSP by almost $60 billion.

Figure 5.5
Corrections to ARB 2020 GSP Reductions



NOTES: Banking Corrected: ARB supplied correct credit cost x credits needed x RIMS II; Transmission Line Costs from PUC RPS Implementation Analysis Amortized over 20 years x 8 years included in analysis x RIMS II; Backup capacity equal to 10 percent of ARB Calculated Renewables Volume x Natural Gas Cost x RIMS II

6. Independent Economic Analysis

As part of this study, we developed an independent assessment of the costs and economic impact of AB 32. Our charge was to perform our analysis utilizing the following principles:

- Transparency: All aspects of our methodology are documented within this report. All data sources are cited and assumptions clearly articulated. No proprietary models were utilized in this analysis.
- Most trusted data: Our study leverages existing studies and data sources. All studies and data sources utilized in this report are public and sourceable. We relied to the extent possible on government data when it existed. All data sources are cited and none are proprietary.
- Conservative estimates: Because of the uncertainty involving program implementation, market development and the economy as a whole, we developed three cases to embody plausible scenarios which may develop. Our Low Case scenario analysis is our base case. Our base case provides estimates that, to the extent possible, understate the actual cost of AB 32. We supplement our base case analysis with Optimistic and High Case scenarios for illustrative purposes. The assumptions for our Low Case, Optimistic Case and High Case are described below:

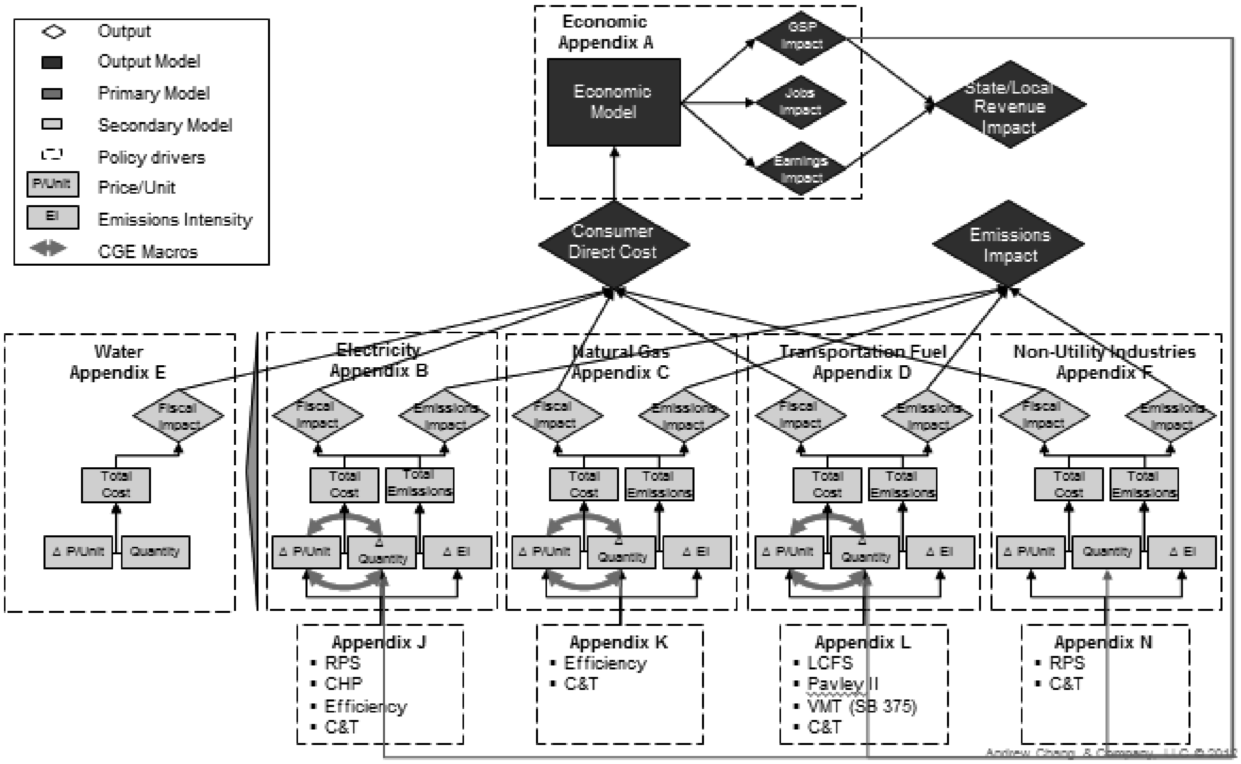
Table 6.1
Assumption by Case

	Low Case	Optimistic Case	High Case
Base 2020 Credit Price	$25	$50	$100
Cellulosic Production (relative to OECD U.S. projection)	575% (50% to CA)	150% (50% to CA)	50% (50% to CA)
Brazilian Ethanol Cost Basis	Ample – Available at standard market rates plus import cost	Midpoint of Ample and Impacted	Impacted – Only available at a significant premium, based on the cost of replacement gasoline in Brazil
Biodiesel Premium	$2.00	$2.50	$3.00
Efficiency Growth	3% (2% standard + 1% from measures)	2.5% (2% standard + .5% from measures)	1% (2% standard – 1% due to preexisting technological penetration)
SB 375	Fully Implemented (4%)	Half Implemented (2%)	Half Implemented (2%) with increased transit need
Combined Heat and Power	CEC High Penetration	CEC Low Penetration	CEC Low Penetration
Offsets Availability	8%	8%	8%

Direct Cost Estimation Model

Our overall approach is described in this section. Detailed appendices documenting our specific calculations, data sources and assumptions are provided in this document's appendix. As shown in Figure 6.1, our analysis is built on 24 models that collectively measure the GHG emissions and fiscal impacts of AB 32 policies. Each program impacts the cost and volume of modeled commodities as well as the associated GHG emissions. For each commodity, a shift in demand and per unit price is calculated. Multiplying cost by volume produces the total direct costs to that commodity. A portion of these costs are then recovered as revenue within California and a portion are lost to leakage. The portion of costs that is lost to leakage is then translated into economic impacts, including Gross State Product, Jobs, Earnings and State and Local Revenue.

Figure 6.1
Estimation Model Architecture



SOURCE: Andrew Chang & Company, LLC

The AB 32 programs are analyzed to determine their impact on cost and quantity of electricity, natural gas and transportation fuel. The cost impact of AB 32 on water is derived by determining the additional cost of electricity to provide water to end use customers. The AB 32 programs are also assessed to determine their impact on non-utility industries.

The impacts of each AB 32 program are comingled. There are direct impacts, for example, as the cost of electricity is increased by RPS, which drives down demand for electricity and, conversely, the cost of electricity is decreased by Efficiency Measures, which drives up demand for electricity. In the first case, this increases the reductions from those directly envisioned by RPS and in the second, it decreases the reductions envisioned from Efficiency Measures. Because of the multiple feedback loops in the model, it is more complicated to calculate demand than it would be in a model focused on a single policy. We assume that California is an efficient market as it relates to supply and demand of the modeled energy commodities. That is to say, we assume that price and demand will adjust instantly to changes in one another and transactions will occur at the equilibrium point with no lag effects, market spikes or other distortions. In order to achieve this, we calculated the equilibrium price by iterating the impact of demand on cost and vice-versa. For each of the models, we calculate a baseline demand. The model calculates costs based on the price drivers at that demand point. It then calculates an adjusted demand, based on change in spending. Our model replaces the baseline demand with the adjusted demand and recalculates price and adjusted demand. It repeats this process 1,000 times, allowing supply and demand to converge to a stable equilibrium. We only calculate equilibrium prices for electricity, natural gas and transportation fuels. We do not model any shift in water demand due to limited availability of data on consumption and its drivers. We do not model cost-specific shifts in demand for industrial goods, assuming that it grows or shrinks with the economy. The direct consumer effect is calculated and is used to determine the economic effect. The economic impact is used to then fed back into the commodities in the form of decreased usage.

Economic Impact Estimation Model

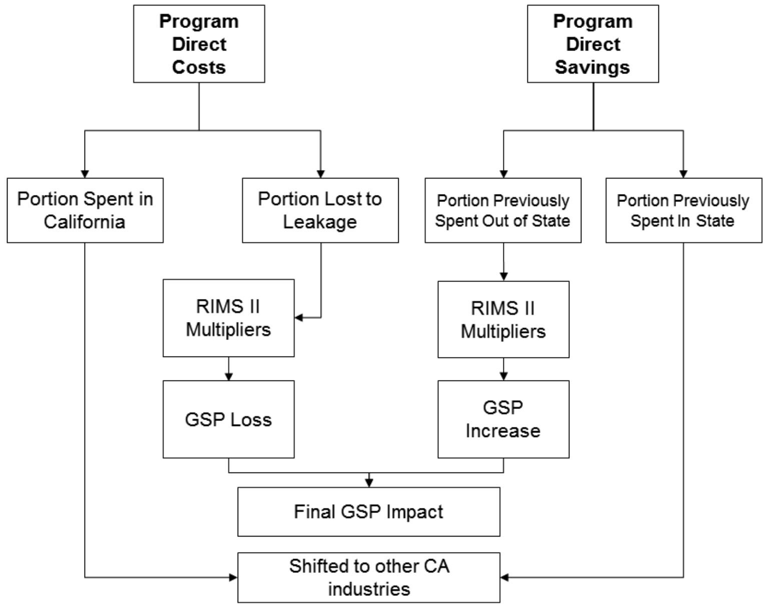
Costs and savings from AB 32 programs impact the economy as a whole. Increased costs will have a negative impact on the economy, while savings resulting from reduced use will have a positive effect. Our model for economic impact is structured as an input-output model. An input-output model divides the national or regional economy into various industrial sectors and tracks how much each industry must purchase from every other industry to produce one unit of output. The model contains feedback loops that force most industries to produce more than the “direct output requirements” would seem to imply. Through a matrix inversion, all of these feedback loops collapse into one step and calculates the extra (“indirect”) output requirements they create. The ratio of the total requirements to the direct requirements is called the input-output multiplier.

Input-output models are used regularly as a national and regional economic impact and forecasting tool. Probably the most visible and publicized use includes projecting the economic impacts of sports facilities, military bases and tourism.

Our model utilizes U.S. Department of Commerce RIMS II multipliers to calculate the economic impact of AB 32. We recognize and model shifts from particular sectors of the economy that bear additional costs and shift the added costs to the sectors of the economy that experience the shift in final demand. We also take into consideration shifts in California that may leak resources out of the state's economy.

For example, SB 375 will require an increase in spending by government and riders on public transit. A portion of these costs will be spent in state on staff, infrastructure, overhead and a portion of fuel costs. The remaining portion will be spent out of state on capital equipment and a portion of fuel costs. The portion that is spent in state is shifted from one industry to another and has minimal impact on the overall economy. The portion that is spent out of state is lost to the California economy. In addition, SB 375 will reduce spending on passenger cars and fuel. A portion of those savings were previously spent out of state, including spending on passenger cars and a portion of fuel costs. A portion of the savings was previously spent in state, including a portion of fuel costs. The portion that was previously spent in state is lost to those industries, but shifted to others, producing a minimal impact on the overall economy. The portion that was previously spent out of state is returned to the California economy, producing savings to the economy. Net costs and savings are then fed through the RIMS II economic multipliers to estimate overall economic impact. Figure 6.2 provides a graphic representation of this economic model.

Figure 6.2
Economic Model Architecture

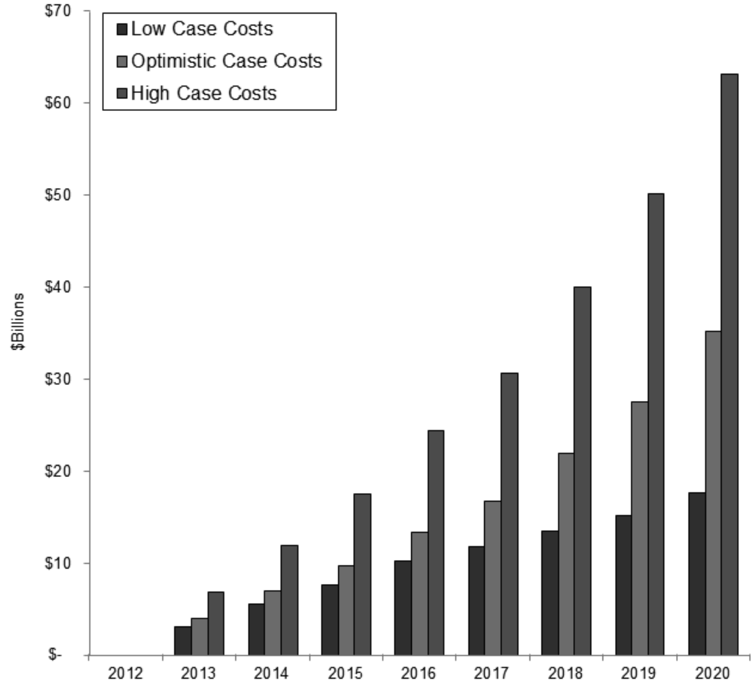


SOURCE: Andrew Chang & Company, LLC

Direct Costs

AB 32 imposes direct costs on California in the form of higher commodity costs, the cost of required technological changes and the cost of Cap-and-Trade compliance credits and offsets as well as direct savings in the form of decreased demand for commodities. Figure 6.3 exhibits our Low, Optimistic and High estimates of direct annual AB 32 costs. In the Low Case, the direct annual cost of AB 32 reaches $17.7 billion by 2020. The Low Case grows at an average rate of 29 percent per year. In the Optimistic Case, the direct annual cost of AB 32 is $35.3 billion in 2020. The Optimistic Case grows at an average rate of 37 percent per year. In the High Case, the direct annual cost of AB 32 grows to $63.3 billion, about 80 percent of California’s 2011-12 General Fund and more than the amount the State collected in Personal Income Tax in FY 2011-12. The High Case grows at an average rate of 38 percent.

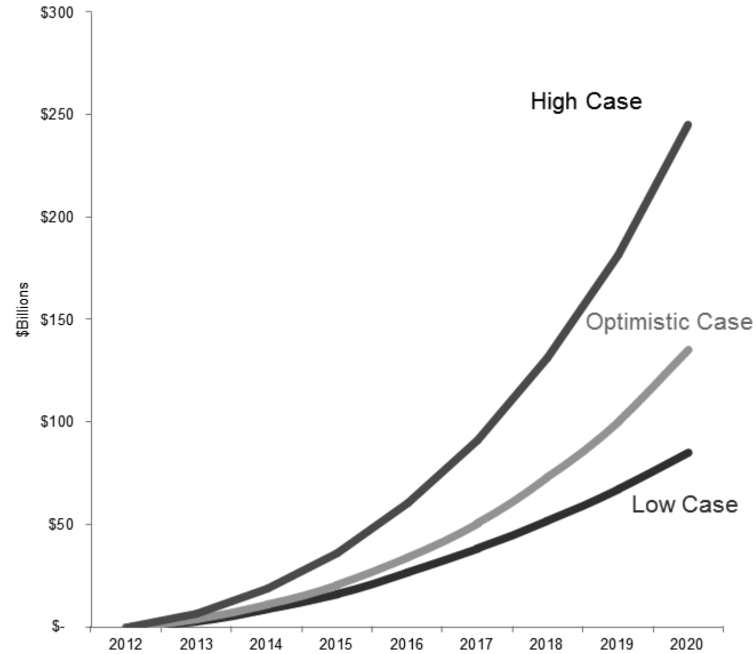
Figure 6.3
Annual Direct Costs by Case



SOURCE: Appendix C

Our cumulative estimates of direct costs are shown in Figure 6.4. In the Low Case, the cumulative cost of AB 32 reaches to $85.2 billion in 2020. The Low Case is growing at an average rate of 66 percent. In the Optimistic Case, the cumulative cost of AB 32 reaches $135.8 billion during the first eight years of implementation. The Optimistic Case is growing at an average rate of 70 percent. In the High Case, the cumulative cost of AB 32 reaches $245.3 billion during the first eight years of implementation. The High Case is growing at an average rate of 72 percent.

Figure 6.4
Cumulative Direct Costs by Case

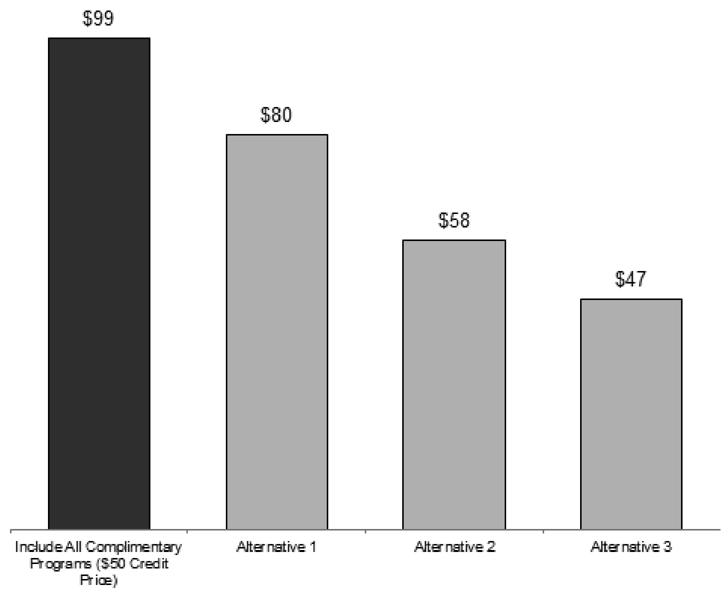


SOURCE: Appendix C

Cost-Effectiveness Analysis

Though this analysis cannot definitively note whether the Scoping Plan is most cost-effective per the authorizing AB 32 statute, our model can suggest if there are more cost-effective solutions available. In this section, we explore whether different configurations of the AB 32 policy levers can be altered to produce more cost effective results. Figure 6.5 exhibits the average cost per ton of GHG of three alternative scenarios. Alternative 1 is pure Cap-and-Trade and lowers direct costs by $24 per ton. Alternative 2 omits LCFS and SB 375 and likewise lowers direct cost per ton by $24. Alternative 3 omits LCFS only. It reduces emissions at a direct cost of only $58, a reduction of $46 per ton. Despite the lower direct cost, this alternative has more negative economic impact than either Alternative 1 or 2 because of leakage and conservation issues.

Figure 6.5
Cost Effectiveness Analysis



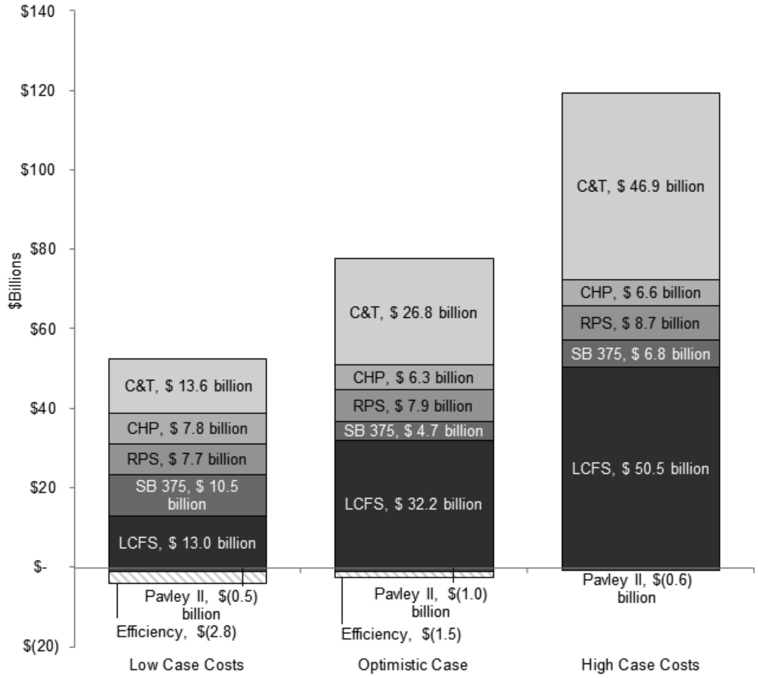
SOURCE: Appendix C

Because of the increased reliance on Cap-and-Trade, these scenarios should be more sensitive to the cost of credits. The impact is relatively minor, however. Shifting from the Low Case's credit price to the High Case's only increases economic loss by a negligible amount. This analysis suggests that a less prescriptive, more market focused program could substantially limit economic costs of AB 32. This should be a key focus for policy makers going forward.

Case Analysis

Our analysis is based on three case scenarios. In the Low Case, relatively optimistic assumptions for the key cost drivers lead to approximately $85.2 billion in cumulative costs by 2020. In the High Case, costs nearly triple to $245.3 billion. 96 percent of the cost variation between the High and Low Case is driven by variations in LCFS, Cap-and-Trade and SB 375, as shown in Figure 6.6.

Figure 6.6
Cost Drivers by Case (Cumulative)[48]



SOURCE: Appendix D, E, F, H

LCFS accounts for the greatest share of this variation. There is substantial uncertainty regarding the price California will pay for fuel under LCFS, which leads to a discrepancy in cumulative cost between the High and Low Cases of $37.5 billion. This amount would be substantially higher, if not for the significant reduction in demand due to cost in the High Case. We note that, this analysis assumes that there is availability of fuels to implement the program. This is a generous assumption given that current reports note that the development of the LCFS market may not be developing at the rate that ARB had assumed. In the event that fuels are not available, the costs could be far higher than even the High Case projects.

Conversely, the successful implementation of SB 375 in the Low Case accounts for $3.7 billion in additional cost, relative to the High Case. These costs are due to the need for transit to replace a portion of the vehicle miles traveled lost due to SB 375. Virtually every local planning

[48] These figures do not include the cost of offsets purchased or the cost of transit related to economic slowdown

agency agrees there will be a substantial increase in need for transit funding due to SB 375. It should be noted that the current public transit infrastructure need is estimated to exceed $223 billion even without considering the impact of AB 32.[49]

Comparison of our independent analysis to other studies

There have been a large number of studies that have discussed or analyzed various issues contained within AB 32. However, only three others have assessed the collective impact of AB 32. All three employed the use of proprietary data or models and the two more rigorous studies, conducted by ARB and Charles River Associates, were conducted prior to the specific development of many AB 32 provisions and before current economic and technological trends became clear. Tanton and Associates completed a less comprehensive study in early 2010. Their study focused on Cap-and-Trade and did not offer detailed accounts of the methodology or results. In addition, there are a number of studies by the EPA, which analyze the economic costs of various Federal proposed Cap-and-Trade systems. The Federal bills included are generally less restrictive than AB 32 and, thus, would be expected to have less negative impact. Additionally, California's history of efficiency has already consumed the "low hanging fruit," meaning further reductions here will likely be even more expensive.

Among these studies, estimated impacts to GSP/GDP per ton of reductions vary from $8 to $168 as shown in Figure 6.7.

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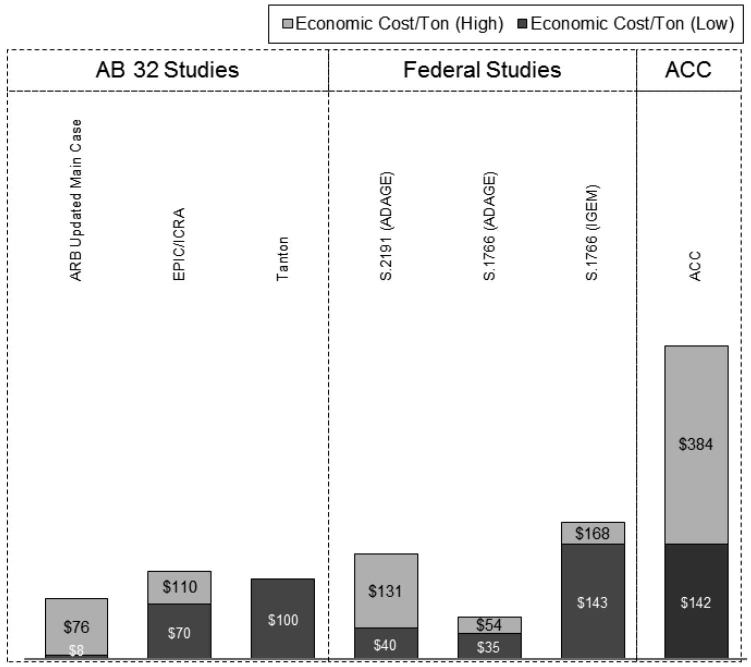
[49] California Transportation Commission, "Statewide Transportation System Needs Assessment, Public Draft: June 17, 2011," June 2011

Figure 6.7
Model Comparison with VMT
(GSP Impact Cost per Ton of Reductions, Low/High)

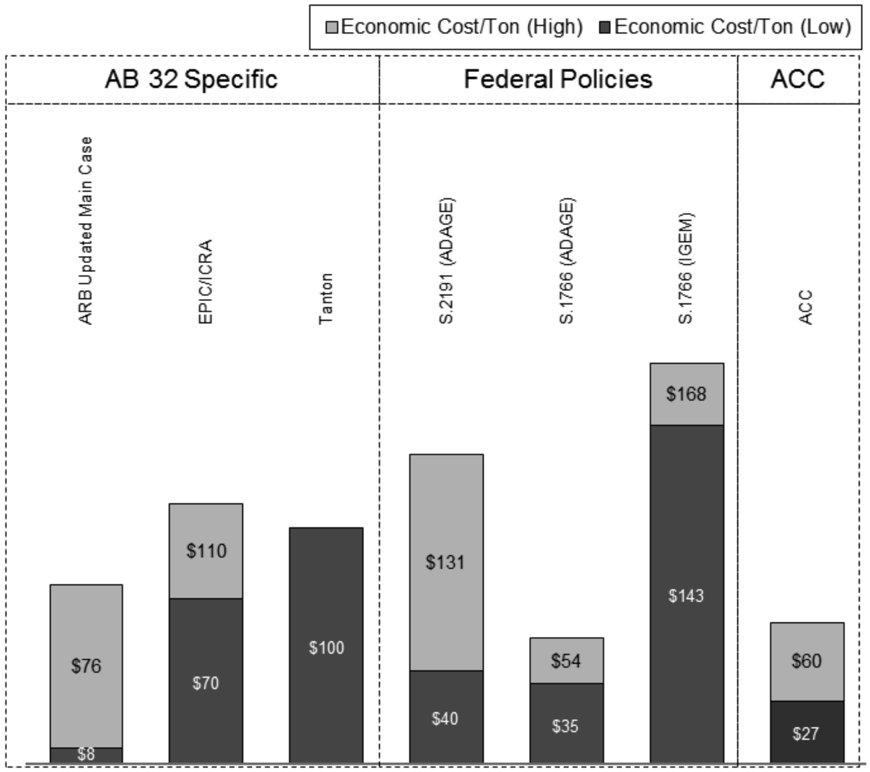


SOURCE: Appendix C

One important distinction between this study and every other study is that we model costs for SB 375. ARB, Charles River and Tanton do not model costs for SB 375, since the program did not have details regarding implementation requirements at the time of their study. No Federal proposals included a similar provision, so there was no reason for the EPA to consider it. We anticipate that a relatively small portion of lost VMT due to SB 375 and economic hardship will need to be replaced by transit, which is supported by the testimony of local planning agencies.

As shown in Figure 6.8, this treatment of VMT and transit accounts for the essentially the entire difference between the Low Case and the general consensus. When the costs of SB 375 are eliminated from our study, GSP cost per ton drops to $27 per ton in our Low Case. Even in our High Case, the cost per ton with SB 375's costs omitted is on the low end of other studies

Figure 6.8
Model Comparison without VMT
(GSP Impact Cost per Ton of Reductions, Low/High)



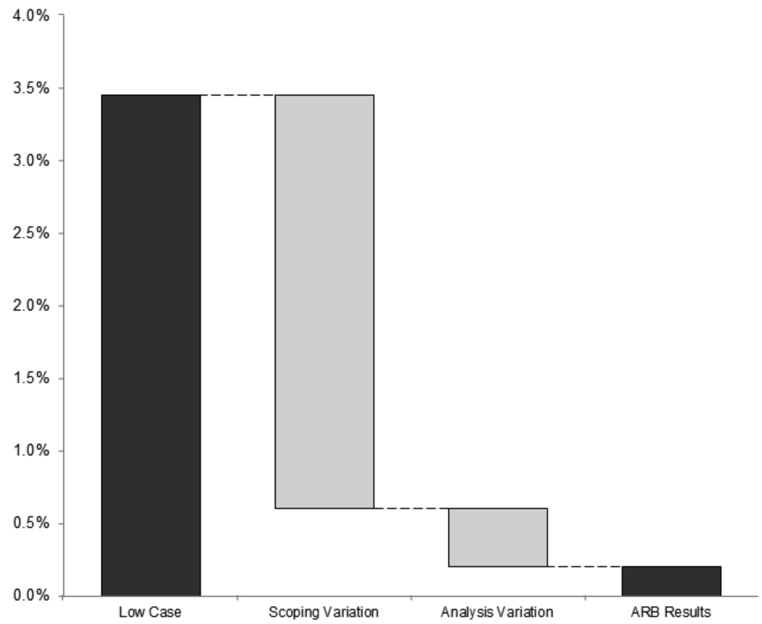
SOURCE: Appendix C

Scoping Analysis

While there is significant variation between our results and ARB's, the reason for this difference is understandable. The vast majority of the difference is accounted for by what we include in the scope of costs for the program. ARB omits the costs of increased public transit due to SB 375 and decreased driving due to fuel costs, which will undoubtedly be necessary to allow Californians to continue to work and engage in commerce. ARB also acknowledges that they fail to account for the costs of transmission lines and of backup capacity for new renewables. We further made adjustments to ARB's banking calculations to make the practice more sustainable.

If we match ARB's scope of analysis, it lowers the economic harm shown by the Low Case of our model by 2.8 percentage points.

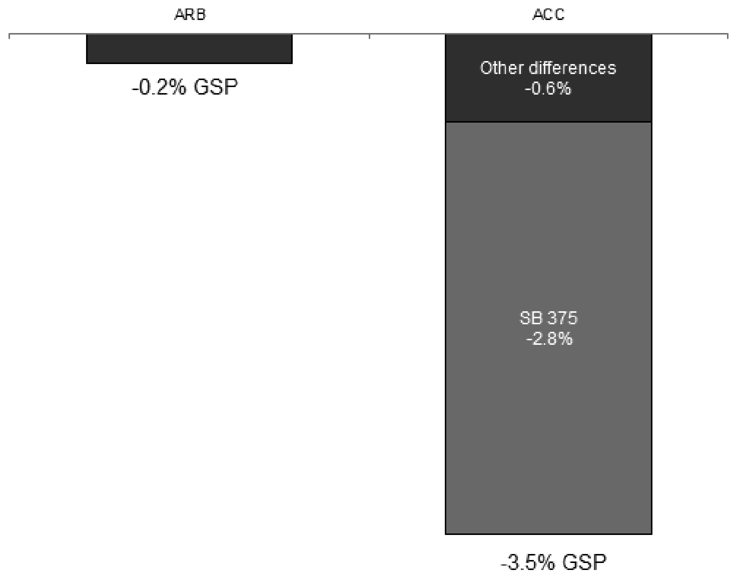
Figure 6.9
Scoping Analysis
(GSP Impact Attributable to Scoping and Methodology Differences)



SOURCE: Appendix C

Of that 3.4 percent, modeling costs for lost VMT transit replacement accounts for the substantial majority of this difference as shown in Figure 6.10 below. This should not be taken to mean that all other programs, aside from SB 375 are harmless. ARB assumes that SB 375 will generate substantial savings because they do not model costs for the program. In this figure, we have matched that assumption. These unlikely savings offset the costs of the other programs, making AB 32 appear far less costly than it likely will be.

Figure 6.10
Low Case Results with SB 375 Costs Omitted



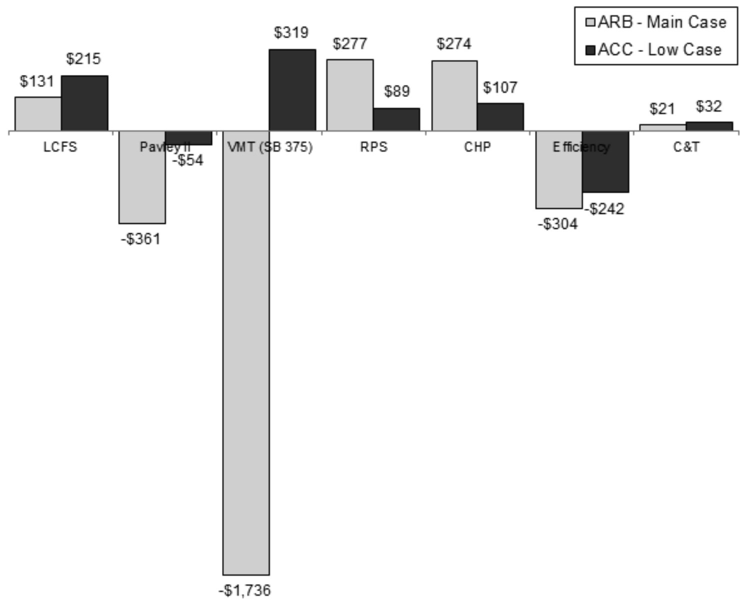
SOURCE: Appendix C

Comparison by Program to ARB's Results

ARB's analysis focused on seven distinct programs for implementing AB 32. They found a cost per ton of implementing these programs that ranged from $1,736 in savings per ton reduced for SB 375 and a cost of $277 per ton reduced for RPS. Our results show similarities for some programs, but distinct differences, both positive and negative, for others.

Figure 6.11 shows how our results vary from ARB's by program under our Low Case scenario. Direct costs per ton are higher for LCFS, VMT and Cap-and-Trade, but lower for RPS and CHP. Efficiency and Pavley II both offer fewer savings per ton than ARB's analysis suggests.

Figure 6.11
Program Comparison
(Direct Cost/Savings per ton of GHG Reductions)



SOURCE: Appendix D, E, F, H

There are clear reasons for these differences. The distinctions are driven by different assumptions and inputs, not differences in the model. In the case of SB 375, for example, ARB fails to consider any costs for the program. In the case of LCFS, experience since ARB's study suggests that low carbon intensity fuels will be more expensive over the life of the Scoping Plan than appear possible when ARB conducted their assessment. The drivers of the differences are summarized in Table 6.2 below.

Table 6.2
Drivers of Differences of Cost Estimates
(Direct Cost/Savings per ton of GHG Reductions)

Policy Lever	ARB (Base Case)	ACC (Base Case)	Difference	Drivers of Differences
Low Carbon Fuel Standard (LCFS)	$131	$215	+$86	ARB assumes extremely optimistic development of 2nd generation biofuels, inconsistent with OECD, EIA, CEC and more recent ARB projections
Pavley II Fuel Standards (Pavley II)	-$361	-$54	+$307	ARB did not include commercial diesel regulations in their analysis. Omitting commercial diesel yields similar results in this model
Vehicle Miles Traveled (VMT)	-$1,736	$319	+$2,055	ARB failed to account for any programmatic costs for SB 375. Local and regional agencies that are responsible for implementing SB 375 have made clear there will be significant costs, especially in regards to public transit
Renewable Portfolio Standard (RPS)	$277	$89	-$188	PUC projections of per unit costs for renewables have decreased since ARB's analysis was released
Combined Heat & Power (CHP)	$274	$107	-$167	Our analysis relied on a CEC study for CHP penetration and cost
Efficiency Measures	-$304	-$242	+$62	Efficiency measures are slightly less effective in our analysis because of the slowing economy due to other more costly measures
Cap-and-Trade (C&T)	$21	$32	+$11	ARB assumes an unsustainable reduction path, which they discuss in their analysis. Their analysis shows adjusting for this factor would add 84 percent to the per credit cost, meaning a slightly higher credit price of approximately $38 per ton

SOURCE: Air Resources Board, "Updated Economic Analysis of California's Climate Change Scoping Plan," March 2010; Appendix C

As shown above, the difference in economic impact is driven by ARB's assumed savings, particularly from SB 375, Pavley II and Efficiency. These three items account for more than 84 percent of the variation between ARB's and our estimated impact. ARB's estimates for these programs do not account for programmatic costs or replacement transportation to achieve the reductions. Our model assumes ARB's estimates of benefits but factors implementation and programmatic costs to derive a net benefit. It should be noted that even the most supportive local government agencies, which will be responsible for implementing SB 375, make clear that substantial additional spending on transit, development incentives and other costs will be necessary to achieve SB 375's goals.

Additionally, we find ARB understates the cost of LCFS due to optimistic assumptions about the availability of high quality replacement fuels. This difference is likely substantially higher, because the assumptions in our Low Case, while not as optimistic as ARB's, are considerably more optimistic than most projections.

Omitted Costs

Though we attempted to make the study comprehensive of costs and benefits as possible, we were unable to account for several notable cost categories:

- Cost of efficiency: This includes any investment or incentive costs that may be required to increase the operational efficiency of commercial and consumer goods.
- SB 375 incentives and development costs: Though we accounted for the additional transit that would be required under SB 375, we have not accounted for any incentive or development costs that may be necessary to implement SB 375.
- LCFS infrastructure development costs: This includes an investment costs to develop or retrofit fueling stations to accommodate LCFS fuels.
- Business leakage: This includes any migration of businesses outside of the state due to increased costs of conforming to AB 32 regulations.
- Program implementation costs: This includes any costs to administer AB 32 programs, including the cost of operating the Cap-and-Trade market, compliance costs, litigation costs, etc.

Economic Leakage

AB 32 imposes significant costs on Californians. Some costs will be recaptured within the state, such as the cost paid to the state government for Cap-and-Trade compliance credits. Other costs leave the state, such as the cost of low-carbon ethanol imported from Brazil. Funds shifted within the state can have a significant impact on various sectors of the economy, both positive and negative. Since we assume an efficient market, however, these impacts balance out and the overall economy is not negatively impacted. In this way, our model, as are most economic models, is conservative. There will likely be some additional loss as the market adapts to new conditions, especially as it relates to retraining and adapting the labor force. This can create particular risk for more experienced workers.

The loss we model in this report is the portion of those costs that leave California. In the Optimistic Case, the model finds that $11.5 billion of additional annual direct costs are spent outside California on low carbon fuels, more expensive vehicles, public transit equipment and other costs. Of that $11.5 billion, $6.9 billion is spent on low carbon ethanol imported from Brazil.

We assume the balance will be spent in other states, primarily on Midwest biofuels and capital equipment. This direct spending will generate approximately 74,000 new jobs, presumably centered in high paying green fields in the Midwest and manufacturing states.

Section 6a: Low Case Results

Our Low Case includes extremely optimistic assumption for key price drivers. Especially as they relate to low carbon intensity fuels, these assumptions are extremely unlikely to materialize. This case is meant to approximate the best possible result, however unlikely it might be to materialize. The Low Case is also the basis for our sensitivity analyses because its underlying assumptions are most comparable to those used by ARB in their 2010 Updated Economic Analysis. This case assumes that:

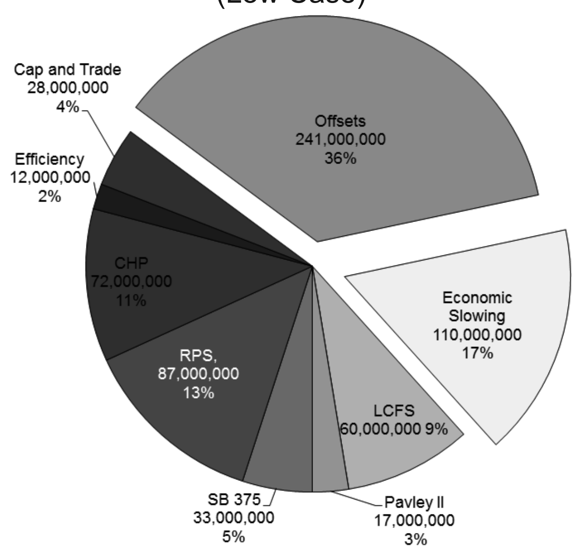
- Low carbon intensity 2nd gen biofuels are available at significantly higher than projected rates (575%), which approximates ARB’s assumptions and Brazilian imports are available at a low costs;
- Cap-and-Trade credits are based on a $25 2020 price (adjusted for the success of other programs), which is in line with the low range of most research;
- RPS and Pavley II are successfully implemented;

- Efficiency Measures are fully implemented;
- SB 375 is fully implemented; and
- CHP is implemented at the High Penetration level.

Impact on GHG Emissions

Our analysis shows that AB 32 reductions in greenhouse gas emissions will come at significant cost to the state's economy. As a result of that, the second largest share of emissions reductions will stem from the economic slowing caused by AB 32. The largest share will be achieved by purchased emissions offsets, while ARB mandated programs will lead to less than half of total reductions, as exhibited in Figure 6.12.

Figure 6.12
Reductions by Source
(Low Case)



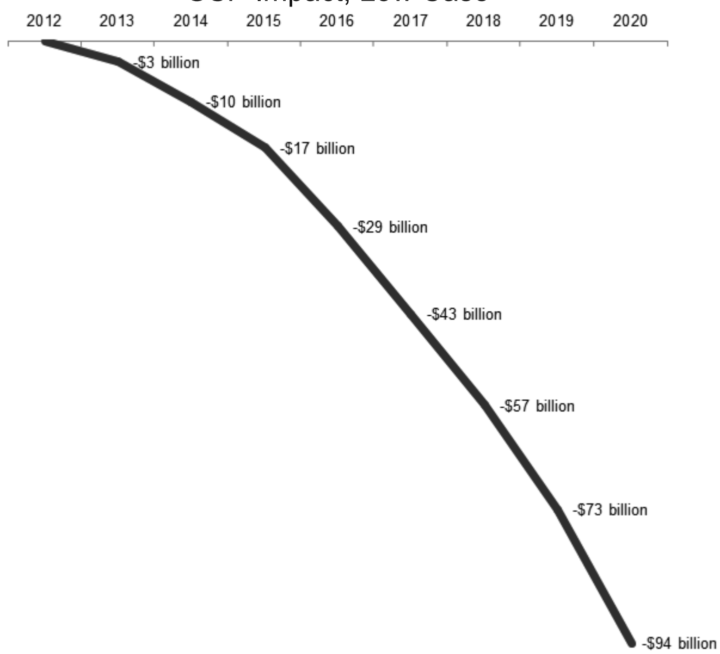
SOURCE: Appendix C

In the Low Case, we find that AB 32 will cumulatively reduce 660 million tons of GHG through 2020. Purchased Cap-and-Trade offsets account for the largest share, 241 million tons. An additional 17 percent of the reduction, 110 million tons, will be due to economic slowdown; the loss of economic productivity driven by AB 32 and the decrease in transportation fuel consumption due to increased costs and decreased earnings.

GSP Impact

Figure 6.13 shows our estimate of AB 32's impact on GSP. Even under our Low Case, AB 32 lowers the projected 2020 GSP from $2.72 trillion to only $2.63 trillion, a loss of $94 billion in 2020. This amounts to a loss of approximately 4.2 percent of GSP in the year 2020. This lost percentage of GSP is roughly 80 percent of California's real GSP loss in the Great Recession in 2008 and 2009. GSP losses grow at an average rate of 68 percent per year.

Figure 6.13
GSP Impact, Low Case



SOURCE: Appendix C

Table 6.3 displays the impact AB 32 will have on California's GSP each year.

Table 6.3
GSP Impact by Year

	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU GSP	$ 2.01 trillion	$ 2.09 trillion	$ 2.17 trillion	$ 2.25 trillion	$ 2.34 trillion	$ 2.43 trillion	$ 2.52 trillion	$ 2.62 trillion	$ 2.72 trillion
Scenario Annual GSP Δ	0.0%	-0.2%	-0.3%	-0.3%	-0.5%	-0.6%	-0.6%	-0.6%	-0.8%
Scenario Δ from Baseline	0.0%	-0.2%	-0.4%	-0.7%	-1.2%	-1.8%	-2.2%	-2.8%	-3.5%
AB 32 GSP	$2.01 trillion	$2.09 trillion	$2.16 trillion	$2.23 trillion	$2.31 trillion	$2.39 trillion	$2.47 trillion	$2.55 trillion	$2.63 trillion

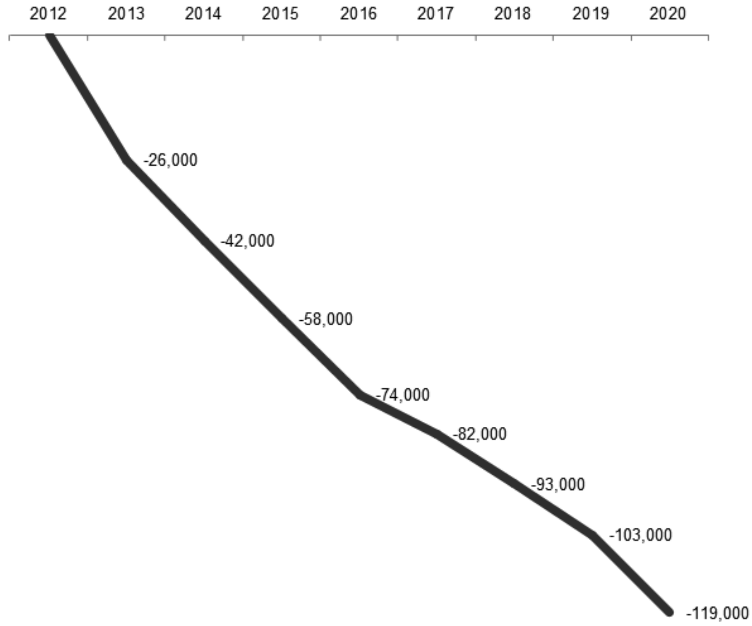
SOURCE: Appendix C

Jobs Impact

Figure 6.14 shows the impact of AB 32 on California's employment under our Low Case. California's unemployment rate remains the third highest in the nation, making lost jobs a significant concern.[50] AB 32 will cause a reduction of 119,000 jobs in 2020. Annual job losses increase by an average of 15,000 jobs per year.

[50] Bureau of Labor Statistics, Regional and State Employment and Unemployment Summary, April 2012

Figure 6.14
Jobs Impact, Low Case

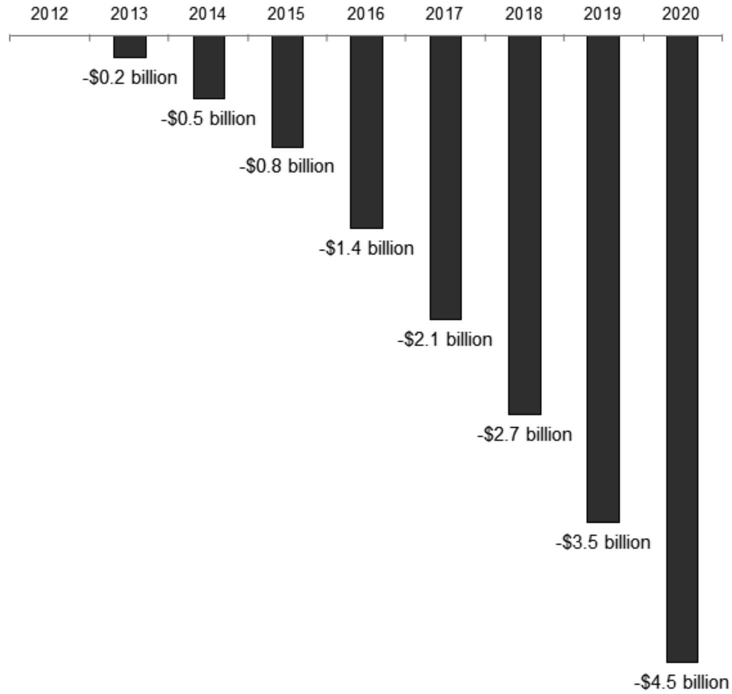


SOURCE: Appendix C

State and Local Revenue Impact

State and local government revenues were hit hard by the Great Recession. Budgets for education, social services, law enforcement, parks and infrastructure have had to be cut significantly. AB 32's impact on the economy will likewise impact state and local revenues as shown in Figure 6.15. AB 32 will reduce state and local tax revenues by $4.5 billion annually by 2020 under the low case. This is more than the state's General Fund expenditures for business, transportation & housing, natural resources, environmental protection, state and consumer services and labor and workforce development combined. The annual revenue loss is increasing by an average of 68 percent per year.

Figure 6.15
State and Local Revenue Impact, Low Case

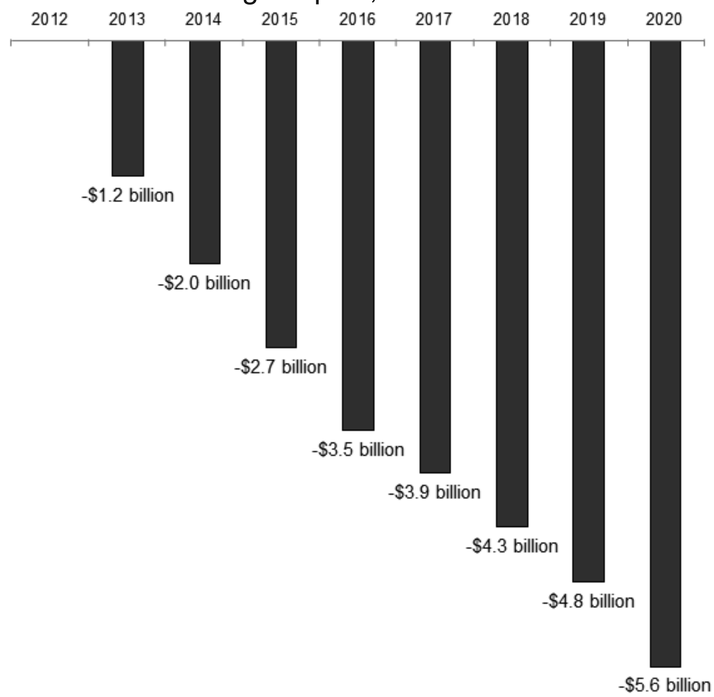


SOURCE: Appendix C

Earnings Impact

Beyond the jobs lost to Californians, AB 32 will have a negative impact on the paycheck of the average working Californian as well. As shown in Figure 6.16, Californians will lose more than $5.6 billion in personal earnings in 2020 resulting from AB 32. This amounts to an average loss of $400 per working family in 2020 alone. This is increasing by an average of 24 percent per year.

Figure 6.16
Earnings Impact, Low Case

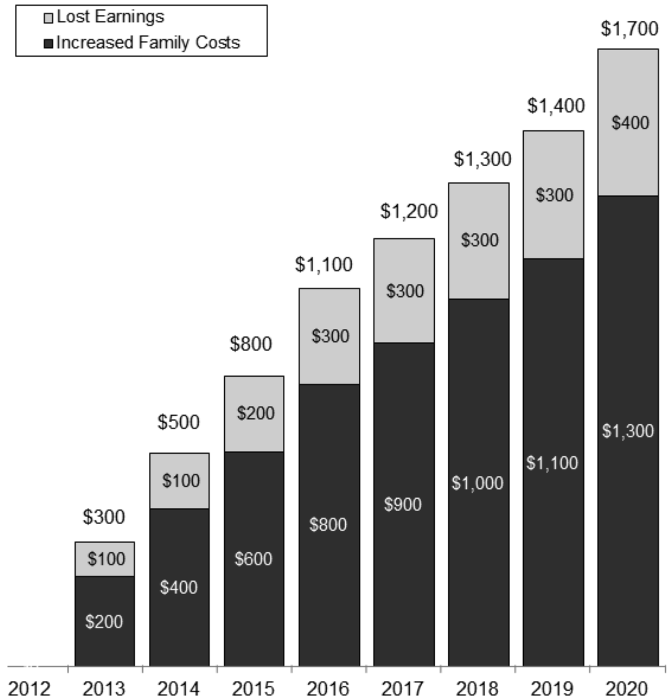


SOURCE: Appendix C

Family Impact

The combined effects of AB 32 will have a significant impact on families. They will lead to a combination of increased prices for commodities, goods and housing, increased taxes and lost earnings. Increased energy and transit prices will cost the average family $1,300 per year by 2020 as shown in Figure 6.17. When combined with the lost earnings, AB 32 will cost the average California family $1,700 per year even under the most optimistic conditions. Combined family impact is increasing by an average of $190 per year.

Figure 6.17
Family Impact, Low Case

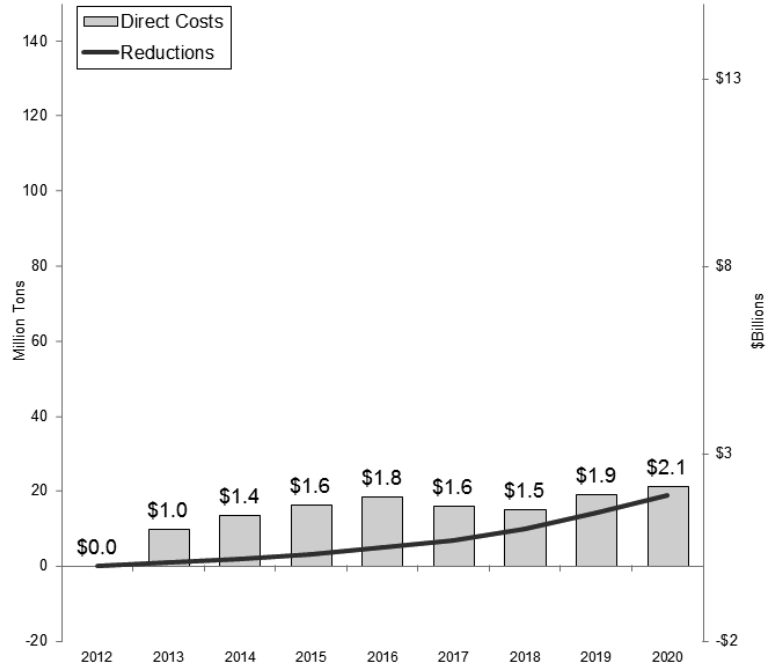


SOURCE: Appendix C

Low Carbon Fuel Standard

The Low Carbon Fuel Standard requires that transportation fuels consumed in California achieve 10 percent lower carbon intensity than they do today. Our analysis shows that LCFS will achieve nearly 18.7 million tons of reductions at a cost of $2.1 billion in 2020. This converts to $215 per ton to reduce emissions. As exhibited in Figure 6.18, costs decline from 2016 to 2018 because 2nd generation biofuels will decline in cost over time. In the later years, carbon intensity reduction requirements spike, causing a related spike in costs.

Figure 6.18
LCFS Direct Costs and Reductions, Low Case

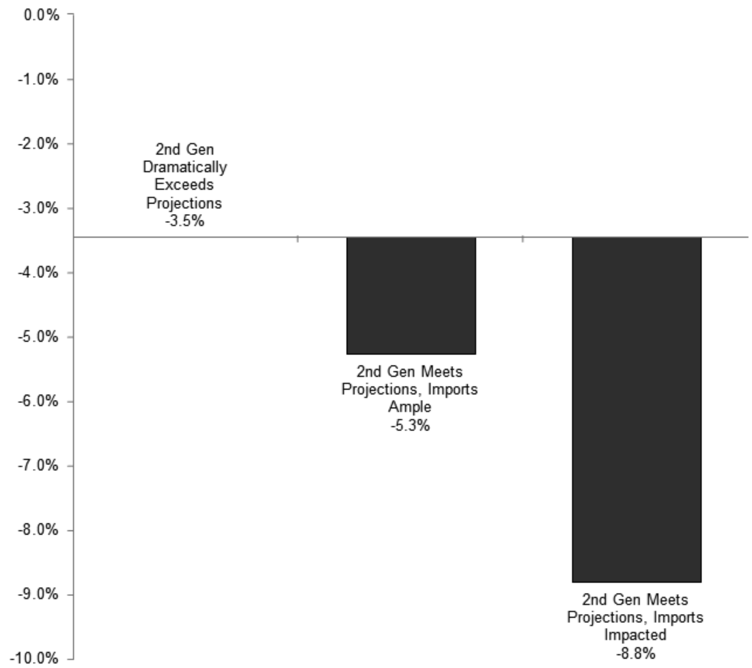


SOURCE: Appendix F

The cost of LCFS is driven by the availability of 2nd generation biofuels in America and the price to import high grade foreign ethanol. 2nd generation biofuels, to the degree that they are available, will likely be the preferred alternative, because even if they are more expensive, their low carbon intensity means they can achieve the required reductions in much lower volumes. Unfortunately, it has become very clear that ARB's assumptions for the development of the LCFS market are unlikely to be achieved. The OECD forecasts that the United States will produce only one-third what is necessary to meet California's LCFS. Moreover, the U.S. EPA has revised down its Federal standards for 2nd generation fuel use to essentially zero due to the markets failure to develop.

In order to avoid overstating the cost of AB 32, we discount market realities and assume that ARB's optimistic assumptions hold and 2nd generation biofuels will be developed at a rate that is adequate to meet the needs of the LCFS. We should note that this means that California will be able to consume 20 percent more 2nd generation biofuels than the OECD projects will exist in the entire world by 2020, nearly twice what will be produced in the United States. This is represented by the first bar on Figure 6.19.

Figure 6.19
LCFS Sensitivity Analysis



SOURCE: Appendix F

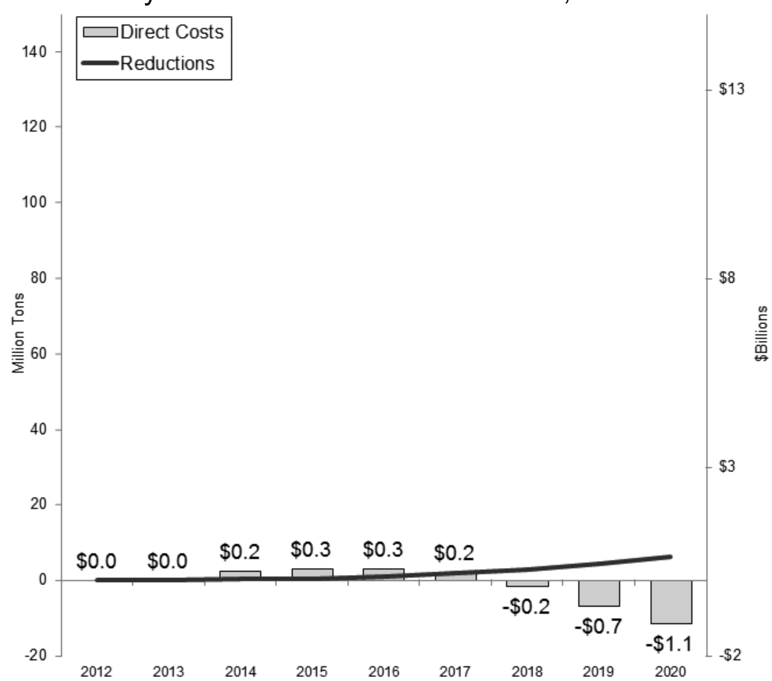
The second bar assumes that U.S. 2nd generation biofuel production matches OECD projections and California is able to consume half of that production. The balance is made of imports of high grade sugar ethanol production, the substantial majority of which is produced in Brazil. This case assumes production will increase substantially faster than Brazilian government projects. The third bar most closely approximates international projections. It assumes OECD's projections for U.S. 2nd generation biofuels and Brazilian projections for domestic ethanol production are realized. This scenario leads to nearly 9 percent loss in GSP.

Pavley II

While Pavley II was superseded by Obama's Federal Fuel Standards, we include it in our analysis because ARB sites Pavley II as an AB 32 policy lever in its Scoping Plan. We estimate that Pavley II will bear some cost per ton to reduce emissions during the early years and achieves net savings in the later years, which will likely grow after 2020. This is the most efficient program for which costs were modeled.

The costs and savings of Pavley II are shown in Figure 6.20. While costs are driven by increased costs of new vehicles, especially commercial trucks, savings are driven by fuel savings. For diesel trucks, the savings are insufficient to cover costs, for passenger vehicles, there is substantial net savings. The commercial diesel regulations begin in 2014, but the passenger vehicle regulations do not come on line until 2017, because earlier years are covered by Pavley I. That is the primary reason the program has net costs in the early years, but net savings in the later years.

Figure 6.20
Pavley II Direct Costs and Reductions, Low Case

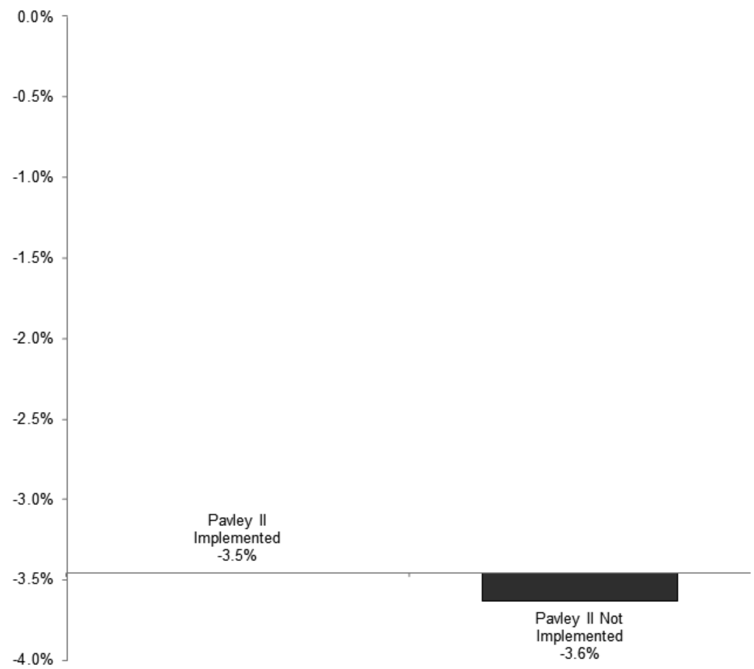


SOURCE: Appendix F

Aside from the implementation timeline discussed above, this is also caused by the relatively slow rate of turnover in the automobile and commercial truck markets. As most cars last more than ten years, the impact of the efficiency savings and emissions reductions will not be fully realized for a number of years.

Figure 6.21 demonstrates the sensitivity of adopting Pavley II standards. The economic impact of Pavley II is negative, but limited. Omitting Pavley II from AB 32 would recover an additional 0.18 percent of lost GSP over the period of implementation. As Pavley II is in effect for more years, its impacts will become more significant. Since vehicles tend to stay on the road for ten or more years, only a small portion of the overall fleet is replaced with the more efficient vehicles each year and the full impact tends to come in later years.

Figure 6.21
Pavley II Sensitivity Analysis



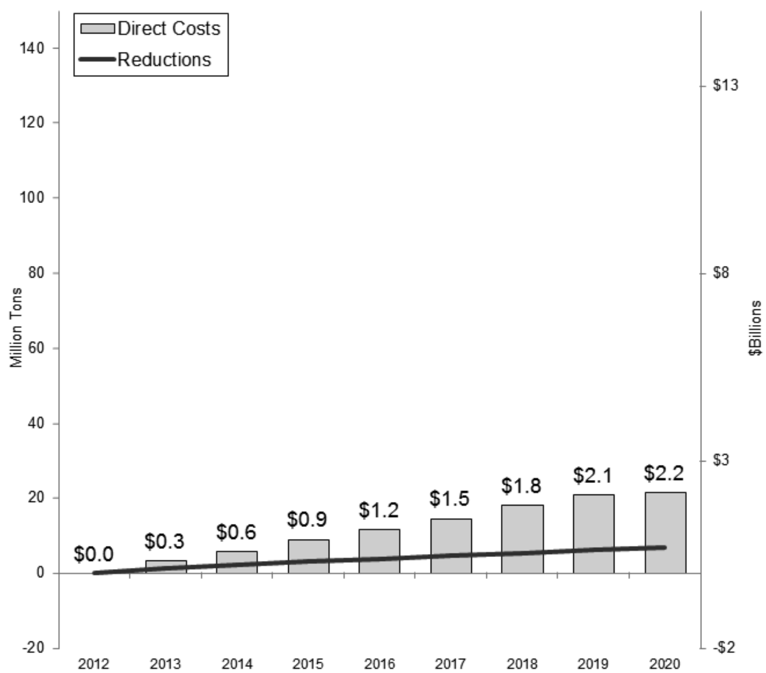
SOURCE: Appendix F

SB 375

A review of the academic literature suggests that far more limited reductions are likely than ARB suggests, however, our Low Case assumes the reductions are made. Virtually all local governments and planning agencies agree that the reduction targets will be difficult to achieve and will require substantial funding for transit, planning and development incentives. Despite this consensus, ARB's analysis does not model costs for the program.

While it is too early to determine the full extent of costs, there will certainly be additional costs for transit. This study assumes that a small portion of the lost VMT will be replaced by transit. It does not model any costs for planning or development incentives, so it likely understates the true cost of the program substantially. Using these parameters, we find that the direct costs of SB 375 will grow to $2.2 billion by 2020 as shown in Figure 6.22. This is a dramatic difference from the substantial savings that ARB models. Their results are to be expected, however, since they modeled the savings, but failed to consider the costs.

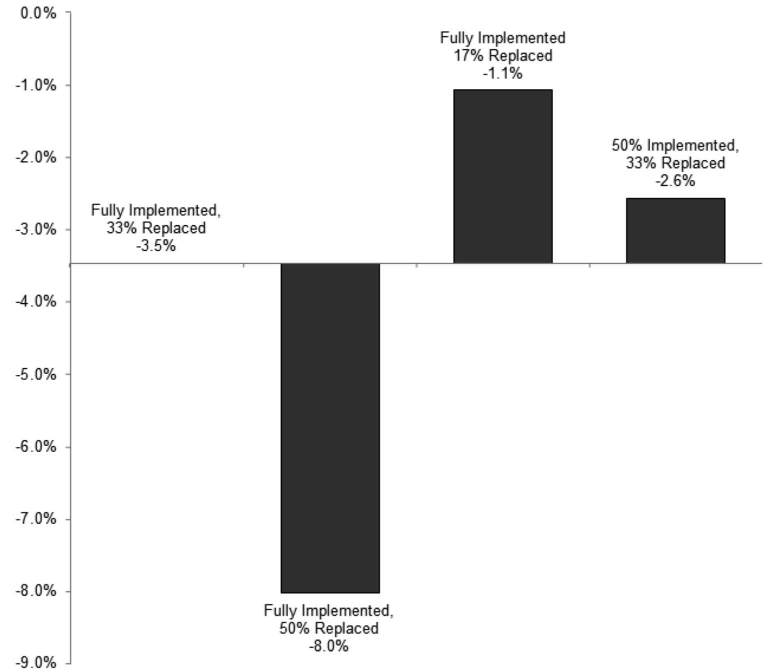
Figure 6.22
SB 375 Direct Costs and Reductions, Low Case



SOURCE: Appendix F

We assume a relatively small portion of lost vehicle miles traveled, 33 percent, are replaced by transit. If 50 percent of vehicle miles are replaced, the loss in GSP nearly doubles to over 8 percent. However, if only 17 percent are replaced, lost GSP dips to 1.1 percent. The cost of SB 375 is highly sensitive to the need for transit to replace vehicle miles traveled as shown in Figure 6.23.

Figure 6.23
SB 375 Sensitivity Analysis



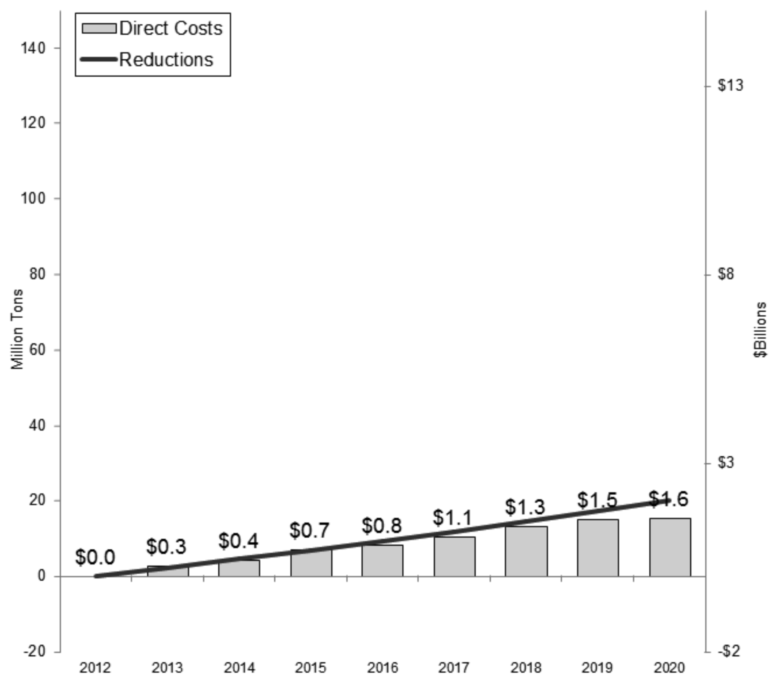
SOURCE: Appendix F

Beyond the direct costs and reductions that are achieved by SB 375, if successfully implemented, it will have a number of other co-benefits that are worth policymakers' consideration. While the increased spending on public transit is costly, this spending will likely largely stay in state in the form of infrastructure spending, spending on operations, maintenance and administration and a portion of the fuel costs. The extent that vehicles and other capital equipment are produced in state could lead to additional economic benefit. SB 375 could also help lead to improved quality of life and productivity from less congested roads and improved mobility for Californians that rely on public transit. SB 375 deserves consideration on its full merits, but these benefits primarily lie outside of the scope of AB 32.

Renewable Portfolio Standard

RPS requires that utilities produce or purchase 33 percent of their electricity portfolio from renewable sources. This will likely primarily be achieved through solar and wind, but small hydro, biomass and geothermal will continue to play a role. RPS will increase the cost of electricity for California's ratepayers. We calculate that RPS will cost $89 per ton to reduce emissions. This is the fourth most costly program for which costs were modeled. Some of this cost is driven by necessary additional transmission lines. The Public Utilities Commission estimates for RPS transmission costs which our study utilized are reflected in Figure 6.24.

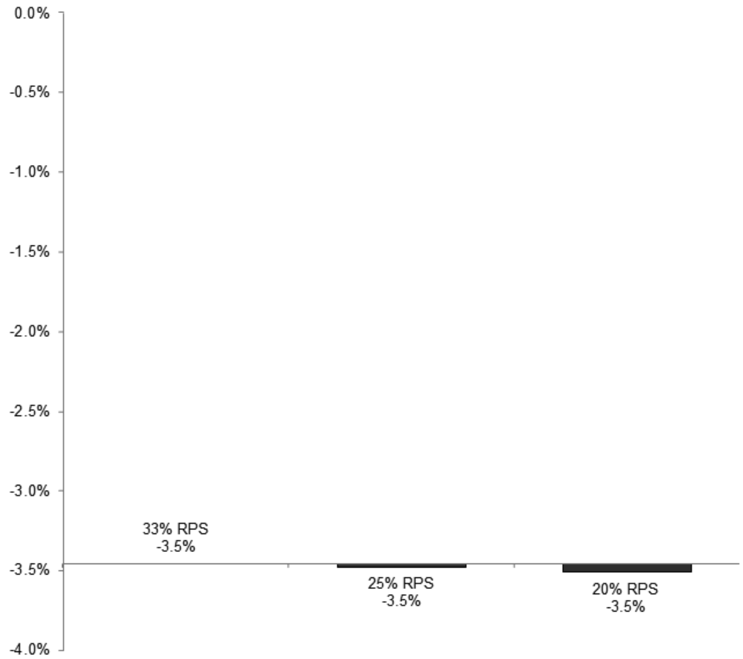
Figure 6.24
RPS Direct Costs and Reductions, Low Case



SOURCE: Appendix D

There appears to be relatively little variation due to various levels of implementation of RPS as shown in Figure 6.25. Our model accounts for varying average costs with increasing renewable electricity demand as the market has to activate less efficient resources. Despite this, full implementation of a 33 percent RPS has a marginally positive impact relative to a 20 percent business-as-usual. Reductions through RPS have slightly less impact per ton to the GSP than the average of AB 32, overall, meaning, while the difference is marginal; it appears to generally be a cost-effective program.

Figure 6.25
RPS Sensitivity Analysis

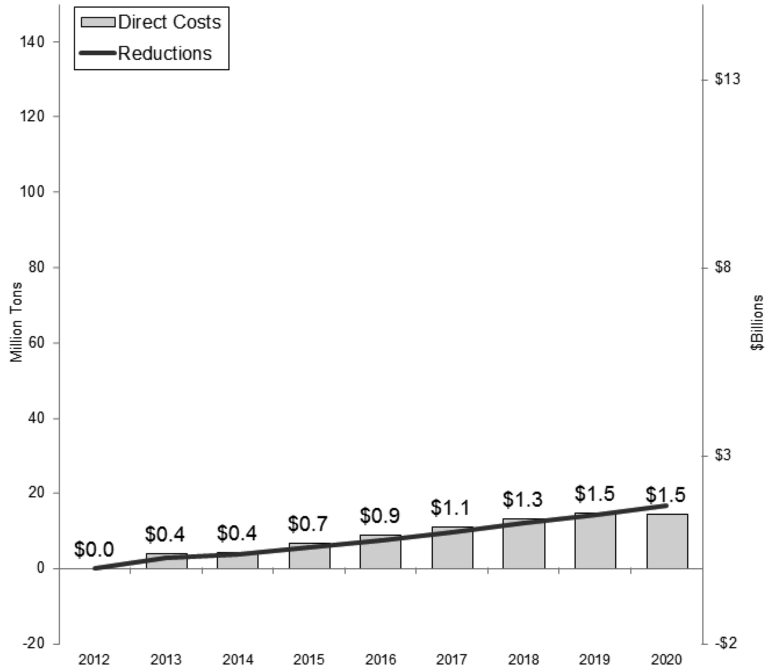


SOURCE: Appendix D

Combined Heat and Power

For our model, we used California Energy Commission estimates for rate of deployment and costs. The Low Case uses CEC's high penetration assumption, which achieves the greatest reductions and the lowest per unit costs. Under these assumptions, CHP will cost $107 per ton of reductions. In total, CHP will cumulatively cost the state $7.8 billion in direct costs and reduce 72.3 million tons of GHG by 2020 as shown in Figure 6.26.

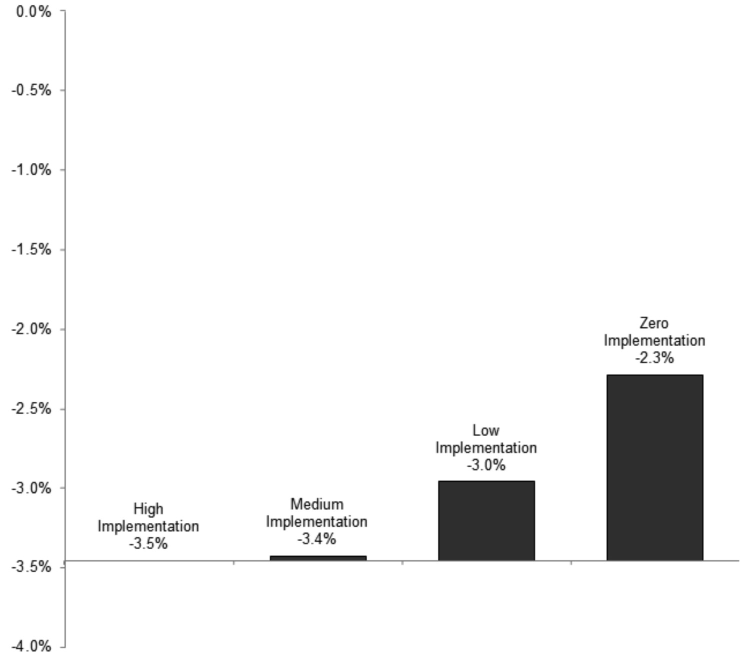
Figure 6.26
CHP Direct Costs and Reductions, Low Case



SOURCE: Appendix D

The sensitivity analysis exhibited in Figure 6.27 shows a range of possible results from CHP. CHP saves money by decreasing demand for electricity from traditional sources and by limiting the need for RPS implementation. It also has significant costs to achieve the assumed implementation levels. The per unit costs decrease with the higher implementation assumptions but the volume increases. These factors push in opposite directions on total costs. Because of that, the high implementation assumption yields comparable total costs than the medium implementation, but higher total costs than the low and zero implementation assumptions.

Figure 6.27
CHP Sensitivity Analysis



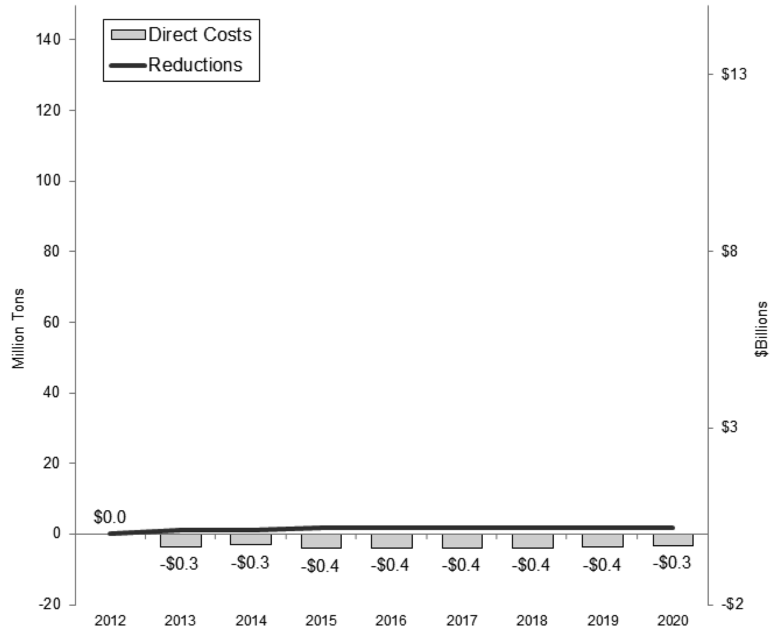
SOURCE: Appendix D

Efficiency Measures

A variety of efficiency measures are assumed to decrease electricity and natural gas demand by 1% annually. In our model, Efficiency Measures realize significant savings because no program costs are measured; this conforms to ARB's assumptions. Annual reductions decline because the decrease of emission intensity of electricity sources and the decline in demand due to economic losses limit the impact of efficiency gains as shown in Figure 6.28.

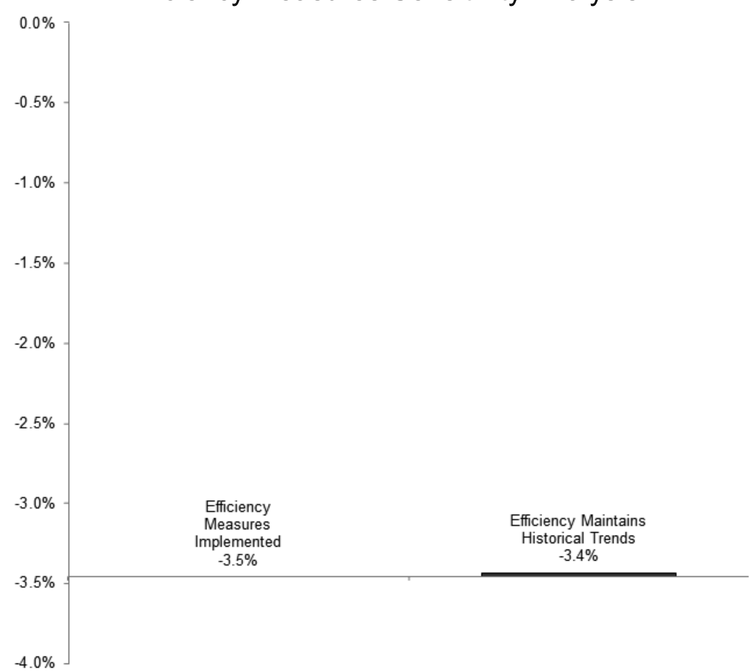
The sensitivity analysis shown in Figure 6.29 shows that the economic impact of Efficiency Measures is negligible.

Figure 6.28
Efficiency Measures Direct Costs and Reductions, Low Case



SOURCE: Appendix D, E

Figure 6.29
Efficiency Measures Sensitivity Analysis



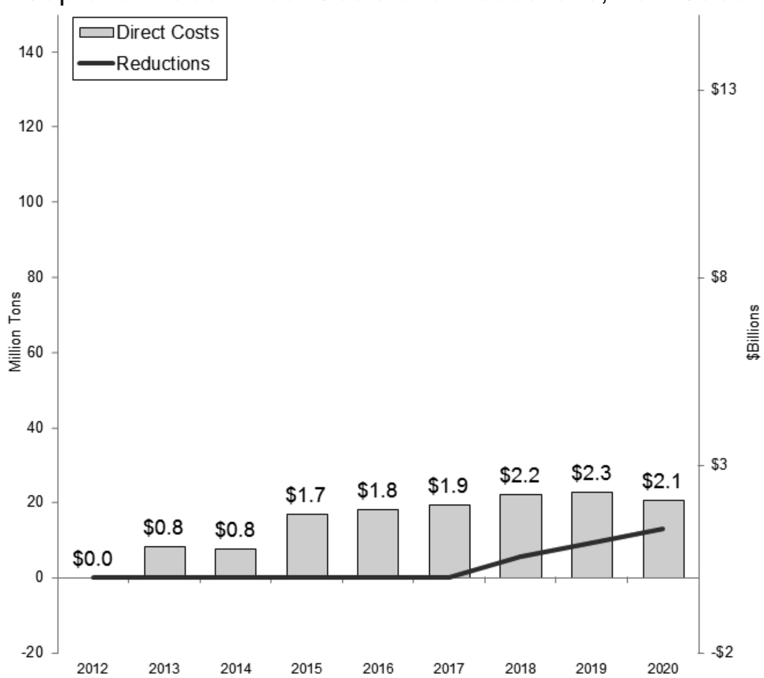
SOURCE: Appendix D, E

Cap-and-Trade

Cap-and-Trade will cost $15 per ton to reduce emissions. This is the second most efficient program for which costs were modeled, behind Pavley II. The average price of reductions is assumed to cost half of the credit price, which in an efficient market would be set at the cost of the marginal reduction.

Figure 6.30 reflects the cost of compliance with Cap-and-Trade, as well as the reductions discussed in the previous paragraph. In addition to implicitly requiring emissions reductions, the Cap-and-Trade program requires covered entities to purchase carbon credits at auction to cover their continued emissions, despite being under the cap. Our model estimates that firms will be forced to spend $0.8 to $2.3 billion per year on auctioned credits, despite assuming that ARB will freely allocate far more credits than is currently planned.

Figure 6.30
Cap-and-Trade Direct Costs and Reductions, Low Case



SOURCE: Appendix I

The literature shows that there is substantial uncertainty in credit price and ARB's own analysis bears this out. Their various results show a 2020 credit price of as low as $16 and as high as $187. Additionally, while the ARB AB 32 Scoping Plan envisions a number of complementary programs combining with Cap-and-Trade to achieve the mandated reductions, it would be possible to design a system under which all reductions were made by Cap-and-Trade and capped emissions would be reduced using the most cost effective measures. In such a case, required reductions would be far greater than in the Base Case, but overall costs may be lower.

Section 6b: Optimistic Case Results

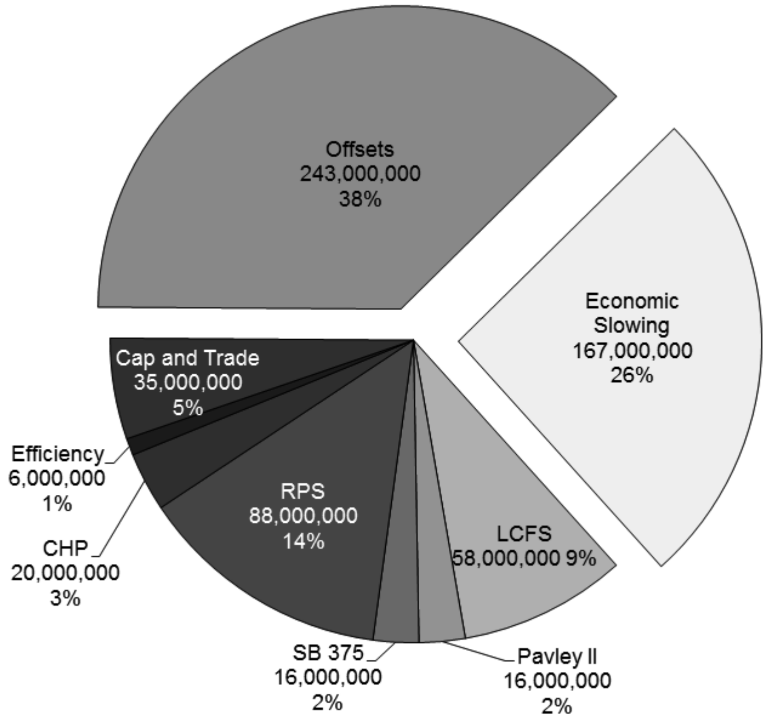
This section outlines the results of our Optimistic Case. It is more realistic than our low case, but still assumes that American produced 2nd generation biofuels will be available at an unlikely level. This case assumes that:

- Low carbon intensity 2nd gen biofuels are available at modestly higher than projected rates (150%) and Brazilian imports are available at a modest premium;
- Cap-and-Trade credits are based on a $50 2020 price (adjusted for the success of other programs), which is in line with the midrange of most research;
- RPS and Pavley II are successfully implemented;
- Efficiency Measures are implemented, though at half the rate of the Low Case;
- SB 375 is implemented at 50%. Although this may not seem optimistic, because of the costly nature of the program, this does lower economic loss, relative to the Low Case; and
- CHP is implemented at the Low Penetration level. Similarly to SB 375, a lower implementation level lowers economic loss.

Impact on GHG Emissions

Our analysis shows that AB 32 reductions in greenhouse gas emissions will come at significant cost to the state's economy. The second largest share of emissions reductions will stem from the economic slowing caused by AB 32, while a larger share will be achieved by purchased offsets, as exhibited in Figure 6.31.

Figure 6.31
Reductions by Source, Optimistic Case



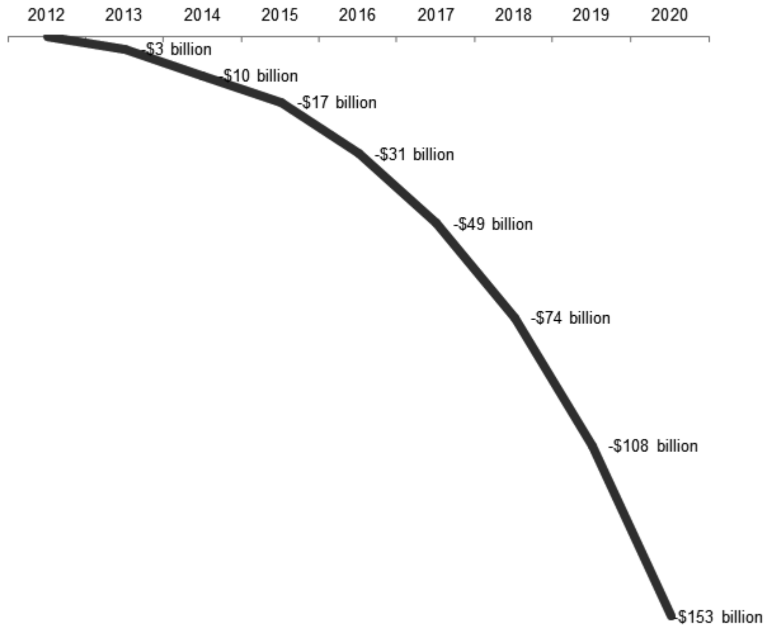
SOURCE: Appendix C

In the Optimistic Case, we find that AB 32 will cumulatively reduce 648 million tons of GHG through 2020. Purchased offsets under Cap-and-Trade account for the largest share with 243 million tons, with an additional 35 million tons of reductions made by capped entities. An additional 26 percent of the reduction, 167 million tons, will be due to economic slowdown resulting from AB 32 and the decrease in transportation fuel consumption due to increased costs and decreased earnings.

GSP Impact

Figure 6.32 shows our estimate of AB 32's impact on GSP. Even under our Optimistic Case, AB 32 lowers the projected 2020 GSP from $2.72 trillion to only $2.57 trillion, a loss of $153.2 billion in 2020. This amounts to a loss of approximately 5.6 percent of GSP in the year 2020. GSP losses grow at an average rate of 78 percent per year.

Figure 6.32
GSP Impact, Optimistic Case



SOURCE: Appendix C

Table 6.3 displays the impact AB 32 will have on California's GSP each year.

Table 6.3
GSP Impact by Year, Optimistic Case

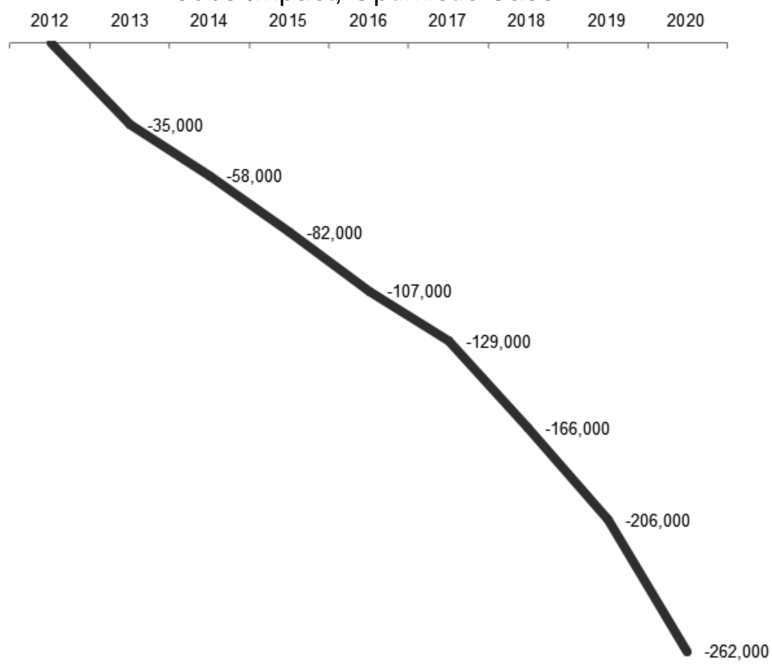
	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU GSP	$ 2.01 trillion	$ 2.09 trillion	$ 2.17 trillion	$ 2.25 trillion	$ 2.34 trillion	$ 2.43 trillion	$ 2.52 trillion	$ 2.62 trillion	$ 2.72 trillion
Scenario Annual GSP Δ	0.0%	-0.2%	-0.3%	-0.3%	-0.6%	-0.8%	-1.0%	-1.3%	-1.7%
Scenario Δ from Baseline	0.0%	-0.2%	-0.5%	-0.8%	-1.3%	-2.0%	-2.9%	-4.1%	-5.6%
AB 32 GSP	$2.01 trillion	$2.09 trillion	$2.16 trillion	$2.23 trillion	$2.31 trillion	$2.38 trillion	$2.45 trillion	$2.51 trillion	$2.57 trillion

SOURCE: Appendix C

Jobs Impact

Figure 6.33 shows the impact of AB 32 on California's employment under our Optimistic Case. California's unemployment rate remains the third highest in the nation, making lost jobs a significant concern.[51] AB 32 will cause a reduction of 262,000 jobs in 2020. This cumulatively amounts to over one million job years during the first 8 years of the program. Annual job losses increase by an average of 33,000 jobs per year.

Figure 6.33
Jobs Impact, Optimistic Case



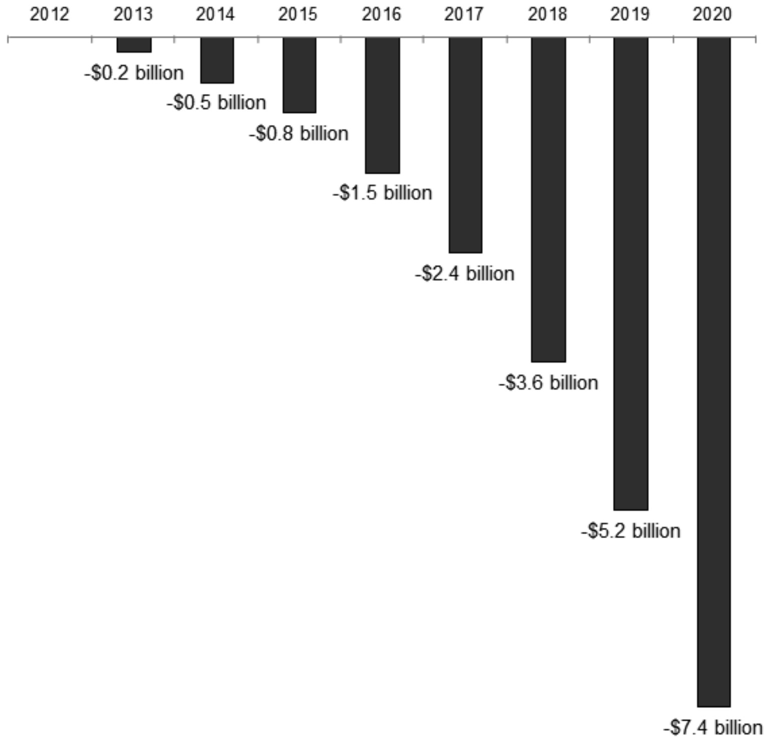
SOURCE: Appendix C

State and Local Revenue Impact

State and local government revenues were hit hard by the Great Recession. Budgets for education, social services, law enforcement, parks and infrastructure have had to be cut significantly. AB 32's impact on the economy will likewise impact state and local revenues as shown in Figure 6.34. AB 32 will reduce state and local tax revenues by over $7.4 billion annually by 2020 under the low case. Cumulatively, this amounts to $21.6 billion in lost state and local tax revenues. The annual revenue loss is increasing by an average of 78 percent per year.

[51] Bureau of Labor Statistics, Regional and State Employment and Unemployment Summary, April 2012

Figure 6.34
State and Local Revenue Impact, Optimistic Case

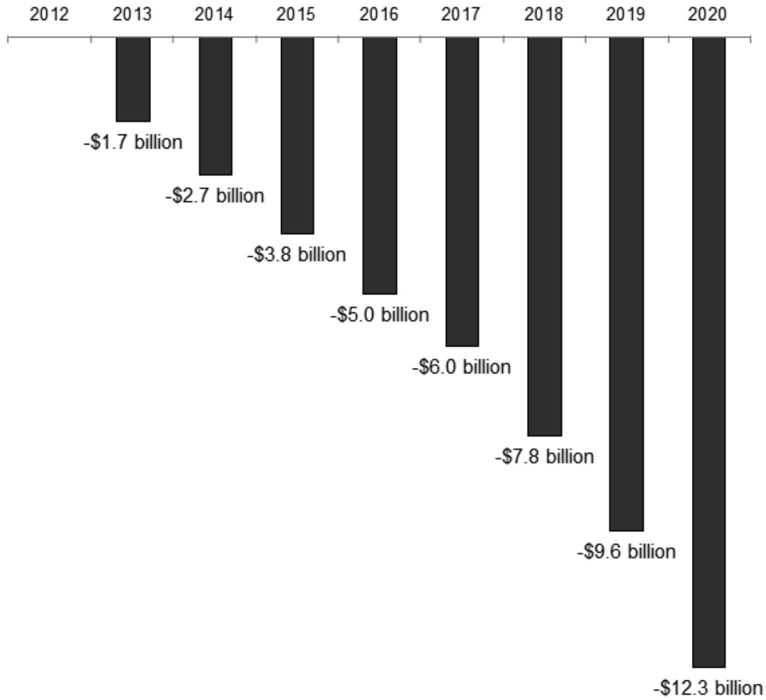


SOURCE: Appendix C

Earnings Impact

As shown in Figure 6.35, Californians will lose more than $12.3 billion in personal earnings in 2020 resulting from AB 32. This amounts to an average loss of $900 per working family in 2020 alone. The loss will total $48.9 billion between 2012 and 2020. This is increasing by an average of 34 percent per year.

Figure 6.35
Earnings Impact, Optimistic Case

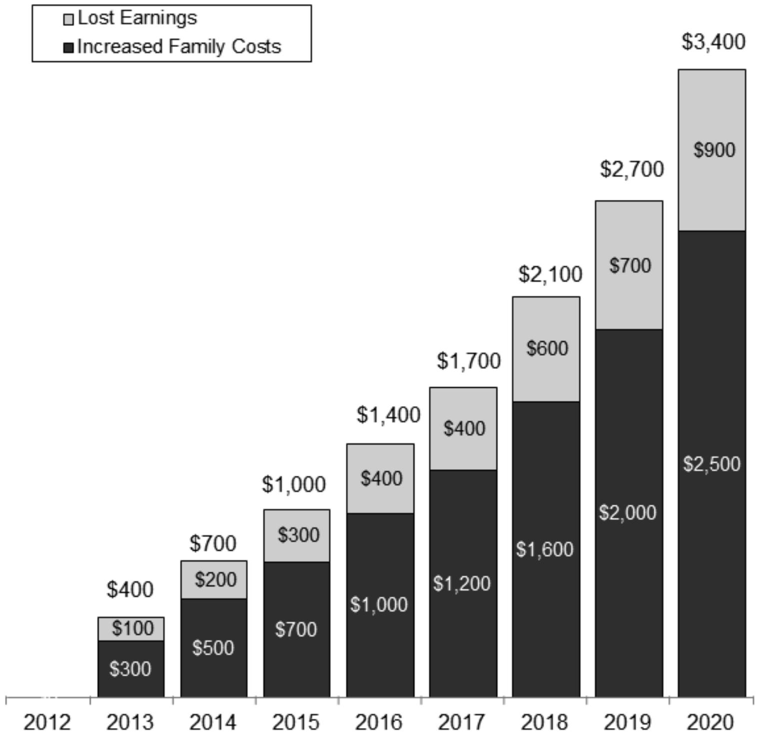


SOURCE: Appendix C

Family Impact

The combined effects of AB 32 will have a significant impact on families. They will lead to a combination of increased prices for commodities, goods and housing, increased taxes and lost earnings. Increased energy and transit prices will cost the average family $2,500 per year by 2020 as shown in Figure 6.36. When combined with the lost earnings, AB 32 will cost the average California family $3,400 per year even under the most optimistic conditions. Combined family impact is increasing by over $420 per year in 2020.

Figure 6.36
Family Impact, Optimistic Case

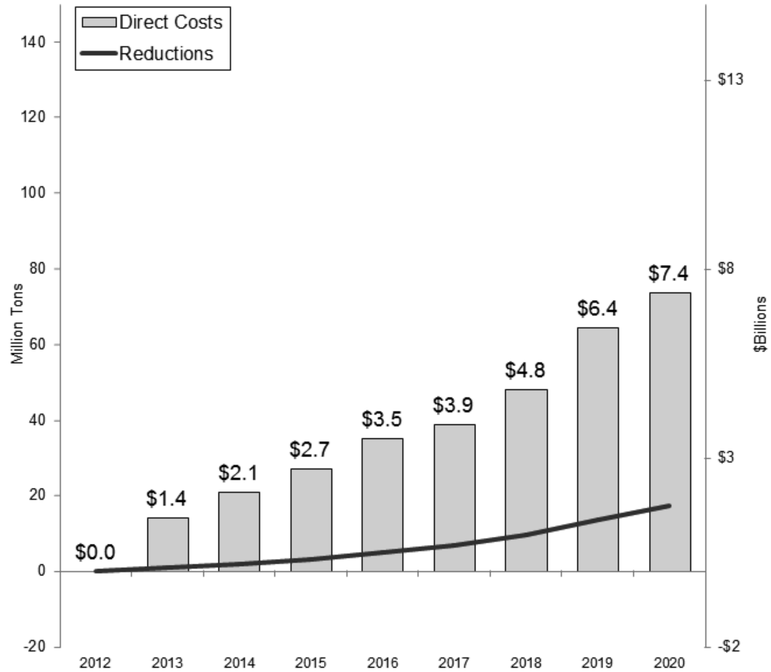


SOURCE: Appendix C

Low Carbon Fuel Standard

The Low Carbon Fuel Standard requires that transportation fuels consumed in California achieve 10 percent lower carbon intensity than they do today. Our analysis shows that LCFS will achieve 17.2 million tons of reductions at a cost of $7.4 billion in 2020, as exhibited in Figure 6.37. This converts to $560 per ton to reduce emissions over the life of the program.

Figure 6.37
LCFS Direct Costs and Reductions, Optimistic Case



SOURCE: Appendix F

The cost of LCFS is driven by the availability of 2nd generation biofuels in America and the price to import high grade foreign ethanol. 2nd generation biofuels, to the degree that they are available, will likely be the preferred alternative, because even if they are more expensive, their low carbon intensity means they can achieve the required reductions in much lower volumes. Unfortunately, it has become very clear that ARB's assumptions for the development of the LCFS market will likely not be achieved. The OECD forecasts that the United States will produce only one-third what is necessary to meet California's LCFS. Moreover, the U.S. EPA has revised down its Federal standards for 2nd generation fuel use to essentially zero due to the markets failure to develop. In order to maintain an optimistic approach to this forecast, we assume that OECD projections for 2nd generation fuel production in America are exceeded by 50% (150% of total).

Another consideration is that, in order to consume the volume of cellulosic and sugar based ethanol necessary to lower emission to meet the LCFS standard, California will need to substantially increase the number of Flex Fuel vehicles that are capable of burning fuels with more than 10% ethanol. Assuming Flex Fuel vehicles are filled with E85 half of the time, which is far above current norms, nearly 30% of all new passenger cars purchased between 2012 and 2020 will need to be Flex Fuel to make it possible to consume this much ethanol.

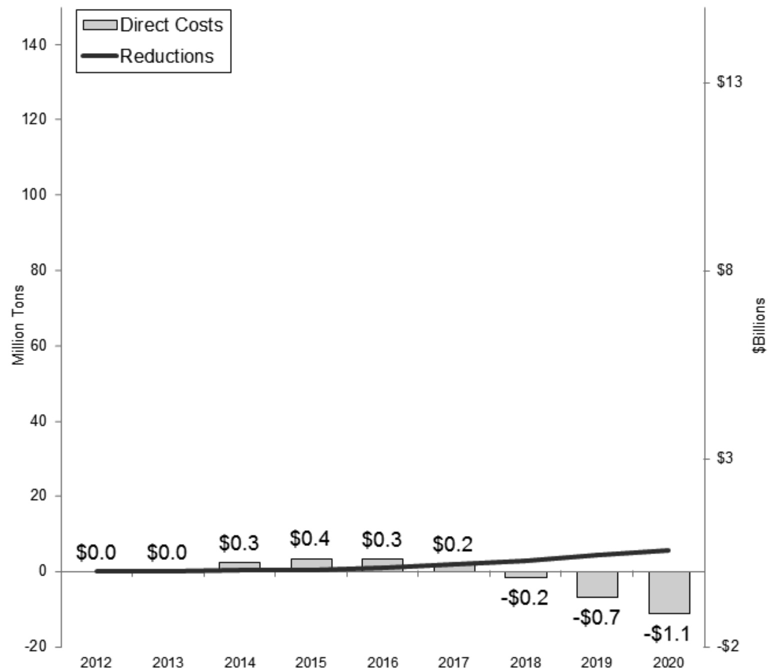
Pavley II

While Pavley II was superseded by Obama's Federal Fuel Standards, we include it in our analysis because ARB sites Pavley II as an AB 32 policy lever in its Scoping Plan. We estimate that Pavley II will bear some cost per ton to reduce emissions during the early years and achieves net savings in the later years, which will likely grow after 2020. This is the most efficient program for which costs were modeled.

The costs and savings of Pavley II is shown in Figure 6.38. While costs are driven by increased costs of new vehicles, especially commercial trucks, savings are driven by fuel savings. For diesel trucks, the savings are insufficient to cover costs, for passenger vehicles, there is substantial net savings. The commercial diesel regulations begin in 2014, but the passenger vehicle regulations do not come on line until 2017, because earlier years are covered by Pavley I. That is the primary reason the program has net costs in the early years, but net savings in the later years.

Because of a slowing economy and SB 375's move away from automobile travel, the model anticipates a slower rate of adoption of new vehicles than in the Business-as-Usual Case. In Business as usual, the model estimates that 5.6 million new passenger vehicles purchased between 2017 and 2020 under the BAU Case, but only 4.8 million under the Optimistic Case. 2017 through 2020 is when the new Pavley II passenger vehicle standards are in effect. Because of this slower rate of adoption, the state's average fleet efficiency in 2020 is actually higher under BAU, 32.8 mpg, without the higher Pavley II standards than with AB 32 in effect, including Pavley II, 32.5 mpg. This is not because Pavley II is ineffective, but because of other programs. Under AB 32 without Pavley II, projected average fuel efficiency is only 31.4 mpg in 2020.

Figure 6.38
Pavley II Direct Costs and Reductions, Optimistic Case



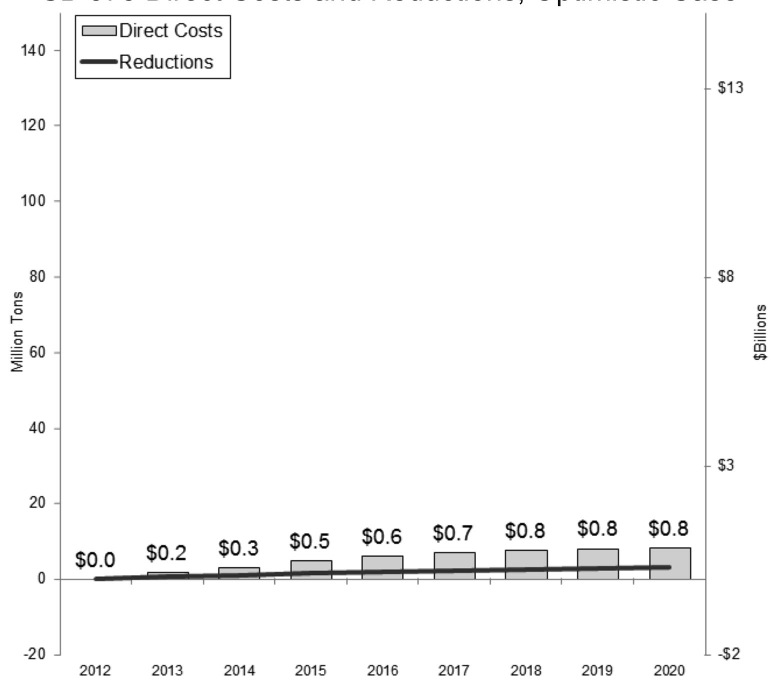
SOURCE: Appendix F

SB 375

A review of the academic literature suggests that far more limited reductions are likely than ARB suggests and may not materialize at all. To account for this, and to mitigate the impact of this costly program on our Optimistic Case, we assume that half of ARB's anticipated reductions are made. Virtually all local governments and planning agencies agree that the reduction targets will be difficult to achieve and will require substantial funding for transit, planning and development incentives. Despite this consensus, ARB's analysis does not model costs for the program.

While it is too early to determine the full extent of costs, there will certainly be additional costs for transit. This study assumes that a small portion of the lost VMT will be replaced by transit. It does not model any costs for planning or development incentives, so it likely understates the true cost of the program substantially. Using these parameters, we find that the direct costs of SB 375 will grow to $0.8 billion by 2020 as shown in Figure 6.39. This is a dramatic difference from the substantial savings that ARB models. Their results are to be expected, however, since they modeled the savings, but failed to consider the costs.

Figure 6.39
SB 375 Direct Costs and Reductions, Optimistic Case

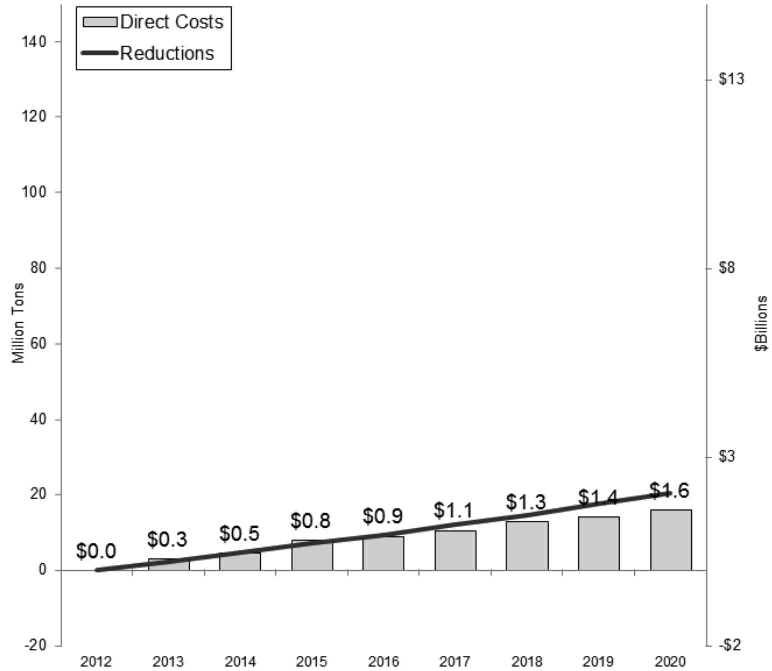


SOURCE: Appendix F

Renewable Portfolio Standard

RPS requires that utilities produce or purchase 33 percent of their electricity portfolio from renewable sources. This will likely primarily be achieved through solar and wind, but small hydro, biomass and geothermal will continue to play a role. RPS will increase the cost of electricity for California's ratepayers. We calculate that RPS will cost $90 per ton to reduce emissions. This is the fourth most costly program for which costs were modeled. Some of this cost is driven by necessary additional transmission lines. The Public Utilities Commission estimates for RPS transmission costs which our study utilized are reflected in Figure 6.40.

Figure 6.40
RPS Direct Costs and Reductions, Optimistic Case

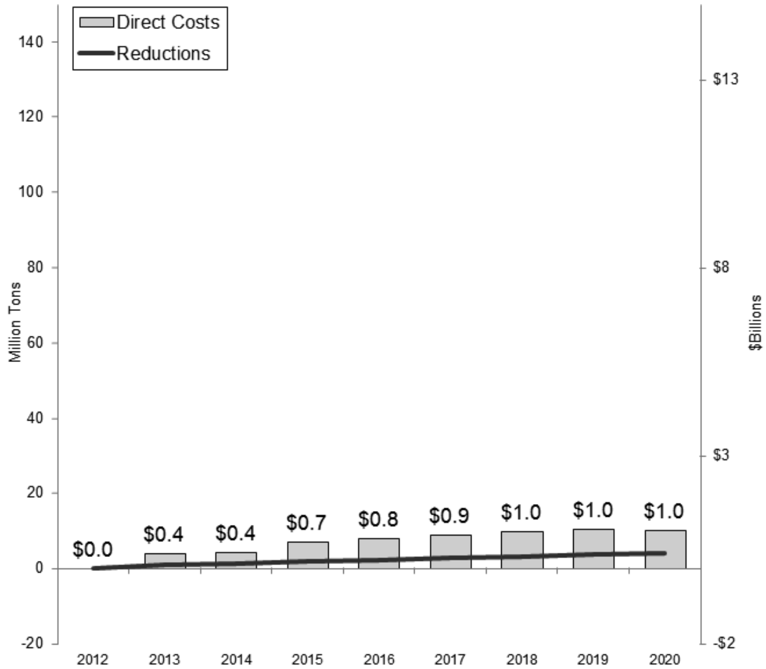


SOURCE: Appendix D

Combined Heat and Power

For our model, we used California Energy Commission estimates for rate of deployment and costs. Because of the costly nature of this program, the Optimistic Case uses CEC's low penetration assumption, which the least reductions at the least cost. In total, CHP will cumulatively cost the state $6.3 billion in direct costs and reduce 20.4 million tons of GHG by 2020 as shown in Figure 6.41.

Figure 6.41
CHP Direct Costs and Reductions, Optimistic Case

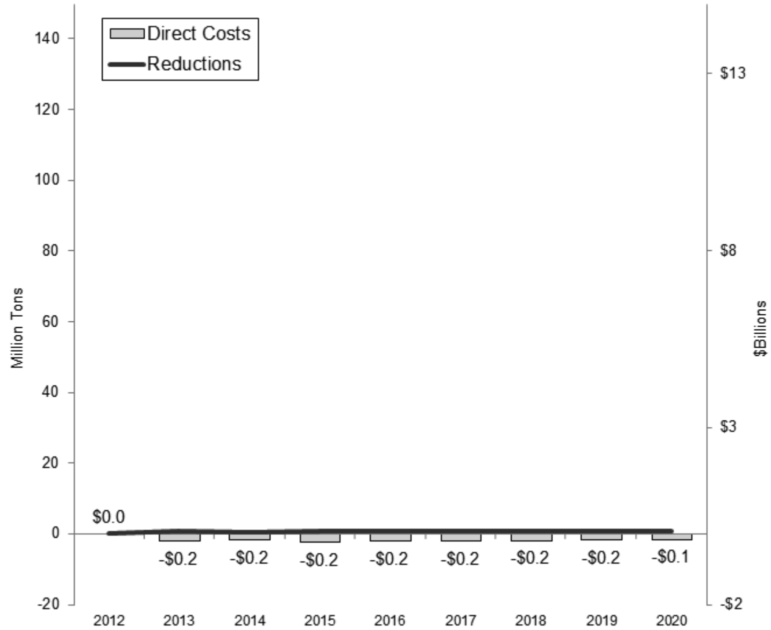


SOURCE: Appendix D

Efficiency Measures

In our model, Efficiency Measures realize significant savings because no program costs are measured; this conforms to ARB's assumptions. Annual reductions decline because the decrease of emission intensity of electricity sources and the decline in demand due to economic losses limit the impact of efficiency gains as shown in Figure 6.42.

Figure 6.42
Efficiency Measures Direct Costs and Reductions, Optimistic Case



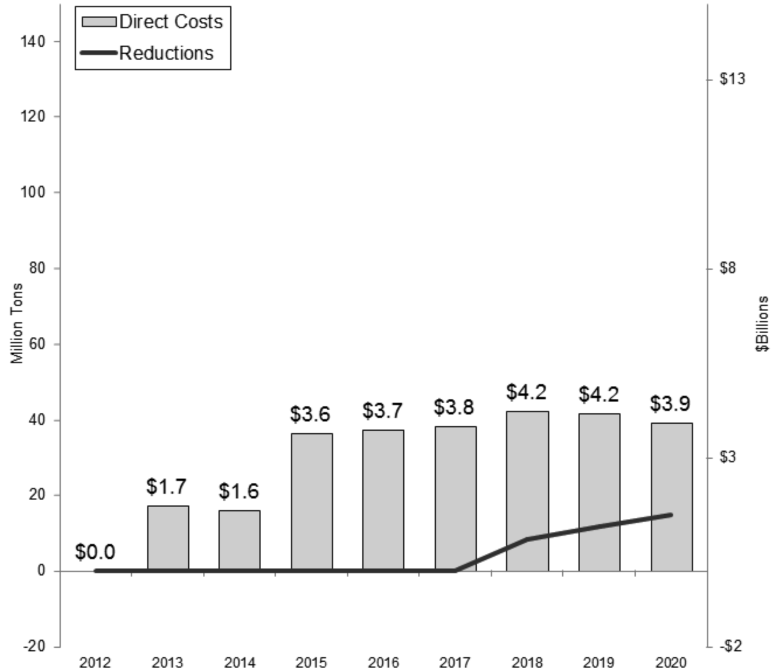
SOURCE: Appendix D, E

Cap-and-Trade

It will cost $21 per ton to reduce emissions through Cap-and-Trade. This is the second most efficient program for which costs were modeled, behind Pavley II. The average price of reductions is assumed to cost half of the credit price, which in an efficient market would be set at the cost of the marginal reduction.

Figure 6.51 reflects the cost of compliance with Cap-and-Trade, as well as the reductions discussed in the previous paragraph. In addition to implicitly requiring emissions reductions, the Cap-and-Trade program requires covered entities to purchase carbon credits at auction to cover their continued emissions, despite being under the cap. Our model estimates that firms will be forced to spend $1.6 to $4.2 billion per year on auctioned credits, despite assuming that ARB will freely allocate far more credits than is currently planned.

Figure 6.43
Cap-and-Trade Direct Costs and Reductions, Optimistic Case



SOURCE: Appendix I

Section 6c: High Case Results

This section outlines the results of our High Case. It is more approximately the opposite of our low case, assuming less successful program implementation and high costs for key price drivers. This case assumes that:

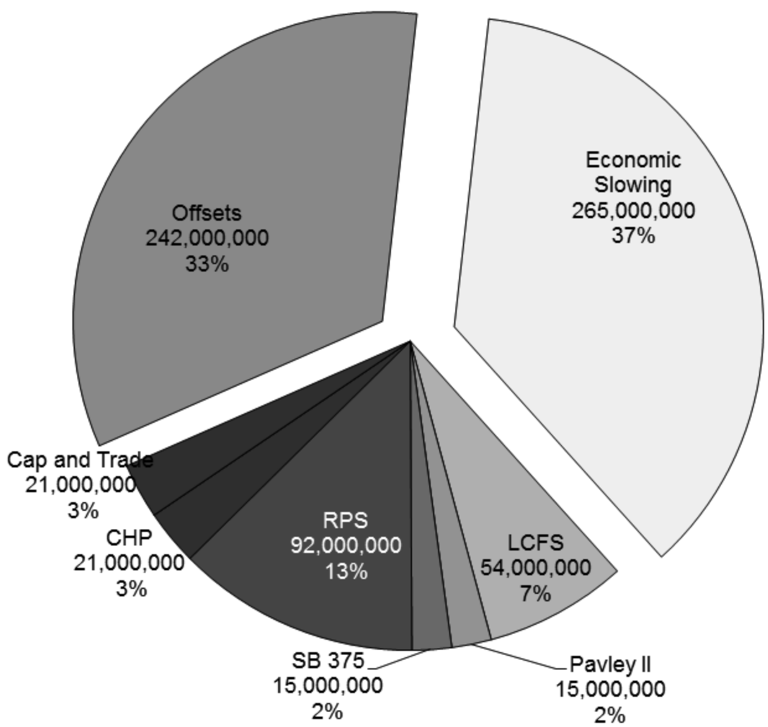
- Low carbon intensity 2nd gen biofuels are available at modestly lower than projected rates (50%) and Brazilian imports are only available at a significant premium;
- Cap-and-Trade credits are based on a $100 2020 price (adjusted for the success of other programs), which is in line with the high end of most research. This effectively means that the implied cap, set at the cost per ton reduced of additional renewable electricity is always binding, leaving the credit price at approximately $90;
- RPS and Pavley II are successfully implemented;

- Efficiency Measures are not implemented. Additionally, due to the previous penetration of high efficiency technologies, California's efficiency growth slows by 1%;
- SB 375 is implemented at 50%. Additionally, the amount of lost VMT that must be replaced by transit is increased by one-third; and
- CHP is implemented at the Low Penetration level.

Impact on GHG Emissions

Our analysis shows that AB 32 reductions in greenhouse gas emissions will come at significant cost to the state's economy. The second largest share of emissions reductions will stem from the economic slowing caused by AB 32, while a slightly larger share will be achieved by Cap-and-Trade, as exhibited in Figure 6.44.

Figure 6.44
Reductions by Source, High Case



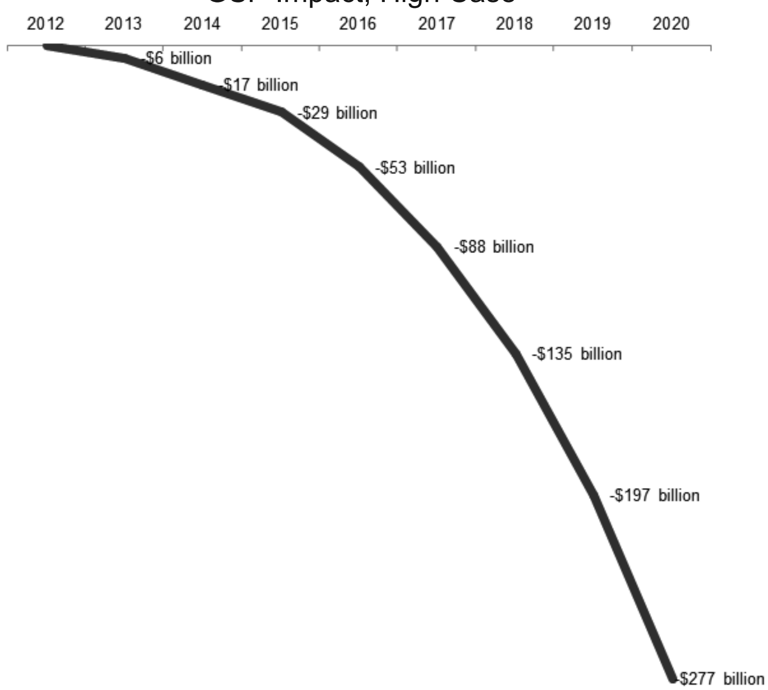
SOURCE: Appendix C

In the High Case, we find that AB 32 will cumulatively reduce 725 million tons of GHG through 2020. Economic slowdown accounts for the greatest share, with 37 percent of the reduction, 265 million tons. This represents the loss of economic productivity driven by AB 32 and the decrease in transportation fuel consumption due to increased costs and decreased earnings. Purchased offsets account for the second largest share, 242 million tons.

GSP Impact

Figure 6.45 shows our estimate of AB 32's impact on GSP. Even under our Low Case, AB 32 lowers the projected 2020 GSP from $2.72 trillion to only $2.44 trillion, a loss of $277 billion in 2020. This amounts to a loss of approximately 10.2 percent of GSP in the year 2020.

Figure 6.45
GSP Impact, High Case



SOURCE: Appendix C

Table 6.4 displays the impact AB 32 will have on California's GSP each year.

Table 6.4
GSP Impact by Year, High Case

	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU GSP	$ 2.01 trillion	$ 2.09 trillion	$ 2.17 trillion	$ 2.25 trillion	$ 2.34 trillion	$ 2.43 trillion	$ 2.52 trillion	$ 2.62 trillion	$ 2.72 trillion
Scenario Annual GSP Δ	0.0%	-0.3%	-0.5%	-0.5%	-1.0%	-1.5%	-1.9%	-2.5%	-3.2%
Scenario Δ from Baseline	0.0%	-0.3%	-0.8%	-1.3%	-2.3%	-3.6%	-5.4%	-7.5%	-10.2%
AB 32 GSP	$2.01 trillion	$2.08 trillion	$2.15 trillion	$2.22 trillion	$2.28 trillion	$2.34 trillion	$2.39 trillion	$2.42 trillion	$2.44 trillion

SOURCE: Appendix C

Jobs Impact

Figure 6.46 shows the impact of AB 32 on California's employment under our Low Case. California's unemployment rate remains the third highest in the nation, making lost jobs a significant concern.[52] AB 32 will cause a reduction of 460,000 jobs in 2020. This cumulatively amounts to nearly 1.9 million job years during the first 8 years of the program. Annual job losses increase by an average of 57,000 jobs per year.

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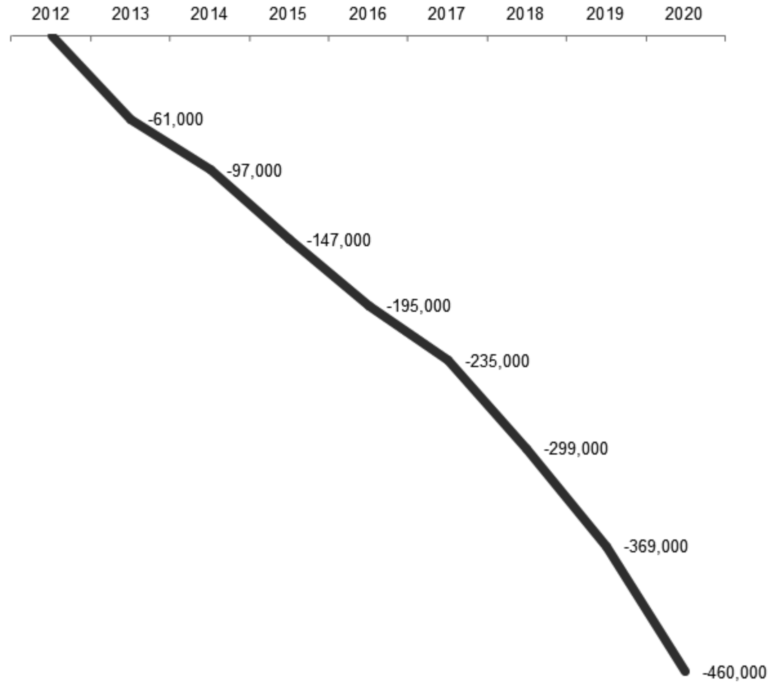
[52] Bureau of Labor Statistics, Regional and State Employment and Unemployment Summary, April 2012

Figure 6.46
Jobs Impact, High Case

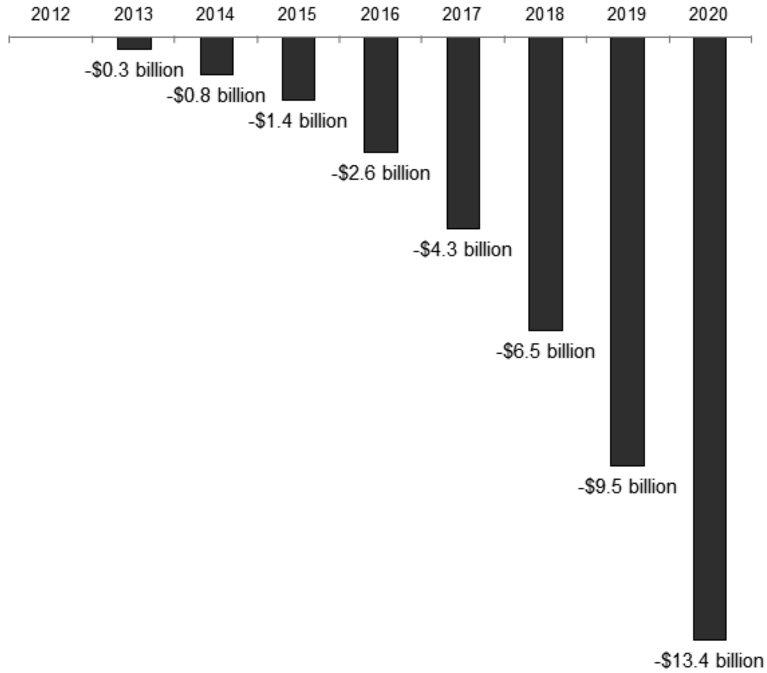


SOURCE: Appendix C

State and Local Revenue Impact

State and local government revenues were hit hard by the Great Recession. Budgets for education, social services, law enforcement, parks and infrastructure have had to be cut significantly. AB 32's impact on the economy will likewise impact state and local revenues as shown in Figure 6.47. AB 32 will reduce state and local tax revenues by $13.4 billion annually by 2020 under the low case. Cumulatively, this amounts to over $38.8 billion in lost state and local tax revenues. The annual revenue loss is increasing by an average of 80 percent per year.

Figure 6.47
State and Local Revenue Impact, High Case

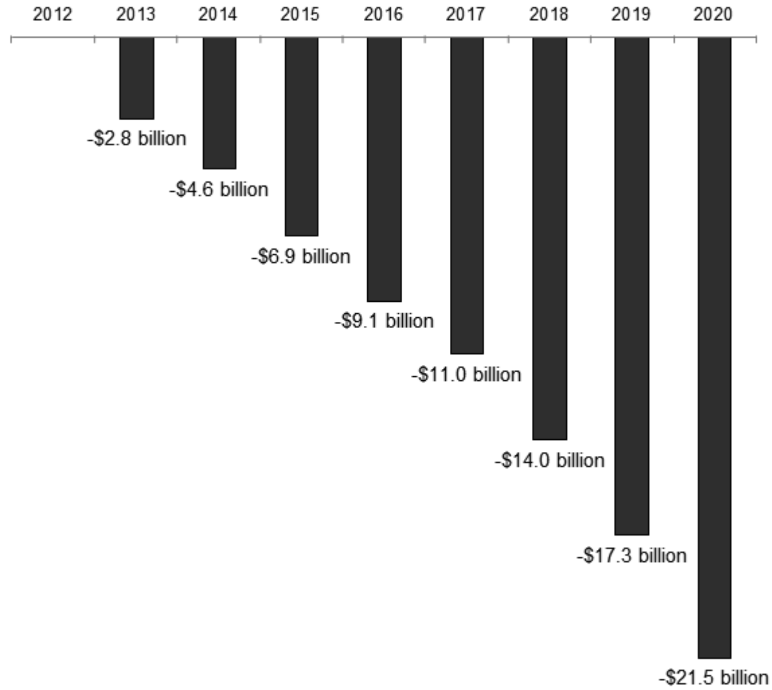


SOURCE: Appendix C

Earnings Impact

As shown in Figure 6.48, Californians will lose more than $21.5 billion in personal earnings in 2020 resulting from AB 32. This amounts to an average loss of $1,500 per working family in 2020 alone. The loss will total $87.2 billion between 2012 and 2020. This is increasing by an average of 34 percent per year.

Figure 6.48
Earnings Impact, High Case

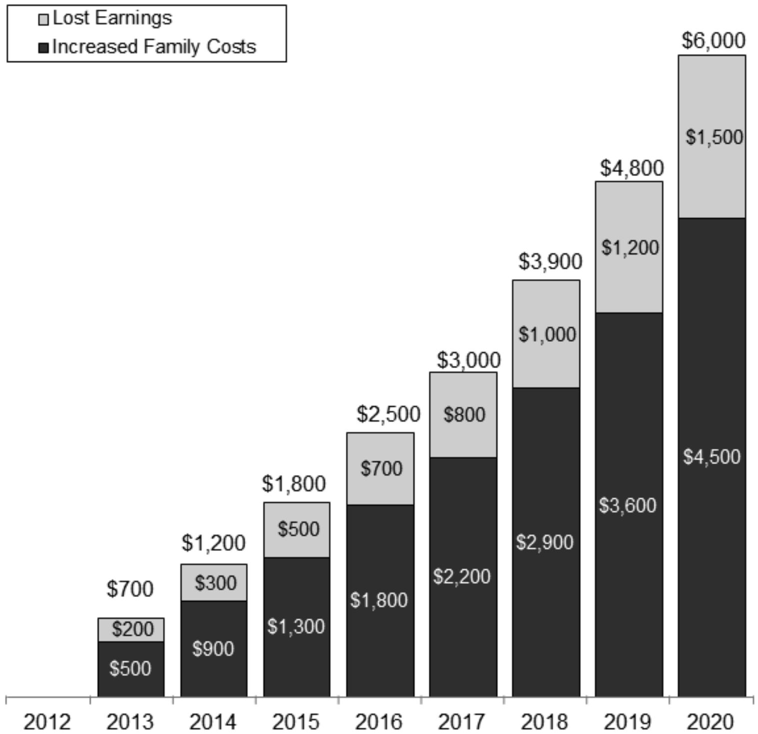


SOURCE: Appendix C

Family Impact

The combined effects of AB 32 will have a significant impact on families. They will lead to a combination of increased prices for commodities, goods and housing, increased taxes and lost earnings. Increased energy and transit prices will cost the average family $4,500 per year by 2020 as shown in Figure 6.49. When combined with the lost earnings, AB 32 will cost the average California family over $6,000 per year even under the most optimistic conditions. This is nearly equal to an additional six monthly mortgage payments annually. Family impact is increasing by an average of $750 per year.

Figure 6.49
Family Impact, High Case

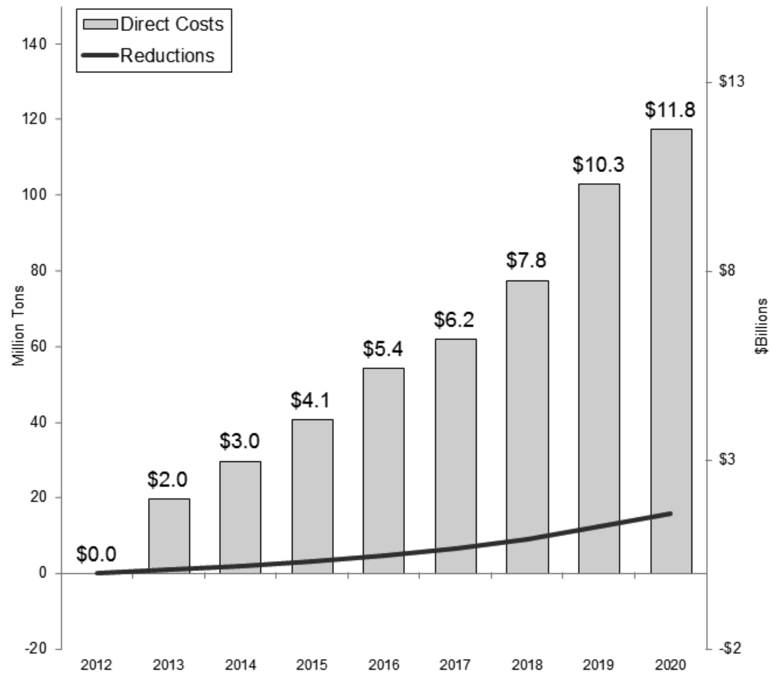


SOURCE: Appendix C

Low Carbon Fuel Standard

The Low Carbon Fuel Standard requires that transportation fuels consumed in California achieve 10 percent lower carbon intensity than they do today. Our analysis shows that LCFS will achieve 15.7 million tons of reductions at a cost of $11.8 billion in 2020, as exhibited in figure 6.50. This converts to $930 per ton to reduce emissions over the life of the program.

Figure 6.50
LCFS Direct Costs and Reductions, High Case



SOURCE: Appendix F

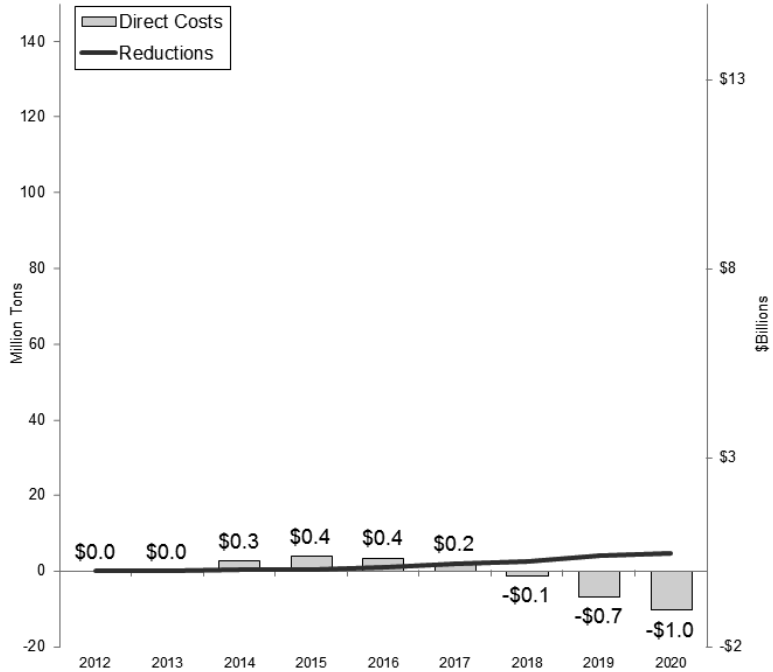
The cost of LCFS is driven by the availability of 2nd generation biofuels in America and the price to import high grade foreign ethanol. 2nd generation biofuels, to the degree that they are available, will likely be the preferred alternative, because even if they are more expensive, their low carbon intensity means they can achieve the required reductions in much lower volumes. Unfortunately, it has become very clear that ARB's assumptions for the development of the LCFS market will likely not be achieved. The OECD forecasts that the United States will produce only one-third what is necessary to meet California's LCFS. Moreover, the U.S. EPA has revised down its Federal standards for 2nd generation fuel use to essentially zero due to the markets failure to develop. As with any forecast, there is the possibility of either exceeding the forecasted production or coming up short. Both the Low and Optimistic Cases assume production will exceed OECD forecasts, though by varying degrees. In the High Case, we assume 2nd generation fuels develop, although at half the rate OECD forecasts. This reflects the substantial uncertainty of forecasting the development of a product that currently does not exist at a commercially viable level.

Pavley II

While Pavley II was superseded by Obama's Federal Fuel Standards, we include it in our analysis because ARB sites Pavley II as an AB 32 policy lever in its Scoping Plan. We estimate that Pavley II will bear some cost per ton to reduce emissions during the early years and achieves net savings in the later years, which will likely grow after 2020. This is the most efficient program for which costs were modeled.

The costs and savings of Pavley II are shown in Figure 6.51 While costs are driven by increased costs of new vehicles, especially commercial trucks, savings are driven by fuel savings. For diesel trucks, the savings are insufficient to cover costs, for passenger vehicles, there is substantial net savings. The commercial diesel regulations begin in 2014, but the passenger vehicle regulations do not come on line until 2017, because earlier years are covered by Pavley I. That is the primary reason the program has net costs in the early years, but net savings in the later years.

Figure 6.51
Pavley II Direct Costs and Reductions, High Case



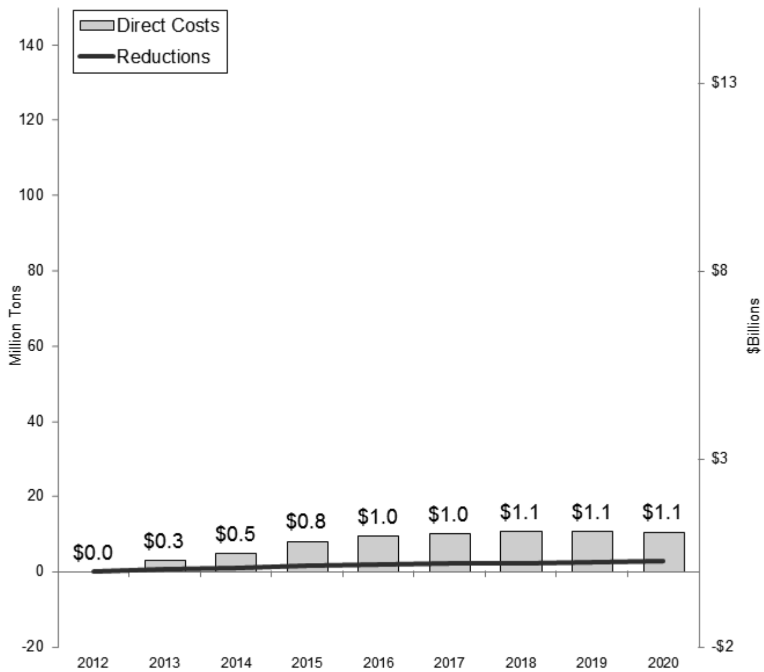
SOURCE: Appendix F

SB 375

A review of the academic literature suggests that far more limited reductions are likely than ARB suggests and may not materialize at all. Reflecting this, we assume that half of ARB's anticipated reductions are made in the high case. Virtually all local governments and planning agencies agree that the reduction targets will be difficult to achieve and will require substantial funding for transit, planning and development incentives. Despite this consensus, ARB's analysis does not model costs for the program.

While it is too early to determine the full extent of costs, there will certainly be additional costs for transit. This study assumes that a small portion of the lost VMT will be replaced by transit. Reflecting the uncertainty in this cost, the High Case assumes that a modestly larger portion of lost VMT must be replaced by transit. It does not model any costs for planning or development incentives, so it likely understates the true cost of the program substantially. Using these parameters, we find that the direct costs of SB 375 will grow to $1.1 billion by 2020 as shown in Figure 6.52. This is a dramatic difference from the substantial savings that ARB models. Their results are to be expected, however, since they modeled the savings, but failed to consider the costs.

Figure 6.52
SB 375 Direct Costs and Reductions, High Case

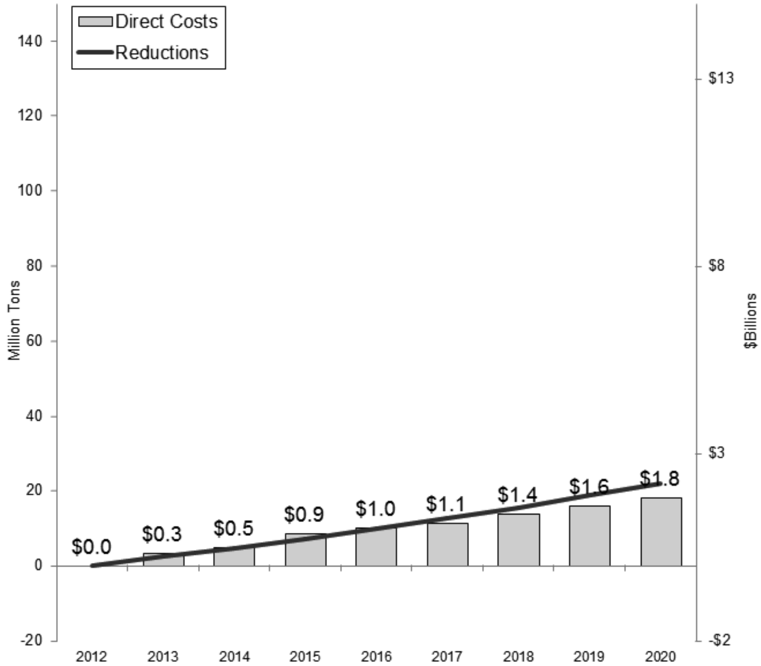


SOURCE: Appendix F

Renewable Portfolio Standard

RPS requires that utilities produce or purchase 33 percent of their electricity portfolio from renewable sources. This will likely primarily be achieved through solar and wind, but small hydro, biomass and geothermal will continue to play a role. RPS will increase the cost of electricity for California's ratepayers. We calculate that RPS will cost $94 per ton to reduce emissions. This is the fourth most costly program for which costs were modeled. Some of this cost is driven by necessary additional transmission lines. The Public Utilities Commission estimates for RPS transmission costs which our study utilized are reflected in Figure 6.53.

Figure 6.53
RPS Direct Costs and Reductions, High Case

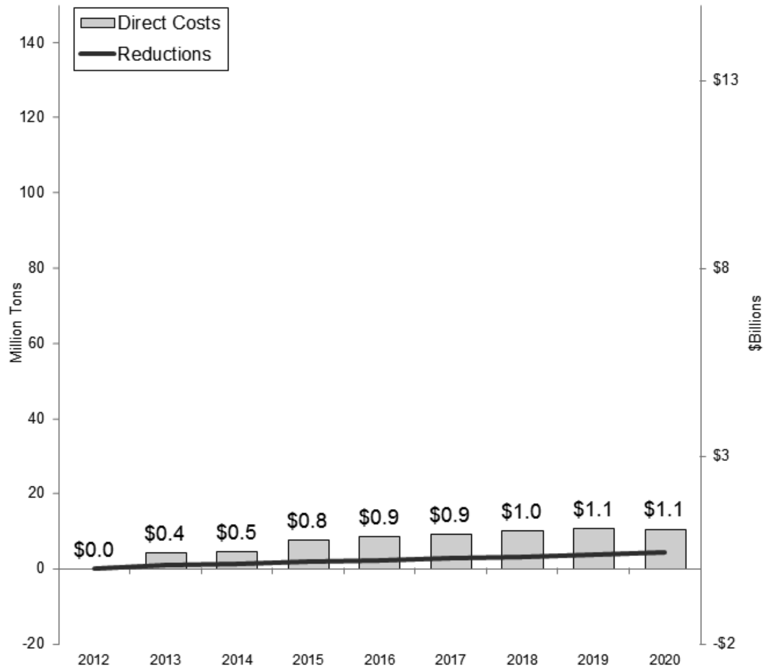


SOURCE: Appendix D

Combined Heat and Power

For our model, we used California Energy Commission estimates for rate of deployment and costs. The High Case uses CEC's low penetration assumption, which achieves the least reductions and the lowest total costs. In total, CHP will cumulatively cost the state $6.6 billion in direct costs and reduce 20.6 million tons of GHG by 2020 as shown in Figure 6.54.

Figure 6.54
CHP Direct Costs and Reductions, High Case



SOURCE: Appendix D

Efficiency Measures

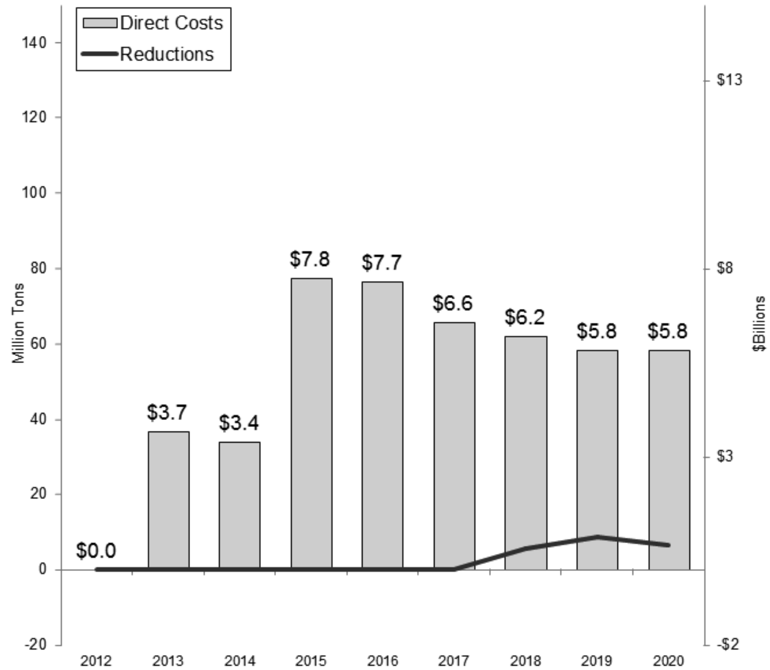
In our High Case, we assume that Efficiency Measures are ineffective and have no impact.

Cap-and-Trade

Cap-and-Trade will cost $43 per ton to reduce emissions through Cap-and-Trade. This is the second most efficient program for which costs were modeled, behind Pavley II. The average price of reductions is assumed to cost half of the credit price, which in an efficient market would be set at the cost of the marginal reduction.

Figure 6.55 reflects the cost of compliance with Cap-and-Trade, as well as the reductions discussed in the previous paragraph. In addition to implicitly requiring emissions reductions, the Cap-and-Trade program requires covered entities to purchase carbon credits at auction to cover their continued emissions, despite being under the cap. Our model estimates that firms will be forced to spend $3.4 to $7.8 billion per year on auctioned credits, despite assuming that ARB will freely allocate far more credits than is currently planned.

Figure 6.55
Cap-and-Trade Direct Costs and Reductions, High Case



SOURCE: Appendix I

7. Conclusion

AB 32's balanced goal of reducing California's GHG to promote environmental sustainability in a cost-effective manner is both ambitious and laudable. However, our review using the most current resources available suggests that the cost and economic impact of AB 32 will likely be significantly higher than what was reported by ARB in its base case more than three years ago. Even under the most hopeful of circumstances, ARB's implementation of AB 32 will lower California's 2020 GSP by 3.5 percent when costs are fully accounted.

Our analysis has identified policies that are considerably more cost effective than ARB reported in their most current study, including RPS and CHP. However, we believe that policy makers should pay particular attention to areas for which program details and data have recently emerged which may considerably increase the expected program costs. These policy areas include LCFS, Pavley II and SB 375 for which costs are considerably higher than estimated by ARB in its study from three years ago. In particular, the most recent data indicates that the US LCFS market has not developed as rapidly as is required to make it a workable program. This program, which is already underway, is dependent on LCFS supplies that currently do not exist and will not likely develop at an adequate pace to meet the LCFS timeline. In addition, though there may exist strong policy rationales for maintaining SB 375, policy makers should be aware of the program implementation costs that are required.

At this critical junction, policy makers should also consider if there are more cost-effective solutions that may produce the same GHG reductions. As noted, AB 32 has a balanced mandate to produce cost-effective solutions. However, despite the considerable amount of research that has been produced or commissioned by ARB, no study has comprehensively assessed whether ARB's plan is indeed cost-effective. Though not comprehensive in nature, our study suggests that alternatives to ARB's plan could reduce program costs by over 50 percent while reducing GHG emissions by the same amount prescribed by ARB. Because of the potential harms and benefits that could emerge, policy makers should explore this issue in greater detail.

Appendix A:
Literature Review

Appendix A-1
LCFS

Study	Synopsis	Methodology	Key Findings
[1] Canes, M. and Murphy, E., "Economics of a National Low Carbon Fuel Standard," Marshall Institute, 2009	Considers the possibility and effects of enacting a national low carbon fuel standard	Examines the literature and makes adjustments and assumptions to project the real cost of shifting to a low carbon fuel standard	▪ A national LCFS would cost $65.5 billion annually ▪ Emission reductions from LCFS would be offset by increased high emission use elsewhere ▪ Few, if any, readily available fuels have life cycle emissions lower than standard gasoline
[2] Air Resources Board, "Low Carbon Fuel Standard 2001 Program Review Report," December 2011	Gives an overview of the various considerations for a Low Carbon Fuel Standard and updates key components from ARB's previous report, especially fuel and technological availability and costs	Models a variety of scenarios as to how the LCFS could be reached through 2020	▪ No scenarios that do not rely on a "complete technology shift future" actually meet the LCFS in a sustainable way ▪ All other scenarios require California to consume virtually all of the nation's projected ethanol ▪ All scenarios require technology that is not currently commercially viable ▪ Finds that fuel costs will remain relatively stable, changing by no more than 13¢, depending on the scenario
[3] Lyons, J. and Daly, A., "Preliminary Review of the ARB Staff Analysis of 'Illustrative' Low Carbon Fuel Standard (LCFS) Compliance Scenarios - Draft," Sierra Research Inc, December 2011	A critical response to ARB's 2011 Program Review	Compares ARB's assumptions to projections made by other government entities	▪ ARB makes a number of unrealistic assumptions about the availability and improving quality of plant-based fuels ▪ ARB's assumptions about fuel costs are out of line with other agency projections and dramatically understate the cost of compliance
[4] Holland, S.P., et al, "Greenhouse Gas under Low Carbon Fuel Standards?" American Economic Journal: Economics Policy, 2009	A theoretical analysis of the economic implications of a low carbon fuel standard	A theoretical econometric model that considers the relative demand of low and regular carbon fuels	▪ LCFS does not necessarily reduce emissions ▪ Costs at least $307 per ton of CO2 reductions ▪ Allowing for compliance through trading reduces costs

[5] Farrell, A.E. and Sperling, D., “A Low Carbon Fuel Standard for California: Part 1: Technical Analysis,” California Energy Commission, August 2007	A broad view of the numerous options theoretically available to meet the LCFS	Constructs 12 scenarios to display a range of different outcomes		CO2 Reduced
			Corn	17% MW 44% CA
			Cellulose	84-111%
			Electric	(17)%-(53)%
			Hydrogen	(11)%-49%
			CNG	26%
			Biodiesel	58%
			▪ Scenarios require substantial advancement in technology and/or production to come to fruition ▪ Does not discuss costs of implementing technologies ▪ Expanding the use of biodiesel would require expanded rail and/or pipeline infrastructure	
[6] Unasch, S., et al, “Full Fuel Cycle Assessment Well to Wheels Energy Inputs, Emissions and Water Impacts,” California Energy Commission/TIAX LLC, February 2007	Analyzes the impact a Low Carbon Fuel Standard would have in California	Uses the GREET model to calculate well to wheel energy needs and emissions for various fuels		CO2 Reduced
			Corn	5-30% MW 30-50% CA
			Sugarcane	80%
			Cellulose	70-87%
			CNG	15-27%
			Electric	40-50%
			Hydrogen	(60)%-80%
			LPG	18-23%
			Biodiesel	8-12%
			LNG/CNG HD	0-15%
[7] Air Resources Board, “Table 6. Carbon Intensity Lookup Table for Gasoline and Fuels that Substitute for Gasoline,” December 2009	ARB’s official estimates of full cycle carbon intensity for various fuels sources	Not included	Corn	-4% MW 0% CA
			Sugarcane	23%
			CNG	29%

			Electric	-29%
			Hydrogen	(48)%-21%
			Biodiesel	12%
			CNG HD	29%
[8] Montgomery, D., et al, “Economic and Energy Impacts Resulting from a National Low Carbon Fuel Standard,” Consumer Energy Alliance/Charles River Associates, June 2010	Considers the economic impacts of a national low carbon fuel standard law	Uses MRN-NEEM modeling system to evaluate the impacts of a 10 percent reduction in carbon intensity of fuel	▪ A nationwide LCFS would result in 2.3-4.5 million jobs lost by 2025 ▪ GDP would decline by 2-3 percent	
[9] National Research Council, “Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy,” Committee on Economic and Environmental Impacts of Increasing Biofuels Production, 2011	Studies the economic and environmental benefits and concerns of the Renewable Fuel Standard as amended by the Energy Independence Security Act of 2007	Projects the availability and costs of various biofuels from 2012 to 2022 using the National Biorefinery Siting Model	▪ Federal standards are unlikely to be met without substantial technological advances or policy changes ▪ Biofuels are not economically competitive with gasoline ▪ Renewable fuels may be ineffective and lowering CO2 emissions	
[10] Schremp, G. “Low Carbon Fuel Standard (LCFS) Analysis & Compliance Costs: Role of Alternative Fuels in California’s Transportation Energy Future,” California Energy Commission, November 24, 2011	An analysis of the cost of compliance with the Low Carbon Fuel Standard	Models three scenarios with different assumptions on fuel availability	▪ Cellulosic biofuels and Brazilian ethanol will not be available at the levels ARB projects	

Appendix A-2

Pavley II

Study	Synopsis	Methodology	Key Findings
[1] Zabin, Carol and Andrea Buffa. "Addressing The Employment Impacts Of AB 32, California's Global Warming Solutions Act." UC Berkeley Center for Labor Research and Education, February 2009.	The most significant savings under AB 32 arise from the Pavley vehicle emissions regulations.	This study used ARB created models of E-DRAM and BEAR to gauge macroeconomic benefits over Business As Usual (BAU) estimates.	▪ $11 billion in fuel savings from increased vehicle efficiency
[2] "Updated Economic Analysis of California's Climate Change Scoping Plan." California Air Resources Board, March 24, 2010.	ARB calculated significant net savings under the Pavley II fuel standards through full implementation.	This analysis begins with an updated economic and energy forecast, based on California Energy Commission estimates and uses two primary tools: the Energy 2020 model and E-DRAM, a CGE model of the California economy.	▪ $1,722 (2007$) in fuel expenditure savings a year by 2020 ▪ $279 million (2007$) in annualized investments and operating costs
[3] "Comments on the ARB's Updated Economic Impacts Analysis." Economic and Allocation Advisory Committee, California Environmental Protection Agency, April 18, 2010.	The study found a lack of sensitivity analysis for critical assumptions and parameters influencing costs and an optimistic use of an economic forecast for the "reference case."	The report uses comparative studies to provide some insight into ARB's justification for its assumptions about the costs of individual complementary policies.	▪ Due to U.S. EPA testing protocol, to achieve 42.5 mpg on the road, the test efficiency would need to be about 53 mpg ▪ Overly optimistic ARB analysis assumes that the capital cost for the incremental fuel efficiency increase would be small, relative to the value of fuel saved ▪ Pavley fuel efficiency of new cars is likely to either restrict consumer choice away from light duty trucks or to require much greater use of hybrids. ▪ ARB provides no analysis to show that such incremental increases in fuel efficiency would be available at relatively low cost
[4] Roland-Holst, David. "Energy Prices & California's Economic Security Prepared." Next 10, October 2009.	Energy efficiency and renewables offer a valuable hedge against the risks of higher fossil fuel prices.	The report uses the Berkeley Energy and Resources (BEAR) model to analyze six energy price and source scenarios and track market interactions across the California economy.	▪ $2,010 cost per vehicle ▪ $594 million total cost ▪ $1,609 million in savings (438 million gallons at $3.67 per gallon)
[5] Goulder, Lawrence H., Mark R. Jacobsen and Arthur A. van Benthem. "Unintended Consequences From	There are substantial offsetting impacts (or leakage) in the states that do not impose the Pavley limits. Much	Using several adoption models, the study compared Pavley rules to federal CAFE standards and the new versus	▪ 11.1 percent leakage of the state car market ▪ 162 million in total reduction in

Nested State & Federal Regulations: The Case of the Pavley Greenhouse-Gas-Per-Mile Limits." National Bureau Of Economic Research, September 2009.	of this leakage derives from interactions between the Pavley limits and the federal CAFE standard, as well as the used car market.	used vehicle market.	gasoline consumption ▪ 521 million gallons in absolute leakage ▪ $9.67 cost per gallon of fuel saved (discounted to 2009$) ▪ From 2009 through 2020, about 65 percent of emissions reductions achieved in the new car market in Pavley states would be offset by increased emissions in new car markets elsewhere
[6] Goulder, Lawrence H. and Robert N. Stavins. "Challenges from State-Federal Interactions in US Climate Change Policy." American Economic Review: Papers & Proceedings 2011, 101:3, 253–257.	Problems arise when state and federal policies overlap, specifically in renewable electricity and clean energy standards and automobile fuel-economy standards. State level efforts may fail to reduce greenhouse gas emissions nationally and may reduce the cost effectiveness of the overall national effort.	The paper analyzes the interactions between California's Pavley II fuel-efficiency standards and federal CAFE standards.	▪ Pavley II and CAFE in place allows manufacturers to change the composition of its sales outside of the Pavley states toward larger cars with lower fuel economy ▪ Tougher state-level standards could accelerate the development of new technologies that auto manufacturers will eventually adopt throughout the nation

Appendix A-3
VMT

Study	Synopsis	Methodology	Key Findings
[1] Tangri, S.D. and Harrington, R.S., "Prop 23 Won't Derail Climate Change," Environmental & Land Development Blog, Alston + Bird LLP, October 2010	An overview of Proposition 23's effect on Greenhouse Gas regulation in California	Authors' expert opinion and analysis	▪ SB 375's implementation would not be impacted by Proposition 23, which would have delayed AB 32
[2] Elkind, E., "The Myth of SB 375," Legal Planet, September 2010	A critical interpretation of the real impact of SB 375	Authors' expert opinion and analysis	SB 375 is unlikely to meet emission reduction goals because: ▪ Does not actually require localities to meet target, just to create a theoretical plan ▪ Transit funding purportedly tied to SB 375 implementation is not likely to be affected ▪ Policies similar to SB 375's support policies go largely unused
[3] Shigley, P., "Bureaucratic Compliance With SB 375 May Not Reduce Driving," California Planning and Development Report, July 2009	A discussion of potential shortcomings in the implementation of SB 375	Authors' expert opinion and analysis	▪ Regulatory realities may lead to "paper shuffling" to meet AB 32 compliance, not actual reductions
[4] Henderson, A.R. and Cammarota, N., "Moving Beyond Vehicle Miles Traveled," February 2009	A legal analysis of the intent of SB 375	Analyzes the evolving legislative language of various drafts of SB 375 from original submission to passage	▪ SB 375 is an independent greenhouse gas emission measure ▪ Final language of SB 375 moved away from Vehicle Miles Traveled to focus on emissions
[5] Legislative Analyst's Office, "California Jobs and Housing Act," Initiatives Fiscal Analysis, March 2010	An overview of the fiscal impacts of Prop 23	Provides a high level overview of fiscal impacts of the implementation of Prop 23	▪ Programs that are independently authorized in statute would not be affected
[6] Knittel, C.R. and Sandler, R., "Carbon Prices and Automobile Greenhouse Gas Emissions: The Extensive and Intensive Margins," NBER conference on The Design and Implementation of U.S. Climate Policy, April 2010	Analyzes the effect of fuel prices on automobile purchase and driving decisions as it relates to carbon emissions	Uses mileage data from smog test records, using the Cox model to calculate effects on purchase and scrapage decisions and a logistic model on vehicle miles traveled	▪ There is between a .14 and .399 elasticity between fuel price and VMT ▪ The elasticity for fuel efficient vehicles is 1.6x lower than inefficient vehicles

Appendix A-4
RPS

Study	Synopsis	Methodology	Key Findings
[1] Wiser, Ryan and Ole Langniss. "The Renewables Portfolio Standard in Texas: An Early Assessment." Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, November 2001.	Early experience from Texas suggests that an RPS can spur renewables development and encourage competition among renewable energy producers.	Surveyed more than 12 energy producers in Texas to determine median pricing of wind-based energy.	▪ Wind power costs less than \$0.03/kWh (includes a federal production tax credit of \$0.017/kWh) ▪ Single-year growth of 930 MW of wind generation ▪ Obligated electrical suppliers have been willing to sign long-term contracts (10-25 years) to allow renewable build-out to economies of scale
[2] "Cashing In on Clean Energy." Union of Concerned Scientists. July 2007.	A national renewable electricity standard will benefit California's economy and the environment.	20 percent RPS standard for California using EIA's National Energy Modeling System, but uses costs and performance assumptions for: wind, coal, natural gas and nuclear technology developed by Black & Veatch, solar, geothermal and biomass technologies that are more in line with projections by the DOE's Office of Energy Efficiency and Renewable Energy; takes into account recent cost increases from actual conventional and renewable energy projects; macroeconomic impacts calculated using IHS Global Insight model.	▪ New capital investment in renewable energy of \$14.89 billion ▪ Biomass energy payments of \$1.3 billion ▪ Property tax revenues of \$631 million ▪ Wind power land lease payments of \$131 million ▪ Annual CO2 emission savings of 223 million metric tons nationally ▪ \$1.85 billion in lower electricity and natural gas bills by 2020 (growing to \$3.82 billion by 2030) ▪ 16,000 new jobs from renewable energy development ▪ \$704 million in state income ▪ \$539 million in GSP
[3] Renewable Energy Policy Project. "Wind Turbine Development: Location Of Manufacturing Activity." September 2004.	A national RPS standard would increase the total amount of wind power being developed, leading to an increase in employment and investment in certain wind-energy related industries.	The report assumes 50,000 MW of wind power developed across the country and spreads the total demand among the regions of the country by allocating the \$50 billion investment according to the number of employees at wind-related firms identified by the NAICS codes. The report translates the regional dollar allocation by assuming that all component manufacturing has the same ratio of jobs/total investment of 3000 FTE jobs/\$1 billion of investment.	▪ 12,717 in new full-time employment in California ▪ \$4.24 billion in average investment in California

[4] Energy and Environmental Economics, Inc., Aspen Environmental Group. "33 Percent Renewables Portfolio Standard: Implementation Analysis Preliminary Results." California Public Utilities Commission, June 2009.	To meet a 33 percent RPS by 2020 target, seven additional lines at a cost of $12 billion would be required. In addition, the 33 percent RPS target is projected to require almost a tripling of renewable electricity, from 27 terawatt hours (TWh) in 2008 to approximately 75 TWh in 2020.	Four renewable caste studies: 33 percent RPS Reference Case (California's current procurement path, heavily dependent on new technologies), High Wind Case (from California and Baja California), High Out-of-State Delivered Case (more transmission lines from other western states) and High Distributed Generation (DG) Case (more extensive, smaller-scale, localized renewable generation); and two additional scenarios: All-Gas Scenario (all new needs from gas-fired) and 2008 Costs (current cost of electricity in California for comparison to 2020).	▪ Baseline 16.7 percent growth in the cost of kWh from 2008 to 2020 ▪ Current RPS strategy will cost 7.1 percent higher compared to the 20 percent RPS and 10.2 percent higher compared to an all-gas scenario ▪ $115 billion needed in new infrastructure investment between 2008 and 2020 ▪ $12 billion for seven additional transmission lines ▪ $0.169/kWh for the 33 percent RPS Reference Case ▪ $54.2 billion in total electricity expenditures in 2020 for the 33 percent RPS Reference Case
[5] Mahone, A., C.K. Woo, J. Williams, I. Horowitz. "Renewable portfolio standards and cost-effective energy efficiency investment." Energy Policy, Volume 37, Issue 3, March 2009, Pages 774–777.	Combining RPS standards with energy-efficiency operations, states can increase renewable energy sources while balancing total marginal costs	Three case studies (already meeting RPS standards, current energy mix tracks standard in the long-term, installed energy is short of standard) used to determine marginal costs; final costs determined by subtracting the total costs of renewable energy versus combined-cycle natural-gas turbine (CCGT) energy.	▪ Total marginal costs of 33 percent renewable energy target is $119.4/MWh ▪ CCGT cost of approximately $94/MWh for meeting demand growth ▪ Natural-gas price of $7.85/MMBTU ▪ Marginal costs of renewable energy of $171/MWh at the 33 percent target
[6] Palmer, Karen and Dallas Burtraw. "Cost-Effectiveness of Renewable Electricity Policies." Resources for the Future, January 2005.	The report analyzes the cost-effectiveness of a Cap-and-Trade policy versus a renewable portfolio standard and determines the costs associated with various national RPS strategies.	A 13-region model built to compare Cap-and-Trade and RPS standards, as well as comparable RPS standards on renewable generation, economic surplus effects and the effects of national policies on regions.	▪ $0.07455/kWh national price for electricity in 1999 dollars ▪ $0.035/kWh national price for renewables in 1999 dollars ▪ 89.2 MMT of total emissions in California, by share of population ▪ $3.3 billion negative impact on economic surplus, by share of population in 1999 dollars

Appendix A-5

<u>CHP</u>

Study	Synopsis	Methodology	Key Findings
[1] ICF International. "CHP Market Assessment." Integrated Energy Policy Report Committee Combined Heat and Power Workshop, California Energy Commission, July 23, 2009.	The ARB Scoping Goal is overly optimistic both in terms of level of penetration and in expected GHG emissions savings.	The study analyzes the market for current and future CHP technology, size and applications, penetration over time, electrical costs and capacity. The study also considers policy levers to increase effectiveness.	▪ 917 lb/MWh avoided CO2 emissions, under baseload ▪ $0.1170/kWh average savings from baseload CHP – 50 to 500 kW (2019$) ▪ $0.1159/kWh average savings from baseload CHP - 500 kW to 5 MW (2019$) ▪ $0.1080/kWh average savings from baseload CHP - 5 to 20 MW (2019$) ▪ $0.1048/kWh average savings from baseload CHP - 5 to 20 MW (2019$) ▪ 1,926 MW of new generation in base
[2] Stadler, Michael. "The CO2 Reduction Potential of Combined Heat and Power in California's Commercial Buildings." Clean Tech Law & Business journal, 2010.	CHP installation at medium-sized commercial buildings will not meet the necessary capacity or GHG emissions reductions prescribed by ARB.	The report applies a mixed-integer linear program (MILP) that minimizes a site's annual energy costs as its objective using 138 representative mid-sized commercial sites in the state, existing tariffs of three major electricity distribution utilities plus a natural gas company and performance data of available technology in 2020.	▪ Mid-sized commercial building sector can install 1.4 GW of economic CHP capacity ▪ 7.2 TWh of the 30 TWh needed in annual generation ▪ Reduction potential is just 19 percent of the goal, 1.3 Mt of 6.7 Mt needed ▪ Carbon costs ranging from $45/MMT to $415/MMT
[3] Shipley, Anna, Anne Hampson, Bruce Hedman, Patti Garland and Paul Bautista. "Combined Heat And Power: Effective Energy Solutions for a Sustainable Future." Oak Ridge National Laboratory, December 2008.	CHP is effective at reducing CO2 emissions through greater energy efficiency, reducing business costs, localized and relieves grid congestion and improves energy security.	The report took stated goals of increased generation and estimates based off of European nations for comparable capacity; macroeconomic benefits were calculated at 4 jobs created for every $1 million in capital investment.	▪ 240,900 MW of power in U.S. by 2030 ▪ Total U.S. annual CO2 reduction of 848 MMT ▪ 936,000 jobs created nationally

Appendix A-6
Efficiency Measures

Study	Synopsis	Methodology	Key Findings
[1] McKinsey and Company, “Impact of the financial crisis on carbon economics: Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve,” 2010	An updated overview of the worldwide potential emissions abatement and associated costs after the economic collapse	Through a proprietary methodology, calculates the costs and abatement potential of all significant abatement sources worldwide	▪ Abatement potential is stable worldwide from previous study at 38GtCO2 but drops in North America to 4.5 GtCO2 ▪ It would cost €119 billion/year to achieve these reductions ▪ This is approximately $34.64/ton
[2] McKinsey and Company, “Paths to a Low Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve,” 2009	An overview of the worldwide potential emissions abatement and associated costs	Through a proprietary methodology, calculates the costs and abatement potential of all significant abatement sources worldwide	▪ In North America there is 5.1 GtCO2 abatement potential at a cost of €140 billion/year ▪ Most potential (56 percent) for abatement in North America’s energy sector is through Carbon Capture and Storage, a technology that ARB does not think will be viable by 2020
[3] McKinsey and Company, Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?” U.S. Greenhouse Gas Abatement Mapping Initiative, December 2007	An overview of the national potential emissions abatement and associated costs	Through a proprietary methodology, calculates the costs and abatement potential of all significant abatement sources nationally	▪ Western region has far less abatement potential than nation ▪ Abatement potential is disproportionately in power sector
[4] Federal Energy Management Program, “Energy Incentive Programs, California,” U.S. Department of Energy, December 2011, retrieved from http://www1.eere.energy.gov/femp/financing/eip_ca.html	Provides an overview of the programs available to California consumers that incentivize reduction in energy demand	Na	▪ $3.1 billion in various incentives are currently available to California energy consumers to reduce consumption through the PUC ▪ Dozens of other programs are available through specific utilities

Appendix A-7

C & T

Study	Synopsis	Methodology	Key Findings		
[1] California Air Resources Board, "Updated Economic Analysis of California's Climate Change Scoping Plan," March 2010	Broad based CGE model, intended to quantify the entire impacts of AB 32 across the California economy, including breakdown on key industries	Integrates the E-DRAM and Energy 2020 models by feeding E-DRAM macroeconomic outputs into Energy 2020, which adjusts energy costs and volume, which feeds back into E-DRAM. Energy 2020 (proprietary CGE) simulates demand and supply pictures for various fuel types, given a policy scenario. E-DRAM is a static CGE model of the California economy		GSP	Allowance
			Case 1	-.2%	$21
			Case 2	-0.9%	$106
			Case 3	-1.0%	$40
			Case 4	-0.8%	$87
			Case 5	-1.4%	$102
[2] Roland-Holst, D., "Energy efficiency, innovation and job creation in California," Center for Energy, Resources and Economic Sustainability, October 2008	A review of literature and government documents covering the experience of carbon regulation in America and internationally	Employs the BEAR (CGE) model, which is similar to E-DRAM, with additional components, with particular emphasis on technological change over time		GSP	Allowance
[3] Bernstein, P.M., et al, "Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach", Electric Power Research Institute/Charles River Associates, June 2007	A CGE model intended to weigh the economic impacts of various scenarios and policy strategies	Applies the MRN-NEEM (proprietary CGE) model integrates a top down general equilibrium economic model with a bottom up quadratic programming model of the electric sector		GSP	Allowance
			PureTrade	-1.4%	
[4] Weiss, J. and Sarro, M., "The Economic Impact of AB 32 on California Small Businesses," Union of Concerned Scientists/The Brattle	An economic model to consider how increased electricity costs under AB 32 will impact small businesses	A static electrical sector model that calculates the emissions of RPS 33 standards and applies assumed allowance price to additional required		GSP	Allowance
			Conservative	No Forecast	$40

Group, December 2009		reductions	Extreme	No Forecast	$60
[5] Weiss, J. and Sarro, M., “The Economic Impact of AB 32 on California Small Businesses: An Update,” Union of Concerned Scientists/The Brattle Group, October 2010	An update of the previous model, using the same methodology but newer data	A static electrical sector model that calculates the emissions of RPS 33 standards and applies assumed allowance price to additional required reductions	2020	GSP	Allowance
			Conservative	No Forecast	$42.46
			Extreme	No Forecast	$100
[6] Tanton, T., “An Estimate of the Economic Impact of A Cap-and-Trade Auction Tax on California,” AB 32 Implementation Group/T2 & Associates, March 2010	A an econometric study analyzing direct employment loss, associated costs for families, loss of statewide economic activity and impact to the state budget	A static model that calculates the costs to businesses, government and consumers, based on adding the cost of carbon allowances to the cost of production	2020	GSP	Allowance
			Low	-2%	$20
			Mid	-2%	$60
			High	-2%	$200
[7] U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Low Carbon Economy Act of 2007,” January 2008	A multi-model study of the economic impacts of LCFA	A suite of two primary models. ADAGE is a dynamic CGE model, which examines policy impacts on the state, national and international levels. IGEM is a dynamic multi-sector model that tracks changes in industry	2030	GSP	Allowance
			ADAGE	-0.5%	$25
			IGEM	-0.9%	$25
[8] U.S. Environmental Protection Agency, Office of Atmospheric Programs, “EPA Analysis of the Lieberman-Warner Climate Security Act of 2008,” March 2008	A multi-model study of the economic impacts of LWCSA	A suite of two primary models. ADAGE is a dynamic CGE model, which examines policy impacts on the state, national and international levels. IGEM is a dynamic multi-sector model that tracks changes in industry	2030	GSP	Allowance
			ADAGE	-0.9%	$61
			IGEM	-3.8%	$83
[9] Congressional Budget Office, “The Economic Effects of Legislation to Reduce Green-House Gas Emissions,” September 2009	A report considering the economic impacts of H.R. 2454, the American Clean Energy and Security Act of 2009	Calculates estimates on the policy’s effects on the national economy, based on previous studies		GDP	Allowance
			Low	-.25%	$23
			High	-.75%	$23
[10] Busterud, J.W., “Re: PG&E’s Comments on the California Air Resources Board’s 11/16/09 Workshop on AB 32 Economic Analysis,” PG&E, December 2009	A comment offering feedback on the updated ARB Scoping Analysis	Offers stakeholder opinion and experience	▪ Analysis fails to account for shortcomings and sensitivities ▪ Analysis fails to identify cost-effective options		

[11] California Air Resources Board, “Peer Review of the Economic Supplement to the AB 32 Draft Scoping Plan: Major Peer Review Comments and Air Resources Board Staff Responses”, November 2008	Commentary and criticism by a number of significant academic researchers, with limited staff response and clarification	Six academic experts review and give commentary and criticism on ARB’s original economic analysis	Significant consistent criticism includes: ▪ Problems with the baseline ▪ Omission of uncertainty and risk ▪ Overly optimistic assumptions ▪ Results inconsistent with other significant studies
[12] Aldy, J.E. and Stavins, R.N., “The Promise and Problems of Pricing Carbon: Theory and Experience”, Faculty Research Working Paper Series, October 2011	A review of literature and government documents covering the experience of carbon regulation in America and internationally	Considers theory and world experience with various carbon limitation policy choices	▪ Specific policy choices, such as offsets, safety valves and international coordination can drive the real cost of the overall policy significantly.
[13] Stavins, R.N., Jaffe, J. and Schatzki, T., “Too Good To Be True? An Examination of Three Economic Assessments of California Climate Change Policy,” AEI-Brookings Joint	A review of early, optimistic studies on the impact of AB 32	Critically reviews several early AB 32 studies	▪ Reviewed studies’ results differ dramatically from other studies ▪ Fail to consider leakage ▪ Assumes full emission reductions from overlapping programs ▪ Assumes massive market failure ▪ Omit costs including implementation costs and
[14] Johnston, L., et al, “2011 Carbon Dioxide Price Forecast,” Synapse Energy Economics, Inc, February 2011	Surveys the carbon emission allowance price projections of federal several federal studies and makes a projection based on anticipated potential policy choices	Reviews dozens of government and utility forecasts for emission prices and assumptions therein to make a recommendation on emission allowance price.	▪ High forecast starts at $15 and increases to $80/ton ▪ Mid forecast starts at $15 and increases to $50/ton ▪ Low forecast starts at $15 and increases to $30/ton ▪ Flexible policies will lower prices ▪ Technological advancement is a key variable
[15] Taylor, M., “Evaluating the Policy Trade-Offs in ARB’s Cap-and-Trade Program,” Legislative Analyst’s Office, February 2012	An overview and analysis of various policy choices, including recommendations for implementation	Discusses various policy options and tradeoffs involved in implementation of AB 32	▪ Leakage is a major concern, which could be mitigated through free allowances ▪ Offsets help limit costs ▪ Post 2020 uncertainty increases costs
[16] Economic and Allocation Advisory Committee, “Allocation Emissions Allowances Under a California Cap-and-Trade Program,” Recommendations to the California Air Resource Board and California Environmental Protection Agency, March 2010	An overview of various policy choices, including recommendations for implementation	Discusses the various policy options and tradeoffs in allocating emission allowances	▪ Post 2020 uncertainty increases costs ▪ Projected allowance prices range from $8 to $214/ton ▪ Wide availability of offsets lower costs
[17] Economic and Allocation	A critique and commentary on ARB’s	Discusses the relative strengths and	▪ Problems with the baseline

Advisory Committee, "Comments on the ARB's Updated Economic Analysis," April 2010	Updated Economic Analysis	weaknesses of the ARB's updated analysis, offering recommendations	▪ Fails to account for leakage ▪ Lack sensitivity analysis
[18] McKinsey and Company, "Impact of the financial crisis on carbon economics: Version 2.1 of the Global Greenhouse Gas Abatement Cost Curve," 2010	An overview of the worldwide potential emissions abatement and associated costs	Through a proprietary methodology, calculates the costs and abatement potential of all significant abatement sources worldwide	▪ The most cost effective technologies are in non C&T areas, especially residential ▪ The developing world offers far more abatement potential than North America and Europe
[19] Stavins, R.N., "Storing Carbon in Wood: A Cheaper Way to Slow Climate Change," The Milken Institute Review, 2010	A review of cost savings associated with carbon sequestration, relative to emissions reductions	Discusses scientific literature of potential of sequestration for greenhouse gas reductions	▪ There is potential for at least 300 million tons of sequestration and as much as one billion tons ▪ Estimated costs range from $10 to $37/ton
[20] Rothrock, D. and Burgat, M., "AB 32 Implementation Group's letter to CARB regarding its Cap-and-Trade preliminary draft regulation," AB 32 Implementation Group, January 2010	A critique and recommendations on ARB's analysis and program implementation	Offers feedback based on stakeholder experience	▪ Auction of allowances will hurt business ▪ Maximizing offsets lowers costs ▪ A go-it alone policy will lead to offsets
[21] AB 32 Implementation Group, "Backgrounder: AB 32's Economic Analysis Tens of Billions in Hidden Costs"	A critique and recommendations on ARB's analysis and program implementation	Offers feedback based on stakeholder experience	▪ ARB hides billions in costs ▪ Will raise energy costs by billions ▪ Offsets will lower costs
[22] Cutter, B., et al, "Rules of the Game: Examining Market Manipulation, Gaming and Enforcement in California's Cap-and-Trade Program," Emmett Center on Climate Change and the Environment	A theoretical examination of the impact market manipulation could have on California under AB 32	Assesses the potential for gaming the emissions and energy markets and ARB's efforts to mitigate gaming	▪ Contract shuffling could keep emissions static, simply making California appear cleaner on paper ▪ The Carbon market could be gamed in the manner that led to the 2000-01 energy crisis
[23] Tansey, J., "Re: ARB Cap and Trade 'Alternatives'," Comments on the Supplement to the AB 32 Scoping Plan FED, July 2011	A comment offering background and support for the use of international offsets	Offers stakeholder opinion and experience	▪ International entities are prepared to offer offsets that can lower cost of compliance
[24] Coleman, B.M., "CalChamber's Comments on the Supplement to the AB 32 Scoping Plan Functional Equivalent Document as Released June 13, 2011," California Chamber of Commerce, July 2011	A comment offering background and support for free allocation of allowances, wide availability of offsets and avoidance of command-and-control regulations	Offers stakeholder opinion and experience	▪ Several provisions could lower costs and leakage: ▪ Free allowances ▪ Broad use of offsets ▪ Seamless connection to national and regional programs
[25] LaVenture, R., "Re: Regulation to Implement CA Scoping Plan and Transportation Fuels," United Steel	A comment expressing support for AB 32 but concern that it will lead to leakage, especially for the fuel refining	Offers stakeholder opinion and experience	▪ Risk of leakage puts California jobs at risk

Workers, July 2011	industry		
[26] Lu, E. and Messner, S., “Re: Comments on the AB 32 Scoping Plan Supplemental FED,” Environ, July 2010	Notes a number of shortfalls in the ARB’s analysis	Offers stakeholder opinion and experience	▪ Failure to measure leakage dramatically understates costs of policy
[27] Taylor, M., “Letter to Assembly Member Logue,” Legislative Analyst’s Office, June 2010	Commentary and criticism on the ARB analysis as well as the CRA analysis		▪ There will likely be adverse effects ▪ Economic leakage is a concern ▪ A price safety valve could minimize risk
[28] Montoya, M.D., et al, “Comments Of Southern California Edison Company To The California Air Resources Board On The Updated AB 32 Economic Analysis,” Southern California Edison, December 2009	A comment offering feedback on the updated ARB Scoping Analysis	Offers stakeholder opinion and experience	▪ The scenarios in the current analysis are excessively limited

Appendix B:
Public Comment Review

Appendix B-1
LCFS

Commenter	Subject	Key Insights
Sherri K. Stuewer, ExxonMobil January 2010	ExxonMobil Comments on CARBS's Preliminary Draft Regulation for a California Cap-and- Trade Program	▪ LCFS will result in uncertain, higher costs than a market-driven program ▪ Imposing a carbon cost, based on the Cap-and-Trade credit market would improve transparency, mitigate economic harm and treat industries equitably ▪ Traditional biofuels have limited GHG upside, relative to petroleum
Brent Erickson, Biotechnology Industry Organization January 2010	Comments of Biotechnology Industry Organization	▪ All fuels intensity should be measured based on tailpipe emissions ▪ Biomass should be considered a no-net carbon fuel ▪ Current LCFS rules will increase cost to the consumer
Michael J. McAdams, Advanced Biofuels Association January 2010	Biofuels	▪ ARB regulations treat automotive biofuels unfairly and differently from electric generating biofuels ▪ All carbon emitted by biofuels was recently sequestered by the plants and so they should be considered emissions neutral ▪ Including land use in intensity calculations overburdens the nascent industry
Catherine H. Reheis-Boyd, Western States Petroleum Association January 2010	WSPA Comments on the Cap and Trade Preliminary Draft Regulation: Accelerating Fuels under the California Cap and Trade Program to 2012	▪ The Low Carbon Fuel Standard will cost between $14 and $47 billion from 2010-2020
Catherine H. Reheis-Boyd, Western States Petroleum Association December 2011	Outline of Western States Petroleum Association's Main Comments and Requests of CARB Board Members for the December 16th Board Hearing	▪ There are serious feasibility concerns, EIA, EPA and CEC have all indicated that growth in 2nd gen biofuels has not met expectations ▪ LCFS will cost $4.5 billion in 2020
Bob Dineen, Renewable Fuels Association January 2010	Preliminary Draft Regulation for a California Cap-and-Trade Program	▪ All fuels intensity should be measured based on tailpipe emissions ▪ Biomass should be considered a no-net carbon fuel
Robert M. Sturtz, Fueling California December 2011	Low Carbon Fuel Standard	▪ LCFS will increase transportation fuel costs by $4.5 billion in 2020 ▪ California Energy Commission questions the feasibility of LCFS
Jay McKeeman, California Independent Oil Marketers Association December 2011	Low Carbon Fuel Standard; Request to Suspend	▪ CARB has not performed an adequate economic impact assessment of LCFS ▪ Serious issues exist with quality control and regulatory compliance that CARB has not addressed

Bob Dinneen, Renewable Fuels Association December 2011	Comments of the Renewable Fuels Association (RFA) regarding the December 16, 2011 Public Hearing …	▪ It will be extremely difficult to comply given CARB's assessment of corn based ethanol's carbon intensity
CMTA, et al December 2011	Low Carbon Fuel Standard	▪ LCFS will cost billions more in fuel costs and its feasibility is questionable ▪ Will increase cost of doing business and hurt the economy ▪ Will actually increase emissions, from the production and transport of new fuels
John E. Reese, Shell December 2011	December 16, 2011 Board Hearing	▪ LCFS becomes infeasible before 2015 ▪ 2nd gen biofuels are not yet commercialized and, if successful, will still take 10 years to reach commercialization
Stephen D. Burns, Chevron April 2009	Proposed Regulation to Implement the Low Carbon Fuel Standard	▪ LCFS relies on unproven technology some periodic program reviews are essential ▪ Land use change should be included in assessment to treat all fuels equally
A. G. Kawamura, California Department of Food and Agriculture June 2008	Low Carbon Fuel Standard	▪ Including indirect land use impacts of biofuels will stifle development

Appendix B-2
Pavley II

Commenter	Subject	Key Insights
Edward Mainland, Sierra Club California November 2008	Sierra Club supports implementation of the Pavley “Clean Cars” standards	▪ The Pavley standards will help California to meet 2020 requirements for greenhouse gas reductions, but the state should immediately shift toward plug-in hybrid electric vehicles and battery electric vehicles to meet 2050 greenhouse gas reduction goals
Brian Maas, California New Car Dealers Assn. December 2008	Pavley II standard alternatives	▪ Although a new vehicle feebate program may significantly alter the fleet makeup of new vehicles sold in California, the fleet makeup of total vehicle purchases may not dramatically change ▪ The proposed feebate program is included as backfill to the Pavley regulations without any program design parameters, regulatory structure or cost estimates, other than unsupported assertions of GHG emissions savings and revenue neutrality ▪ CARB becomes a taxing authority

Appendix B-3
VMT

Commenter	Subject	Key Insights
David Schonbrunn, TRANSDEF September 2010	Targets do not achieve Scoping Plan targets	▪ Targets established by ARB will only meet about 2/3 of reductions anticipated by scoping plan
Autumn Bernstein, et al, Climate Plan August 2010	Setting SB 375 Targets for San Joaquin Valley COGs	▪ Because of decline during recession, targets are unrealistic given likely development as economy recovers
Jerry Amante, League of California Citites July 2010	League of California Cities - Orange County Division	▪ SB 375 targets are overly optimistic and put California's economy at risk
Jerry Amante/Mark Waldman, Orange County OCTA/OCCOG September 2010	Proposed SB375 Regional Greenhouse Gas Emission Reduction Target Recommendations	▪ Infeasible targets would put transportation projects in jeopardy and air quality goals at risk ▪ Fiscal hardship on local governments limits their ability to achieve these goals ▪ Funding available for implementation is extremely limited
California Building Industry Association, et al September 2010	Proposed SB 375 Targets	▪ CARB's targets are beyond what both the Southern California Association of Governments and Bay Area Metropolitan Transportation Commission found to be feasible ▪ ARB did not model the feasibility or economic impacts of its targets
William A. Burke, South Coast Air Quality Management District September 2010	Proposed Regional Greenhouse Gas Emission Reduction Targets ...	▪ Supports ARB's targets ▪ Additional state funding for planning organizations is necessary in order to meet these targets
Andrew R. Henderson, Building Industry Association of Southern California September 2010	Building Industry Association of Southern California, Inc. Opposition to the Proposed SB 375 Greenhouse Gas Emission Reduction Targets for the Southern California Association of Governments' Region	▪ Targets are unreasonable without a dramatic shift in public behavior ▪ Implementation would be costly and reliant on already severely strained government budgets ▪ ARB has not conducted an assessment of the cost of implementation
Gil Hurtado, Gateway Cities Council of Governments September 2010	SCAG Action on Proposed Regional GHG Targets Under SB 375	▪ Supports SB375 but required reductions are unrealistic ▪ Their analysis showed that reductions of half ARB's requirements would be extremely ambitious
Meea Kang, California Infill Builders Association September 2010	SB 375 Proposed Final Targets	▪ Supports ambitious targets, which would promote economic growth through infill development ▪ More sophisticated models than ARB's may be better able to set targets

John DiStasio, Sacramento Municipal Utilities District September 2010	SB 375 Proposed Regional GHG Reduction Targets	▪ Supports SB 375 targets ▪ Failure to achieve SB 375 goals will increase required reductions in other sectors
Larry McCallon , Southern California Association of Governments September 2010	Conditional Support	▪ SCAG supports SB375 targets, conditional on restoration and increase of transportation funding, increase in planning funding, funding for incentivizing and increases in a variety of other funding streams
Alejandro Esparza, City of Los Angeles September 2010	Greenhouse Gas Emissions Reduction Targets	▪ Supports targets because they maintain local autonomy and do not impose any sanctions for failure to conform ▪ The City will require more funds to make it possible
Tony Boren, Council of Fresno County Governments September 2010	Comments Regarding The Final Proposed Greenhouse Gas Emission Reduction Targets For The San Joaquin Valley Metropolitan Planning Organizations	▪ Members were discouraged that there input was disregarded by ARB ▪ The targets are unrealistic
Debra L. Moreno, Greater Bakersfield Chamber of Commerce September 2010	Proposed SB 375 Targets	▪ The targets prescribed by the ARB staff report are unreasonably unattainable and will have negative impacts on local area businesses and industries
Arthur T. Leahy, Los Angeles County Metropolitan Transportation Authority September 2010	SB 375 Targets	▪ Supports SB 375 targets ▪ Achieving these goals will require stable state funding for transit
Carl Guardino, Silicon Valley Leadership Group	SB 375 Targets	▪ Supports more stringent targets ▪ Meeting these targets will require a shift in funding priorities

Appendix B-4
RPS

Commenter	Subject	Key Insights
Edward Mainland, Sierra Club California November 2008	Aggressively build out 33 percent RPS standard	▪ Make sure the 33 percent renewables electricity standard is achieved before 2020, either through legislation or regulatory action ▪ Promote and enable Community Choice Electricity Aggregation (CCA) and feed-in tariffs as potentially powerful GHG reduction mechanisms ▪ Implement the CPUC RPS Report that all new procurement of new energy resources between now and 2020 must be entirely renewable energy, except some new fossil for peaking capacity and to replace aging fossil plants critical to renewable integration
John Busterud, Pacific Gas and Electric Company November 2008	Equal impact to all energy producers	▪ Equal treatment of 33 percent RPS to both investor-owned and publicly-owned utilities is necessary, with consistent mandates and accountability rules, to all entities in the state
Sara Birmingham, The Solar Alliance December 2008	RPS carbon allowances	▪ Recommend setting aside carbon allowances on behalf of voluntary renewable power purchases
Karl Gawell, Geothermal Energy Association December 2008	Bolstered support of geothermal transmission and development	▪ Need significant upgrades and expansions of state's electricity transmission system ▪ Expedited leasing and permitting of geothermal development in known resource areas
Harvey Eder, Public Solar Power Coalition July 2011	Development of solar energy	▪ State needs a 10 year solar conversion plan and a back up 20 and 40 year plan

Appendix B-5
CHP

Commenter	Subject	Key Insights
John Busterud, Pacific Gas and Electric Company November 2008	Streamlined CHP permitting	▪ PG&E recommends the ARB communicate its assumption on efficient CHP to the agencies developing the CHP measure such that only CHP that truly represents GHG reductions is supported ▪ Recommendations on CHP policy extraneous to reducing GHG emissions are beyond the mandate of AB 32 and should not be included in ARB recommendations
Beth Vaughan, California Cogeneration Council March 2012	Improve CHP generation targets	▪ GHG emissions for CHP may outpace RPS as the state grid becomes cleaner; portfolio approach is beneficial for this purpose ▪ The CCC urges the support of an even more supportive environment for CHP as outlined in the Medium and High Cases of the ICF report ▪ The Commission should encourage the CPUC and ARB to maintain well-defined CHP targets and require the IOUs to continue to solicit CHP export generation, beyond 2015, especially in the 2016-2020 period ▪ Develop coordinated long term CHP policy in statute to provide certainty ▪ Enable CHP facilities to “self-wheel” power to other owned or affiliated sites ▪ Ensure GHG policies do not disincentivize CHP development ▪ Ensure interconnection processes, costs and fees do not become a barrier to the installation of new CHP

Appendix B-6
Efficiency Measures

Commenter	Subject	Key Insights
John Busterud, Pacific Gas and Electric Company November 2008	Multiparty agreement on efficiency measures	▪ Important to have comparable energy efficiency targets in all regions of California, for all retail providers ▪ Standardized measurement, evaluation and oversight of the EE measures across agencies (CPUC, CEC) and entities (POU, IOU). ▪ Energy Commission efforts to improve and increase compliance with codes and standards ▪ A regular and more structured cycle for codes and standards review and updates which continually tighten the standards and continue to deliver more GHG reductions. This should apply both to building codes and for appliance standards. In addition new standards should be developed for a broader ranger of appliances such as electronics and other energy using devices ▪ Addressing the continued challenges of lower federal energy efficiency standards relative to California (through state efforts at the national level) ▪ The securing of timely funding to provide IOUs an opportunity to meet the additional and ambitious EE targets ▪ Complementary legislation such as AB 811, which allows any city to provide loans for EE and solar that can be repaid through tax assessments
John Kabateck, National Federation of Independent Business; Mary Griffin, National Association of Women Business Owners; John Handley, California Independent Grocers Association; Matt Sutton, California Restaurant Association; Joel Fox, Small Business Action Committee, Larry Dick, Riddle Service Companies; Betty Jo Toccoli, California Small Business Association; Joel Ayala, California Hispanic Chamber of Commerce November 2008	Efficiency measures accelerate too quickly for small and independent businesses	▪ Businesses that can't achieve the efficiency changes quickly will be burdened with higher bills for gas and electricity
Edward Mainland, Sierra Club California November 2008	Increase efficiency audits	▪ Further reductions in GHG emissions can be gained by further strengthening efficiency and conservation efforts, in particular independent auditing, measurement and verification of efficiency measures and programs

Appendix B-7

C & T

Commenter	Subject	Key Insights
In addition to the following, virtually all mentioned		▪ Compliance periods should be three years, not one ▪ The program should be designed to smoothly integrate future regional, national or international regulations
Josh Margolis, CantorCO2e January 2010	Comments Cap & Trade Preliminary Draft Regulation	▪ Severely limiting offsets drives up the compliance cost and increases the chance of economic leakage ▪ A credit price floor violates the intent of AB 32 and potentially increases compliance cost and economic harm
Brenda Coleman, California Chamber of Commerce January 2010	CalChamber Comments on the Preliminary Draft Regulation for a California Greenhouse Gas Cap-And-Trade Program	▪ Auctioning credits would force California businesses to pay $143 billion between 2012 and 2020 to continue operation, free allocation would mitigate those costs ▪ Restricting offsets increases compliance costs
Morgan Stanley Capital Group Inc. January 2010	Preliminary Draft Regulation California Cap-and-Trade Program	▪ Limiting offsets increases the cost of compliance ▪ Offset use should be tradable and/or bankable property
Dave Copeland, Praxair Januart 2010	Preliminary Draft Regulation for a California Cap and Trade Program issued November 24, 2009	▪ Free allocations will mitigate cost to California business in tough economic times and is consistent with the AB 32 legislative language ▪ The baseline year may unfairly impact certain facilities, which had slowed productivity or were completing pre-permitted expansion ▪ Limiting offsets increases compliance cost and is inconsistent with AB 32's goals
Rob Neenan, California League of Food Processors January 2010	CLFP Comments Regarding ARB's Preliminary Draft Regulation for a California Greenhouse Gas Emissions Cap-and-Trade Program	▪ Compliance will be extremely costly. Most firms have already invested significantly in energy efficiency and upgrades for other environmental regulations ▪ Forced curtailing of energy use could compromise food safety
John Larrea, California League of Food Processors June 2010	CLFP Comments on Cap-and-Trade Proposal, May 17	▪ Auctioning allowances would be too costly to businesses ▪ Benchmarking should factor in improvements already made ▪ ARB should focus on the quality of offsets, not artificially limit them
Mona Shulman, Pacific Coast Producers January 2010	Preliminary Draft Regulation for a California Cap-and-Trade Program	▪ Purchasing allowances will put California firms at an enormous disadvantage to out of state competitors, likely leading to leakage ▪ Limiting offsets increases the cost of compliance
Brian G. Anderson, Vulcan Materials Company January 2010	Preliminary Draft Regulation for a California Cap-and-Trade Program	▪ Free allocation of credits with a limited phase-in of auctions is best for the state's ailing economy ▪ Offset limits are counterproductive to program goals

Rhea Hale, American Forest & Paper Association January, 2010	Comments on Preliminary Draft Regulation for a California Cap-and-Trade Program	▪ Allocations should be allocated, not auctioned to protect companies and consumers ▪ Allocations should account for indirect costs as well as direct costs ▪ Broad use of offsets will mitigate costs
Catherine H. Reheis-Boyd, Western States Petroleum Association January 2010	WSPA Comments on the Cap and Trade Preliminary Draft Regulation	▪ CARB does not have the authority to conduct a full-scale auction ▪ Fully auctioning credits would require tens of billions of investments from California companies ▪ A robust offset program will achieve AB 32's goals in the most cost effective manner
Dwayne Phillips, Air Liquide January 2010	Air Liquide comments regarding Preliminary Draft for California Cap & Trade Regulation	▪ Could create incentive for small scale localized production, over commercial scale production to avoid regulation
Brian C. McQuown, RRI Energy January 2010	RRI Energy Comments on the Cap & Trade Preliminary Draft Regulation	▪ A gradual transition from free allocation to auction will lower the cost of compliance ▪ Cost containment should focus on freeing markets, rather than arbitrary interference ▪ A suitable supply of offsets will protect California consumers
Joy Warren, et al, Modesto Irrigation District, Redding Electric Utility, Turlock Irrigation District January 2010	Cap-and-Trade Preliminary Draft Regulation	▪ The proposed regulations could create similar markets to those that led to the 2000-01 energy crisis ▪ Direct allocation of credits will serve the dual purpose of cost containment and emissions abatement
Stephen R. Maguin, County Sanitation Districts of Los Angeles County January 2010	Preliminary Draft Regulation for a California Cap-and-Trade Program	▪ Offset definitions are excessively restrictive
John T. Bloom, Jr., Coalition for Sustainable Cement Manufacturing & Environment January 2010	California Cement Industry's Comments on the Preliminary Draft Regulation for a California Cap-and-Trade Program	▪ The cement industry is unique – a one size fits all approach will not protect it from leakage ▪ Freely allocating credits will help protect the cement industry ▪ Limiting offsets increases compliance costs and will lead to leakage
John T. Bloom, Jr., Coalition for Sustainable Cement Manufacturing & Environment January 2010	Comments on CARB's May 17 Public Meeting on Allowance Allocation	▪ The cement industry is at sever risk of economic and emissions leakage ▪ Support tiered approach, that favors highly exposed industries, like cement
Thomas R. Jacob, Dupont January 2010	Preliminary Draft Regulation for a California Cap-and-Trade Program	▪ ARB's regulations are too restrictive, forcing high marginal cost reductions when more cost efficient reductions exist ▪ There are significant opportunities for increased offsets that are not covered by ARB and could cost effectively lower emissions
John N. Ward, Independent Concrete Producers January 2010	Independent Ready Mixed Concrete Comments on Draft	▪ ARB should expand offset availability to include point of substitution based reductions, allowing smaller firms to reduce emissions and contribute to AB 32

Stephen D. Burns, Chevron January 2010	Chevron Comments on PDR	▪ Transportation fuel facilities should not be included in Cap-and-Trade, studies have shown that there are no cost effective reductions available to California refineries ▪ Barriers to offset eligibility are unreasonable and increase cost of compliance ▪ Auctioning credits, rather than allocating them devalues prior investments made by California companies ▪ Streamline economic growth by matching it with an expansion of offset availability
Keith Adams, Air Products and Chemicals, Inc January 2010	Comments regarding November 24th Preliminary Draft Regulation for a Cap and Trade Program	▪ Allocate credits based on production to provide incentive for companies to act ▪ Expand the availability of offsets to allow cost effective reductions to be achieved ▪ Treat hydrogen and conventional transportation fuels consistently
John W. Busterud, PG&E January 2010	PG&E's Comments on the Air Resources Board's November 29, 200 Preliminary Draft Regulation to Establish Greenhouse Gas Emissions Cap-and-Trade Program Under AB 32	▪ A price floor will motivate investment in efficient technologies ▪ A strategic allowance reserve can help contain costs ▪ Broad availability of offsets will help to contain costs
Meghan Schloat EcoSecurities January 2010	EcoSecurities' Comments on the AB 32 Preliminary Draft Regulation	▪ Overly restrictive offset limits increases the cost of compliance ▪ Broadening the geographic scope will improve performance
Lenny Hochschild, Carbon Markets January 2010	Evolution Markets Comments to the Air Resources Board Preliminary Draft Regulation (PDR)	▪ Offsets should not be limited in type or in volume, they offer a real cost saving mechanism while meeting the goals of AB 32 ▪ Banking and borrowing are essential cost containment policies
Shelly Sullivan, AB 32 Implementation Group June 2010	AB 32 IG Comments on Cap-and-Trade Proposal	▪ Allowances should be allocated, not auctioned and allocation should reflect and reward firms that have already invested significantly in efficiency
Shelly Sullivan, AB 32 Implementation Group July 2010	AB 32 Implementation Group Comments - 'Update on Offsets and linkage in a California Cap and Trade Program' Workshop June 22, 2010	▪ Increasing the supply of offsets is an essential strategy for cost containment and cost effectively reducing emissions
Gregg Morris, Green Power Institute June 2010	Comments of the Green Power Institute on Allocation Options at Issue in the Design of the Cap-and-Trade Program	▪ Allowances should be allocated administratively, at a cost greater than zero but sufficiently less than market rates to protect California firms from out of state competition and avoid leakage
Catherine H. Reheis-Boyd, Western States Petroleum Association June 2010	WSPA Comments on May 17, 2010 Cap-and-Trade Regulation Public Workshop	▪ Minimize use of auctions to limit overall economic impact and allow free allowances to trade exposed industries ▪ A robust offset program, without limitations on geography or quantity is key to cost containment
Bill Yanek, Glass Association of North America June 2010	GANA Comments to May 17 Allocation Workshop	▪ Benchmark based on national emissions standards ▪ Consider product produced in benchmarking ▪ Consider emissions over time, as emissions increase with older equipment

Dale Backlund, Dow Chemicals June 2010	Proposed Comments to the California Air Resources Board on the Draft Greenhouse Gas Cap-and-Trade Regulation	▪ Free allocation of allowances is an important cost-containment element ▪ Facilities that produce multiple distinct products could be administratively challenging ▪ Protection of trade exposed industries is essential ▪ Offsets are essential to any recovery and/or expansion of the California economy
Tamara Rasberry, Sempra Energy June 2010	May 17, 2010 Workshop on Allowance Allocation for a California Cap-and-Trade Program	▪ The cost to electricity generators is driven up by complementary policies ▪ Allowances should be freely allocated to utilities to driven down consumer costs ▪ Allowances should be used to fund local energy efficiency programs
Michael Bloom, City of Roseville January 2010	Comments on Preliminary Draft Regulations for a California Cap-and-Trade Program, November 24, 2009	▪ Limiting offsets makes it extremely difficult for entities like Roseville to fulfill their legal obligations

Appendix C:
Economic Impact Model

(All Dollars in $2012 and $Billions, Unless Otherwise Stated)
Appendix C-1
BAU GSP

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Historical GSP[1]	$1,901.1										
Population Growth Rate		0.9	0.9	0.9	0.8	0.8	1.0	1.0	1.0	0.9	1.0
Assumed Economic Growth Rate (%)[2]		2.0	2.0	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
Multiply Prior Year GSP by 1 plus growth rates	Prior Year GSP x (1 + Population Growth Rate) x (1 + Economic Growth Rate)										
BAU GSP		$1,956.8	$2,014.1	$2,090.2	$2,168.9	$2,250.5	$2,338.2	$2,429.2	$2,523.5	$2,619.4	$2,722.4

Appendix C-2
Scenario GSP

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Historical GSP[3]	$1,901.1										
Prior Year GSP		$1,901.1	$1,956.8	$2,014.1	$2,086.9	$2,159.4	$2,233.8	$2,309.3	$2,386.6	$2,466.7	$2,546.4
BAU GSP		$1,956.8	$2,014.1	$2,090.2	$2,168.9	$2,250.5	$2,338.2	$2,429.2	$2,523.5	$2,619.4	$2,722.4
Calculate Standard Annual Increase	Current Year BAU GSP – Prior Year BAU GSP										
Standard Annual Increase				$76.0	$78.7	$81.6	$87.8	$91.0	$94.3	$95.9	$103.0

[1] U.S. Bureau of Economic Analysis, Gross Domestic Product by State, 2011
[2] Appendix L
[3] U.S. Bureau of Economic Analysis, Gross Domestic Product by State, 2011

Direct Electricity Costs[4]			$0.0	$0.3	$0.4	$0.6	$0.8	$1.0	$1.2	$1.3	$1.5
Direct Natural Gas Costs[5]			$0.0	$0.0	$0.0	$0.1	$0.1	$0.1	$0.1	$0.1	$0.2
Direct Transportation Costs[6]			$0.0	$0.2	$0.4	$0.7	$1.1	$0.8	$0.2	-$0.2	-$0.3
Direct Industry Costs[7]			$0.0	$0.6	$0.7	$0.9	$1.0	$1.1	$1.2	$1.3	$1.4
Direct Transit Costs[8]			$0.0	$1.7	$3.7	$4.8	$7.3	$9.1	$10.7	$11.9	$14.3
Add Costs	Electricity Costs + Natural Gas Costs + Transportation Costs + Industry Costs + Transit Costs										
Total Fiscal Impact			**$0.0**	**$2.8**	**$5.2**	**$7.1**	**$10.2**	**$12.0**	**$13.4**	**$14.5**	**$17.1**
Vehicle Revenue[9]			$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Fuel Revenue[10]			$0.0	-$0.2	-$0.5	-$0.4	-$0.5	-$0.5	-$0.4	-$1.3	-$2.5
CHP Revenue[11]			$0.0	$0.4	$0.6	$0.8	$1.2	$1.7	$2.2	$2.6	$3.1
Electricity Revenue[12]			$0.0	-$0.6	-$0.7	-$0.9	-$2.0	-$2.4	-$2.9	-$3.2	-$3.5
Cap-and-Trade Credit Revenue[13]			$0.0	$0.4	$0.4	$0.9	$0.9	$0.9	$1.1	$1.1	$1.0
Cap-and-Trade Offset Revenue[14]			$0.0	$0.2	$0.2	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3
Cap-and-Trade Reductions Revenue[15]			$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1	$0.2

[4] Appendix D (also includes water costs in calculation)
[5] Appendix E
[6] Appendix H
[7] Appendix H
[8] Appendix F
[9] Appendix H
[10] Appendix H
[11] Appendix D (also includes water costs in calculation)
[12] Appendix D (also includes water costs in calculation)
[13] Appendix D, E, F, H, all credit revenues are assumed to stay in state
[14] Appendix D, E, F, H, all offset revenues are assumed to stay in state
[15] Appendix D, E, F, H, all reduction revenues are assumed to stay in state

Transit Revenue[16]			$0.0	$0.9	$1.8	$2.5	$3.6	$4.5	$5.3	$6.0	$7.1
Total Revenue Impact			**$0.0**	**$1.0**	**$1.8**	**$3.1**	**$3.5**	**$4.5**	**$5.6**	**$5.7**	**$5.7**
Subtract Impacts	Total Revenue Impact – Total Fiscal Impact										
Total Impact			**$0.0**	**-$1.8**	**-$3.4**	**-$3.9**	**-$6.7**	**-$7.5**	**-$7.8**	**-$8.9**	**-$11.4**
Multiply by Weighted Output Multiplier[17]	x 1.8288										
Total Economic Output Impact			**$0.0**	**-$3.3**	**-$6.2**	**-$7.2**	**-$12.3**	**-$13.6**	**-$14.2**	**-$16.2**	**-$20.9**
Multiply by Weighted Employment Multiplier[18]	x 11.1612										
Total Employment Impact[19]			**0.0**	**25,836**	**42,485**	**58,481**	**74,270**	**82,325**	**92,572**	**103,068**	**119,140**
Multiply by Weighted Earnings Multiplier[20]	x 0.5223										
Total Earnings Impact			**$0.0**	**$1.2**	**$2.0**	**$2.7**	**$3.5**	**$3.9**	**$4.3**	**$4.8**	**$5.6**
Add GSP impacts	Prior Year GSP + Standard Annual Increase + Economic Shift from Costs										
Scenario GSP			**$2,014.1**	**$2,086.9**	**$2,159.4**	**$2,233.8**	**$2,309.3**	**$2,386.6**	**$2,466.7**	**$2,546.4**	**$2,628.5**

[16] Appendix H
[17] U.S. Bureau of Economic Analysis, RIMS II multipliers produced by the Regional Product Division of the Bureau of Economic Analysis on June 20, 2011, adjusted for share of industry by GSP
[18] U.S. Bureau of Economic Analysis, RIMS II multipliers produced by the Regional Product Division of the Bureau of Economic Analysis on June 20, 2011, adjusted for share of industry by GSP (jobs per $million of impact to final demand)
[19] Figure is in job years
[20] U.S. Bureau of Economic Analysis, RIMS II multipliers produced by the Regional Product Division of the Bureau of Economic Analysis on June 20, 2011, adjusted for share of industry by GSP

Appendix C-3

Scenario Emission Reductions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total BAU Emissions[21] (Million Tons)			502.1	508.5	514.1	518.4	522.2	525.9	529.9	533.7	538.1
Scenario Electricity Reductions[22] (Million Tons)			0.0	7.0	9.6	14.6	19.7	25.4	31.7	37.1	42.7
Scenario Natural Gas Reductions[23] (Million Tons)			0.0	0.0	0.0	0.0	0.0	0.0	3.2	5.0	6.9
Scenario Transportation Reductions[24] (Million Tons)			0.0	4.9	10.0	13.9	20.2	26.1	32.6	40.8	50.3
Scenario Industry Reductions[25] (Million Tons)			0.0	0.0	0.0	0.0	0.0	0.0	2.8	4.5	6.0
Scenario Offset Reductions[26] (Million Tons)			0.0	27.4	27.0	33.2	32.1	31.1	30.0	28.8	27.6
Scenario Uncapped Sources[27]			65.0	66.5	68.1	69.7	71.2	72.8	74.4	75.9	77.5
Total All Scenario Emissions						+					
Total Scenario Emissions (Million Tons)			500.1	469.2	467.6	456.8	450.2	443.3	429.7	417.4	404.7
Subtract Scenario from BAU Emissions						-					
Total Scenario Emission Change (Million Tons)			**2.0**	**39.3**	**46.6**	**61.7**	**72.0**	**82.6**	**100.3**	**116.3**	**133.4**

21 Appendix C, E, F, G
22 Appendix D
23 Appendix E
24 Appendix F
25 Appendix H
26 Appendix I
27 ARB, "Greenhouse Gas Emissions Inventory," 2010; ARB, "Greenhouse Gas Inventory for 2000-2009," 2011

Appendix D:
Electricity Model

(All Dollars in $2012 and $Billions, Unless Otherwise Stated)
Appendix D-1
Historical Electricity Demand

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Historical GSP[28]	$1338.1	$1385.7	$1460.3	$1571.2	$1692.0	$1800.8	$1875.8	$1911.7	$1847.0	$1901.1
Historical Electricity Demand (GWh)[29]	265,588	247,294	279,800	290,013	289,123	298,094	304,516	307,145	298,310	290,187
Divide Demand by GSP	÷									
Demand Rate (GWh/$Million GSP)	0.20	0.20	0.19	0.18	0.17	0.17	0.16	0.16	0.16	0.15
Divide Previous Year to Get Change in Demand	÷									
Change in Demand	1.06	0.99	0.97	0.96	0.93	0.97	0.98	0.99	1.01	0.95
Average Change in Electricity Demand	**0.98**									

Appendix D-2
BAU Electricity Demand

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU GSP[30]	$1,901.1	$1,956.8	$2,014.1	$2,090.2	$2,168.9	$2,250.5	$2,338.2	$2,429.2	$2,523.5	$2,619.4	$2,722.4
Electricity Demand (GWh)	290,187										
Average Change in Electricity Demand	0.98										
Projected Demand Rate (GWh/$Million GSP)			0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.12
Multiply BAU GSP by Rate by Average Change for Projected Demand	x										

[28] U.S. Bureau of Economic Analysis, Gross Domestic Product by State, 2011
[29] California Energy Almanac, "California Energy Consumption Database," Accessed April 2012
[30] Appendix C

BAU Electricity Demand (GWh)			**295,461**	**300,482**	**305,567**	**310,716**	**316,378**	**322,112**	**327,921**	**333,576**	**339,765**

Appendix D-3
Scenario Electricity Demand

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario GSP[31]	$1,901.1	$1,956.8	$2,014.1	$2,086.9	$2,159.4	$2,233.8	$2,309.3	$2,386.6	$2,466.7	$2,546.4	$2,628.5
Electricity Demand (GWh)	290,187										
Average Change in Electricity Demand	x 0.98										
Projected Demand Rate (GWh/$Million GSP)			0.15	0.14	0.14	0.14	0.14	0.13	0.13	0.13	0.12
Multiply BAU GSP by Rate by Average Change for Projected Demand	x										
Multiply Change in Cost by Elasticity[32]	x 0.795										
Scenario Electricity Demand (GWh)			295,461	295,214	301,328	303,539	307,071	308,907	309,244	311,943	315,058

Appendix D-4
Existing Electrical Generation & Emissions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Generation from Established Coal Sources (GWh)[33]	25,487	25,487	25,487	25,487	25,487	25,487	25,487	25,487	25,487	25,487	25,487
Cost of Fuel for Coal ($/GWh)	x $21,857										
Total Cost for Coal	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6	$0.6
Emission Rate for Coal (tons/GWh)	x 865										
Total Emissions for Coal (Million Tons)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

[31] Appendix C
[32] Appendix L
[33] CEC, California Energy Almanac, “Total Electricity System Power,” 2010

Generation from Established Nuclear Sources (GWh)[34]	45,944	45,944	45,944	45,944	45,944	45,944	45,944	45,944	45,944	45,944	45,944
Cost for Nuclear Fuel ($/GWh)						x $14,260					
Total Cost for Nuclear	$0.7	$0.7	$0.7	$0.7	$0.7	$0.7	$0.7	$0.7	$0.7	$0.7	$0.7
Generation from Established Large Hydro Sources (GWh)[35]	35,453	35,453	35,453	35,453	35,453	35,453	35,453	35,453	35,453	35,453	35,453
Total Existing Generation (GWh) (Excluding Renewables and Natural Gas)	106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883
Add All Existing Electrical Costs (Excluding Renewables and Natural Gas)						+					
Total Generation Cost of Existing Electrical Sources (Excluding Renewables and Natural Gas)	$1.3	$1.3	$1.3	$1.3	$1.3	$1.3	$1.3	$1.3	$1.3	$1.3	$1.3
Total Emissions of Existing Electrical Sources (Million Tons) (Excluding Renewables and Natural Gas)	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**	**22.0**

[34] *ibid*
[35] CEC, California Energy Almanac, “Total Electricity System Power,” 2010

Appendix D-5
BAU Electricity Impacts

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU Electricity Demand (GWh)			295,461	300,482	305,567	310,716	316,378	322,112	327,921	333,576	339,765
BAU Electricity from Renewable Sources (%)[36]			17.0	17.4	17.8	18.1	18.5	18.9	19.3	19.6	20.0
Multiply BAU Demand by Percentage Required	x										
Required Renewable Energy in BAU (GWh)			50,228	52,209	54,238	56,317	58,530	60,799	63,125	65,464	67,953
Multiply Required Renewable Energy by Cost Per GWh	x										
Cost for New Renewable Energy Sources ($/GWh)[37]			$153,564	$155,207	$157,776	$157,776	$155,559	$153,913	$151,728	$151,728	$152,754
Total Cost for BAU Renewable Energy			$7.7	$8.1	$8.6	$8.9	$9.1	$9.4	$9.6	$9.9	$10.4
Total Existing Generation (GWh) (Excluding Renewables and Natural Gas)			106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883
Required Renewable Energy in BAU (GWh)			50,228	52,209	54,238	56,317	58,530	60,799	63,125	65,464	67,953
Subtract Existing and New Energy for BAU Natural Gas Demand (GWh)	–										
BAU Natural Gas Demand (GWh)			143,372	146,611	149,869	153,147	156,817	160,510	164,226	167,775	171,724
Cost for Natural Gas ($/GWh)[38]	x $111,698										
Total BAU Cost for Natural Gas			$16.0	$16.4	$16.7	$17.1	$17.5	$17.9	$18.3	$18.7	$19.2
Emission Rate for Natural Gas (tons/GWh)	X 470										
Total BAU Emissions for Natural Gas (Million Tons)			67.4	68.9	70.4	72.0	73.7	75.4	77.2	78.9	80.7

36 Represents a straight-line calculation regarding the 20% RPS Standard
37 CPUC, “33% RPS Calculator,” July 2009
38 CPUC, “33% RPS Calculator,” July 2009

BAU Total Electricity Cost			**$24.9**	**$25.7**	**$26.5**	**$27.2**	**$27.8**	**$28.5**	**$29.1**	**$29.9**	**$30.8**
BAU Total Electricity Emissions (Million Tons)			**89.4**	**91.0**	**92.5**	**94.0**	**95.7**	**97.5**	**99.2**	**100.9**	**102.8**

Appendix D-6
<u>Scenario Electricity Impacts</u>

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario Electricity Demand (GWh)			295,461	295,214	301,328	303,539	307,071	308,907	309,244	311,943	315,058
Scenario Electricity from Renewable Sources (%)[39]			17.0	19.0	21.0	23.0	25.0	27.0	29.0	31.0	33.0
Multiply Scenario Demand by Percentage Required	X										
Required Renewable Energy in Scenario (GWh)			50,228	56,091	63,279	69,814	76,768	83,405	89,681	96,702	103,969
Multiply Required Renewable Energy by Cost Per GWh	x										
Cost for New Renewable Energy Sources ($/GWh)[40]			$153,564	$157,776	$151,728	$152,754	$148,928	$149,110	$150,252	$150,150	$150,976
Total Cost for Scenario New Renewable Energy			$7.7	$8.8	$9.6	$10.7	$11.4	$12.4	$13.5	$14.5	$15.7
Total Existing Generation from Non-Renewable Sources (GWh)			106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883	106,883
Required Renewable Energy in Scenario (GWh)			50,228	56,091	63,279	69,814	76,768	83,405	89,680	96,702	103,957
CHP Generation (GWh)[41]			4,231	6,112	7,992	11,753	16,129	20,506	24,882	29,258	33,634
Cost of CHP Generation[42]			$0.7	$1.0	$1.4	$2.0	$2.7	$3.5	$4.2	$5.0	$5.7
Subtract Existing and New Energy for Scenario Natural Gas Demand (GWh)	–										

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39 ARB Scoping Plan 2008, straight-lined
40 CPUC, "33% RPS Calculator," July 2009
41 CEC, "Combined Heat And Power: Policy Analysis And 2011 – 2030 Market Assessment," February 2012; Figures for 2020 are straight-lined based on 2030 generation capacity figures
42 *ibid*

Scenario Natural Gas Demand (GWh)			139,141	131,737	129,501	122,070	114,968	106,453	96,766	88,770	80,968
Cost for Natural Gas ($/GWh)[43]	x $111,698									
Total Scenario Cost for Natural Gas			$15.5	$14.7	$14.5	$13.6	$12.8	$11.9	$10.8	$9.9	$9.0
Emission Rate for Natural Gas[44] (tons/GWh)	x 470									
Total Scenario Emissions for Natural Gas (Million Tons)			65.4	61.9	60.9	57.4	54.0	50.0	45.5	41.7	38.1
Scenario Total Generation Cost			$25.2	$25.8	$26.6	$27.5	$28.2	$29.0	$29.7	$30.6	$31.7
Scenario Total Energy Emissions (Million Tons)			**87.4**	**84.0**	**82.9**	**79.4**	**76.1**	**72.1**	**67.5**	**63.8**	**60.1**
Multiply for Total Amount of Offsets by Statutory Rate[45]	x 8%									
Total Amount of Offsets (millions)				6.7	6.6	6.4	6.1	5.8	5.4	5.1	4.8
Multiply for Cost of Offsets (in standard $)[46]				$16.58	$17.21	$17.41	$18.22	$18.75	$19.29	$19.85	$20.43
Total Cost of Offsets				$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Subtract Offsets from Emissions for Total Credits	+									
Scenario Total Energy Emissions (Million Tons)				84.0	82.9	79.4	76.1	72.1	67.5	63.8	60.1
Multiply for Cost of Credits (in standard $)[47]				$16.58	$18.95	$17.41	$19.96	$22.48	$27.59	$30.01	$32.43
Total Cost of Credits				$1.2	$1.4	$1.1	$1.2	$1.2	$1.4	$1.4	$1.4
Scenario Freely Allocated Credits				*84.0*	*82.9*	*79.4*	*76.1*	*72.1*	*67.5*	*63.8*	*60.1*
Multiply for Cost of Credits (in standard $)[48]				*$16.58*	*$18.95*	*$17.41*	*$19.96*	*$22.48*	*$27.59*	*$30.01*	*$32.43*

[43] CPUC, "33% RPS Calculator," July 2009
[44] *ibid*
[45] ARB Scoping Plan 2008
[46] Appendix L
[47] Appendix L
[48] Appendix L

Total Revenue of Credits				*$1.2*	*$1.4*	*$1.1*	*$1.2*	*$1.2*	*$1.4*	*$1.4*	*$1.4*
Scenario Total Electricity Cost			**$25.2**	**$25.7**	**$26.5**	**$27.2**	**$27.8**	**$28.5**	**$29.1**	**$29.9**	**$30.8**
Scenario Total Electricity Emissions (Million Tons)			**87.4**	**84.0**	**82.9**	**79.4**	**76.1**	**72.1**	**67.5**	**63.8**	**60.1**
Total BAU Cost for Natural Gas			$16.0	$16.4	$16.7	$17.1	$17.5	$17.9	$18.3	$18.7	$19.2
Total Scenario Cost for Natural Gas			$15.5	$14.7	$14.5	$13.6	$12.8	$11.9	$10.8	$9.9	$9.0
Subtract BAU Cost from Scenario Cost for Change in Cost	-										
Change in Natural Gas Cost			-$0.5	-$1.7	-$2.3	-$3.5	-$4.7	-$6.0	-$7.5	-$8.8	-$10.1
Portion in CA	79%										
Change in Revenue to CA from Natural Gas			-$0.4	-$1.3	-$1.8	-$2.8	-$3.7	-$4.8	-$6.0	-$7.0	-$8.0
Total BAU Cost for Renewables			$7.7	$8.1	$8.6	$8.9	$9.1	$9.4	$9.6	$9.9	$10.4
Portion in CA			77%	78%	80%	80%	80%	81%	82%	82%	83%
Multiply BAU Cost by Portion in CA for Revenue to CA	x										
Revenue to CA from BAU Renewables			$5.9	$6.3	$6.8	$7.1	$7.3	$7.5	$7.9	$8.2	$8.7
Total Scenario Cost for Renewables			$7.7	$8.8	$9.6	$10.7	$11.4	$12.4	$13.5	$14.5	$15.7
Portion in CA			77%	80%	82%	83%	79%	80%	82%	83%	84%
Multiply Scenario Cost by Portion in CA for Revenue to CA	x										
Revenue to CA from BAU Renewables			$5.9	$7.0	$7.9	$8.9	$9.0	$9.9	$11.0	$12.0	$13.2
Subtract BAU Cost from Scenario Cost for Change in Cost	-										
Change in Revenue to CA from Renewables			$0.0	$0.7	$1.1	$1.8	$1.7	$2.4	$3.1	$3.8	$4.5
Add Revenue from Renewables to Revenue from Natural Gas for Total Change in Electricity Revenue	+										

Scenario Total Change in Electricity Revenue to CA			**-$0.4**	**-$0.6**	**-$0.7**	**-$0.9**	**-$2.0**	**-$2.4**	**-$2.9**	**-$3.2**	**-$3.5**
CHP Generation Net Costs			$0.2	$0.3	$0.4	$0.6	$0.8	$1.0	$1.2	$1.3	$1.5
Portion in CA[49]			61%	61%	61%	61%	63%	63%	63%	63%	63%
Multiply cost of CHP Generation by Portion in CA for Total Change in CHP Revenue to CA						x					
Scenario Total Change in CHP Revenue to CA			**$0.1**	**$0.2**	**$0.2**	**$0.4**	**$0.5**	**$0.6**	**$0.7**	**$0.8**	**$0.9**

[49] Assumes 92% of capital spending is outside of California, consistent with current production and 100% of non-capital spending is within California

Appendix E:
Natural Gas Model

(All Dollars in $2012 and $Billions, Unless Otherwise Stated)
Appendix E-1
<u>BAU Natural Gas Impacts</u>

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Natural Gas Demand[1] (billion therms)			7.2								
Multiply for Annual Increase in Demand[2]						x 0.09%					
Natural Gas Demand (billion therms)			7.2	7.3	7.4	7.4	7.5	7.6	7.6	7.7	7.8
Multiply Emissions Rate[3] (Million Tons/billion therm) for Total Emissions						x 6.7					
BAU Total Natural Gas Emissions (Million Tons)			**48.7**	**49.1**	**49.5**	**50.0**	**50.4**	**50.8**	**51.2**	**51.7**	**52.1**
Multiply Cost[4] ($/therm) for Total Cost						x 1.12					
BAU Total Natural Gas Cost			**$7.8**	**$7.8**	**$7.6**	**$7.8**	**$7.9**	**$8.1**	**$8.4**	**$8.6**	**$8.8**

[1] California Energy Almanac, “California Energy Consumption Database,” Accessed April 2012
[2] CEC, “Preliminary California Energy Demand Forecast: 2012-2022,” 2011
[3] PG&E, “Carbon Footprint Calculator Assumptions,” 2007
[4] U.S. Energy Information Administration, “Annual Energy Outlook 2012 Early Release,” 2012

Appendix E-2

Scenario Natural Gas Impacts

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Natural Gas Demand[5] (billion therms)			7.2								
Multiply for Annual Increase in Demand (%)[6]						x 0.09%					
Multiply Price Elasticity of Natural Gas[7]						x 0.3					
Multiply by Change in Cost[8]			$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Elasticity Shift in Demand[9]			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Multiply Efficiency Measures[10] (%)						x 1.0					
Natural Gas Demand (billion therms)			7.2	7.3	7.4	7.4	7.4	7.5	7.5	7.6	7.6
Multiply Emissions Rate[11] (Million Tons/billion therm) for Total Emissions						x 6.7					
Scenario Total Natural Gas Emissions (Million Tons)			**48.7**	**49.1**	**49.5**	**54.5**	**53.0**	**51.5**	**48.0**	**46.6**	**45.3**
Multiply Cost[12] ($/therm) for Total Cost						x 1.12					
Scenario Total Natural Gas Cost			**$7.8**	**$7.8**	**$7.6**	**$7.8**	**$7.9**	**$8.1**	**$8.4**	**$8.6**	**$8.8**

[5] California Energy Almanac, "California Energy Consumption Database," Accessed April 2012

[6] CEC, "Preliminary California Energy Demand Forecast: 2012-2022," 2011

[7] Median from literature review analysis

[8] Numbers artificially low from rounding

[9] Numbers artificially low from rounding

[10] ARB's Updated Economic Analysis, March 2010

[11] PG&E, "Carbon Footprint Calculator Assumptions," 2007

[12] U.S. Energy Information Administration, "Annual Energy Outlook 2012 Early Release," 2012

Appendix E-3
Emissions Cap

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Base Emissions Cap on Natural Gas[13] (Million Tons)						48.1	46.6	45.2	43.9	42.5	41.3
BAU Total Natural Gas Emissions (Million Tons)						50.0	50.4	50.8	51.2	51.7	52.1
Prior Year times 1%						x 1%					
Reductions from Additional Efficiency (Million Tons)						0.5	0.5	0.5	0.5	0.5	0.5
Multiply for Total Amount of Offsets by Statutory Rate[14]						x 8%					
Total Amount of Offsets (Millions)						3.8	3.7	3.6	3.5	3.4	3.3
Subtract Cap, Additional Efficiency, Offsets from Scenario Total for Base Emissions Reductions Required						-					
Shift from Prior Over/Under Compliance (Million Tons)						-2.6	-2.6	-2.6	-0.7	-0.7	-0.7
Add Shift to Base Reduction						+					
Final Emissions Cap on Natural Gas (Million Tons)						54.5	53.0	51.5	48.0	46.6	45.3
Cost of Reductions[15] ($/ton)						$8.7	$10.0	$11.2	$13.8	$15.0	$16.2
Multiply Cost of Reductions by Reductions for Total Cost						x					
Scenario Natural Gas Cost of Reductions[16]						$0.0	$0.0	$0.0	$0.1	$0.1	$0.2
Final Emissions Cap on Natural Gas (Million Tons)						54.5	53.0	51.5	48.0	46.6	45.3
Total Amount of Offsets (Millions)						3.8	3.7	3.6	3.5	3.4	3.3
Multiply for Cost of Offsets (in standard $)[17]						$17.38	$18.22	$18.75	$19.29	$19.85	$20.43

13 ARB, AB 32 Scoping Plan, 2008; trajectory set in scoping plan
14 ARB, AB 32 Scoping Plan, 2008
15 Appendix L; half of cost of C&T credit
16 Numbers artificially low from rounding
17 Appendix L

Total Cost of Offsets						$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Subtract Offsets from Emissions for Total Credits						–					
Scenario Total Credits						50.7	49.2	47.9	44.5	43.2	42.0
Multiply for Cost of Credits (in standard $)[18]						$17.41	$19.96	$22.48	$27.59	$30.01	$32.43
Total Cost of Credits						$0.9	$1.0	$1.1	$1.2	$1.3	$1.4
Scenario Freely Allocated Credits						*50.7*	*49.2*	*47.9*	*44.5*	*43.2*	*42.0*
Multiply for Cost of Credits (in standard $)[19]						*$17.41*	*$19.96*	*$22.48*	*$27.59*	*$30.01*	*$32.43*
Total Revenue of Credits						*$0.9*	*$1.0*	*$1.1*	*$1.2*	*$1.3*	*$1.4*
Scenario Natural Gas Reductions						**0.0**	**0.0**	**0.0**	**2.7**	**4.6**	**6.4**
Scenario Natural Gas Costs						**$0.1**	**$0.1**	**$0.1**	**$0.1**	**$0.1**	**$0.2**

[18] Appendix L
[19] Appendix L

Appendix F:
Transportation Fuel Model

(All Dollars in $2012 and $Billions, Unless Otherwise Stated)
Appendix F-1
BAU Projected VMT

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU VMT[20] (millions)			330,976								
Population Growth Rate[21] (%)				0.9	0.8	0.8	1.0	1.0	1.0	0.9	1.0
Growth in VMT[22] (%)				2.2							
Multiply Growth Rates by Existing VMT for Projected VMT	x										
BAU Projected VMT (millions)			**330,976**	**341,133**	**351,578**	**362,317**	**373,886**	**385,790**	**398,036**	**410,352**	**423,594**

[20] U.S. Department of Transportation, Research and Innovative Technology Administration, "State Transportation Facts: California," 2010
[21] California Department of Finance, "Interim Projections of Population for California: State and Counties," May 2012
[22] ARB Updated Economic Analysis, March 2010

Appendix F-2
Scenario Projected VMT

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU VMT[23] (millions)			330,976								
Population Growth Rate[24] (%)				0.9	0.8	0.8	1.0	1.0	1.0	0.9	1.0
Growth in VMT[25] (%)				2.2							
Multiply Growth Rates by Existing VMT for Projected VMT	x										
Scenario GSP[26]	$1,901.1	$1,956.8	$2,014.1	$2,086.9	$2,159.4	$2,233.8	$2,309.3	$2,386.6	$2,466.7	$2,546.4	$2,628.5
BAU GSP[27]	$1,901.1	$1,956.8	$2,014.1	$2,090.2	$2,168.9	$2,250.5	$2,338.2	$2,429.2	$2,523.5	$2,619.4	$2,722.4
Subtract BAU from Scenario and Divide by BAU for Change in GSP	(Scenario-Prior Year GSP)/Prior Year GSP										
Change in GSP (%)	0.0%	0.0%	0.0%	-0.2%	-0.3%	-0.3%	-0.5%	-0.6%	-0.6%	-0.6%	-0.8%
Multiply by Gasoline Elasticity of Income[28]	x 0.4										
Change in Fuel Price (%)			0.0%	0.7%	1.2%	1.0%	1.7%	1.8%	2.3%	3.3%	4.5%
Multiply by Gasoline Elasticity of Price[29]	x - 0.25										
Subtotal of Scenario VMT (millions)			330,976	336,303	340,844	348,242	352,653	359,392	366,820	375,544	381,950
BAU Projected VMT (millions)			330,976	341,133	351,578	362,317	373,886	385,790	398,036	410,352	423,594
Divide Scenario by BAU VMT for Percentage of Successful SB 375 Implementation (%)			100%	98.6%	96.9%	96.1%	94.3%	93.2%	92.2%	91.5%	90.2%

23 U.S. Department of Transportation, Research and Innovative Technology Administration, "State Transportation Facts: California," 2010
24 California Department of Finance, "Interim Projections of Population for California: State and Counties," May 2012
25 ARB Updated Economic Analysis, March 2010
26 Appendix C
27 Appendix C
28 Appendix L; Median of literature review
29 Median of literature review

SB 375 Base Impact[30] (millions)			0	2,118	4,236	6,354	8,472	10,590	12,708	14,826	16,944
Multiply Implementation Rate by SB 375 Base Impact For Final Impact	x										
SB 375 Final Impact (millions)			0	2,088	4,107	6,107	7,991	9,865	11,711	13,568	15,507
Subtract SB 375 Impact from VMT Subtotal	-										
Scenario Projected VMT (millions)			**330,976**	**334,215**	**336,737**	**342,135**	**344,662**	**349,527**	**355,108**	**361,976**	**366,443**
Subtract BAU from Scenario VMT	-										
Difference in VMT Projections			0	6,919	14,841	20,182	29,224	36,263	42,927	48,376	57,151
Multiply by Transit Leverage Ratio[31] for Transit Replacement	x 33%										
Total Transit Replacement (million passenger miles)			0	2,283	4,897	6,660	9,644	11,967	14,166	15,964	18,860
Multiply by Cost of Transit[32] ($/mile) for Scenario Transit Cost	x $1.04										
Scenario Transit Cost			**$0.0**	**$2.4**	**$5.1**	**$6.9**	**$10.0**	**$12.4**	**$14.7**	**$16.6**	**$19.6**
Multiply by portion of spending remaining in CA for Transit Revenue to CA[33]	x 36%										
Transit Revenue to CA			**$0.0**	**$0.3**	**$0.5**	**$0.8**	**$1.0**	**$1.2**	**$1.4**	**$1.7**	**$1.9**

30 ARB, AB 32 Scoping Plan 2008, straight-lined
31 Newman and Kenworthy, "Sustainability and Cities," 1999
32 National Transit Database, “Total Funding Time Series” and “Service,” 2010
33 Calculated based on National Transit Database, 2010

Appendix F-3

BAU Gas Mileage

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Vehicles in California[34] (millions)			21.0								
Multiply Growth Rate of Vehicles per Year[35] and Add to Total for Projected Vehicles (%)						1.6					
Projected Vehicles (millions)			21.0	21.4	21.7	22.1	22.4	22.8	23.1	23.5	23.9
Multiply Scrappage Rate of Vehicles per Year[36] for Scrapped Vehicles (%)						4.0					
Scrapped Vehicles (millions)			0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Subtract Current Year Scrappage from Previous Projected Vehicles						-					
Annual New Vehicles (millions)			0.9	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4
Divide Annual New Vehicles by Projection for Annual Percentage						÷					
Annual New Vehicles in Projected Fleet (%)			4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Baseline Fleet Fuel Efficiency[37] (miles per gallon)						25.8					
Multiply Percentage of Scrappage by Baseline Fuel Efficiency						-					
Subchange in Fleet Fuel Efficiency from Scrappage (miles per gallon)						1.1					
New Fuel Efficiency[38] (miles per gallon)			25.8	28.2	30.7	33.1	35.5	35.5	35.5	35.5	35.5
Annual New Vehicles in Projected Fleet (%)			4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Multiply Percentage of New Vehicles by New Fuel Efficiency						x					

[34] California Department of Motor Vehicles, "DMV: Year First Sold Report," March 2009, 2010, 2011, 2012

[35] *ibid*

[36] Matches ARB

[37] Calculated based on ARB's Demand in their Updated Economic Analysis in March 2010

[38] Federal Corporate Average Fuel Economy (CAFÉ) Standard, 2009

Subchange in Fleet Fuel Efficiency from New Fuel Efficiency (miles per gallon)			1.1	1.7	1.8	2.0	2.1	2.1	2.1	2.1	2.1
Subtract Scrappage Subchange from New Fuel Efficiency Subchange						-					
Change in Fuel Efficiency (miles per gallon)			0.0	0.5	0.7	0.8	1.0	1.0	1.0	1.0	1.0
Add Change to Previous Year Fuel Efficiency						+					
BAU Fleet Efficiency (miles per gallon)			**25.8**	**26.3**	**27.0**	**27.9**	**28.9**	**29.9**	**30.9**	**31.8**	**32.8**

Appendix F-4

<u>Scenario Gas Mileage</u>

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Vehicles in California[39] (millions)			21.0								
Multiply Growth Rate of Vehicles per Year[40] and Add to Total for Projected Vehicles (%)	1.6										
Scenario Projected VMT (millions)			330,976	334,215	336,737	342,135	344,662	349,527	355,108	361,976	366,443
BAU Projected VMT (millions)			330,976	341,133	351,578	362,317	373,886	385,790	398,036	410,352	423,594
Subtract BAU from Scenario VMT and divide by BAU	(Scenario-BAU)/BAU										
Shift in Vehicle Demand to Lost VMT (%)			0.0%	2.0%	4.2%	5.6%	7.8%	9.4%	10.8%	11.8%	13.5%
Projected Vehicles (millions)			21.0	21.4	21.6	21.9	22.1	22.3	22.5	22.8	23.0
Multiply Scrappage Rate of Vehicles per Year[41] for Scrapped Vehicles (%)	4.0										
Scrapped Vehicles (millions)			0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
Subtract Current Year Scrappage from Previous Projected Vehicles	-										
Subtotal of Annual New Vehicles (millions)			0.9	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4
Multiply the Annual Subtotal by the Shift in Demand from Lost VMT and add Back to the Subtotal Figure	(Annual New Vehicles x Shift in Demand) + Annual New Vehicles										
Total Annual New Vehicles (millions)			0.9	1.3	1.3	1.2	1.2	1.2	1.2	1.3	1.2
Divide Annual New Vehicles by Projection for Annual Percentage	÷										
Annual New Vehicles in Projected Fleet (%)			4.5%	5.9%	5.8%	5.7%	5.6%	5.5%	5.4%	5.8%	5.2%

39 California Department of Motor Vehicles, "DMV: Year First Sold Report," March 2009, 2010, 2011, 2012

40 *ibid*

41 California Department of Motor Vehicles, "DMV: Year First Sold Report," March 2009, 2010, 2011, 2012

Baseline Fleet Fuel Efficiency[42] (miles per gallon)	25.8									
Multiply Percentage of Scrappage by Baseline Fuel Efficiency	-									
Subchange in Fleet Fuel Efficiency from Scrappage (miles per gallon)	1.1									
New Fuel Efficiency[43] (miles per gallon)			25.8	28.2	30.7	33.1	35.5	37.6	39.7	41.8	43.9
Annual New Vehicles in Projected Fleet (%)			4.5%	5.9%	5.8%	5.7%	5.6%	5.5%	5.4%	5.8%	5.2%
Multiply Percentage of New Vehicles by New Fuel Efficiency	-									
Subchange in Fleet Fuel Efficiency from New Fuel Efficiency (miles per gallon)			1.1	1.7	1.8	1.9	2.0	2.1	2.1	2.4	2.3
Subtract Scrappage Subchange from New Fuel Efficiency Subchange	-									
Change in Fuel Efficiency (miles per gallon)			0	0.5	0.6	0.7	0.8	0.9	1.0	1.3	1.2
Add Change to Previous Year Fuel Efficiency	+									
Scenario Fleet Efficiency (miles per gallon)			**25.8**	**26.3**	**26.9**	**27.7**	**28.5**	**29.4**	**30.4**	**31.7**	**32.9**
Annual New Vehicles in Projected Fleet (%)			4.5%	5.9%	5.8%	5.7%	5.6%	5.5%	5.4%	5.8%	5.2%
Additional Cost Per Vehicle[44] (in standard $)								$151	$342	$566	$820
Scenario Total Vehicle Cost								**$0.0**	**$0.1**	**$0.3**	**$0.5**

[42] Matches ARB
[43] Federal Corporate Average Fuel Economy (CAFÉ) Standard, 2011; supersedes Pavley II standard
[44] National Highway Traffic Safety Administration, "Corporate Average Fuel Economy for MY 2017-MY 2025 Passenger Cars and Light Trucks: Preliminary Regulatory Impact Analysis," 2011

Appendix F-5

Diesel Fuel Efficiency

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU Effective Fuel Efficiency[45] (miles per gallon)						**5.0**					
Scenario Effective Fuel Efficiency[46] (miles per gallon)			**5.0**	**5.0**	**5.0**	**5.0**	**5.1**	**5.1**	**5.2**	**5.2**	**5.3**
Total Number of Trucks in California[47] (millions)			0.8								
Growth Rate for Trucks[48] (%)						2.8					
Multiply Growth Rate for Projected Trucks						X					
Projected Trucks (millions)			0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0
Scrappage Rate for Diesel Trucks[49] (%)						2.3					
Scrapped Diesel Trucks				18,906	19,440	19,990	20,555	21,137	21,735	22,349	22,981
Subtract Current Year Scrappage from Previous Projected Vehicles						-					
Annual New Diesel Trucks				41,036	42,197	43,390	44,617	45,879	47,177	48,511	49,883
Additional Cost Per Vehicle[50] (in standard $)					$6436	$6278	$6070	$6857	$6645	$6533	$6420
Multiply New Trucks by Cost Per Vehicle for Total Additional Cost						X					
Total Additional Cost for Diesel Trucks					**$0.3**	**$0.3**	**$0.3**	**$0.3**	**$0.3**	**$0.3**	**$0.3**

[45] National Highway Traffic Safety Administration, "Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards For Medium and Heavy-Duty Engines and Vehicles; Regulatory Impact Analysis," 2011

[46] National Highway Traffic Safety Administration, "Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards For Medium and Heavy-Duty Engines and Vehicles; Regulatory Impact Analysis," 2011

[47] California Department of Motor Vehicles, "DMV: Year First Sold Report," March 2009, 2010, 2011, 2012

[48] *ibid*

[49] *ibid*

[50] National Highway Traffic Safety Administration, "Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards For Medium and Heavy-Duty Engines and Vehicles; Regulatory Impact Analysis," 2011

Scenario Total Vehicle Cost								$0.0	$0.1	$0.3	$0.5
Add Total Vehicle Cost to Total Diesel Cost						+					
Total Additional Capital Cost					$0.3	$0.3	$0.3	$0.3	$0.4	$0.6	$0.8
						3%					
						x					
Vehicle Revenue to CA[51]					**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**	**$0.0**

Appendix F-6
BAU Gasoline Fuel Costs and Emissions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU Projected VMT (millions)			330,976	341,133	351,578	362,317	373,886	385,790	398,036	410,352	423,594
BAU Fleet Efficiency (miles per gallon)			25.8	26.3	27.0	27.9	28.9	29.9	30.9	31.8	32.8
Divide Fleet Efficiency into VMT for Demand						÷					
BAU Demand (million gallon equivalents)			12,829	12,946	12,999	12,992	12,948	12,918	12,902	12,888	12,904
Percentage of Demand from Corn-based Ethanol (%)						10.0					
Multiply Demand by Corn Ethanol for Corn Ethanol Consumption						x					
BAU Corn-based Ethanol Consumption (million gallons)			1,283	1,295	1,300	1,299	1,295	1,292	1,290	1,289	1,290
Corn Ethanol Price[52] ($/gallon)			$4.0	$3.1	$3.2	$3.9	$3.9	$4.0	$4.0	$4.0	$4.0
Multiply Price by Consumption for Total Cost						x					
BAU Total Corn-based Ethanol Cost			$5.1	$4.0	$4.1	$5.1	$5.0	$5.1	$5.1	$5.1	$5.1

[51] Total artificially low due to rounding
[52] U.S. Energy Information Administration, "Annual Energy Outlook," 2011

Emissions Rate[53] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions						x					
BAU Total Corn-based Ethanol Emissions (Million Tons)			17.9	17.8	17.7	17.5	17.3	17.1	16.9	16.7	16.6
Percentage of Demand from Gasoline (%)						90.0					
Multiply Demand by Gasoline for Gasoline Consumption						x					
BAU Gasoline Consumption (million gallons)			11,546	11,652	11,699	11,693	11,653	11,627	11,611	11,599	11,613
Gasoline Price[54] ($/gallon)			$3.0	$3.2	$3.3	$3.4	$3.4	$3.5	$3.5	$3.6	$3.6
Multiply Price by Consumption for Total Cost						x					
BAU Total Gasoline Cost			$34.8	$37.0	$38.2	$39.2	$39.6	$40.4	$41.0	$41.4	$41.9
Emissions Rate[55] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions						x					
BAU Total Gasoline Emissions (Million Tons)			161.0	162.5	163.2	163.1	162.5	162.2	162.0	161.8	162.0
Add Total Costs						+					
BAU Total Fuel Costs			**$46.7**	**$48.0**	**$49.2**	**$50.9**	**$50.7**	**$51.2**	**$51.0**	**$50.7**	**$50.2**
Add Total Emissions						+					
BAU Total Fuel Emissions (Million Tons)			**178.9**	**180.4**	**180.9**	**180.6**	**179.9**	**179.3**	**178.9**	**178.5**	**178.6**

[53] ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011
[54] U.S. Energy Information Administration, "Annual Energy Outlook," 2011
[55] ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011

Appendix F-7

Scenario Gasoline Fuel Costs and Emissions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario Projected VMT (millions)			330,976	334,215	336,737	342,135	344,662	349,527	355,108	361,976	366,443
Scenario Fleet Efficiency (miles per gallon)			25.8	26.3	26.9	27.7	28.5	29.4	30.4	31.7	32.9
Divide Fleet Efficiency into VMT for Demand	÷										
Scenario Demand (million gallon equivalents)			12,829	12,699	12,500	12,362	12,091	11,881	11,676	11,417	11,153
U.S. Production of Second Generation Biofuels[56] (million gallon equivalents)			175	302	458	639	840	1,333	2,033	3,006	4,446
Consumed in CA[57]			0	127	229	320	420	666	1,016	1,485	1,944
Divide Second Gen Fuels by Scenario Demand for Percentage	÷										
Percent of Demand from Second Generation Biofuels			0.0%	1.0%	1.8%	2.6%	3.5%	5.6%	8.7%	13.0%	17.4%
Static Second Gen Fuels Price[58] ($/gallon)			$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3	$5.3
Multiply Improvement in Second Generation Ethanol Pricing[59] (%)	x 2.0										
Second Generation Ethanol Price ($/gallon)			$5.3	$5.2	$5.1	$5.0	$4.9	$4.8	$4.7	$4.6	$4.5
Multiply Price by Consumption for Total Cost	X										
Scenario Total Second Gen Fuel Cost			$0.0	$0.7	$1.2	$1.6	$2.1	$3.2	$4.8	$6.9	$8.8
Emissions Rate[60] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions	X										

56 Defined as 575% of OECD: with half delivered to CA, approximates ARB's projected availability
57 Up to half of U.S. production, capped at volume needed to meet LCFS
58 Eggert, H., Greaker, M., Potter, E., "Policies for Second Generation Biofuels: Current Status and Future Challenges," 2011
59 Appendix L
60 ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011

Scenario Total Second Gen Fuel Emissions (Million Tons)			0.0	0.9	1.5	2.1	2.7	4.2	6.3	9.0	11.5
Imported Ethanol Needed to Meet Standard (million gallon equivalents)			0.0	0.0	32.8	76.9	332.5	220.3	81.4	0.0	0.0
Divide Imported Ethanol by Scenario Demand for Percentage	÷										
Percent of Demand from Imported Ethanol			0.0%	0.0%	0.3%	0.6%	2.7%	1.9%	0.7%	0.0%	0.0%
Imported Ethanol Price ($/gallon)[61]			$4.48	$4.52	$4.57	$4.61	$4.65	$4.70	$4.74	$4.78	$4.83
Multiply Price by Consumption for Total Cost	X										
Scenario Total Imported Ethanol Cost			$0.0	$0.0	$0.1	$0.4	$1.5	$1.0	$0.4	$0.0	$0.0
Emissions Rate[62] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions	X										
Scenario Total Imported Ethanol Emissions (Million Tons)			0.0	0.0	0.4	0.8	3.6	2.4	0.9	0.0	0.0
Subtract Percent of Demand for Second Gen Fuel and Imported Ethanol from 10% Blend Level	-										
Percentage of Demand from Corn-based Ethanol (%)			10.0%	9.0%	7.9%	6.8%	3.8%	2.5%	0.6%	0.0%	0.0%
Multiply Demand by Corn Ethanol for Corn Ethanol Consumption	X										
Scenario Corn-based Ethanol Consumption (million gallons)			1,283	1,142	988	840	456	301	70	0	0
Corn Ethanol Price[63] ($/gallon)			$4.0	$3.1	$3.2	$3.9	$3.9	$4.0	$4.0	$4.0	$4.0
Multiply Price by Consumption for Total Cost	X										
Scenario Total Corn-based Ethanol Cost			$5.1	$3.6	$3.1	$3.3	$1.8	$1.2	$0.3	$0.0	$0.0
Emissions Rate[64] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

[61] Appendix O Assumptions
[62] ARB, “Proposed Changes to the LCFS Lookup Tables as of February 24, 2011,” 2011
[63] U.S. Energy Information Administration, “Annual Energy Outlook,” 2011
[64] ARB, “Proposed Changes to the LCFS Lookup Tables as of February 24, 2011,” 2011

Multiply Rate by Consumption for Total Emissions	X										
Scenario Total Corn-based Ethanol Emissions (Million Tons)			17.9	15.7	13.5	11.3	6.1	4.0	0.9	0.0	0.0
Percentage of Demand from Gasoline (%)			90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	87.0%	82.6%
Multiply Demand by Gasoline for Gasoline Consumption	X										
Scenario Gasoline Consumption (million gallons)			11,546	11,429	11,250	11,125	10,881	10,693	10,508	9,931	9,209
Gasoline Price[65] ($/gallon)			$3.0	$3.2	$3.3	$3.4	$3.4	$3.5	$3.5	$3.6	$3.6
Multiply Price by Consumption for Total Cost	X										
Scenario Total Gasoline Cost			$34.8	$36.3	$36.7	$37.3	$37.0	$37.2	$37.1	$35.5	$33.3
Emissions Rate[66] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions	X										
Scenario Total Gasoline Emissions (Million Tons)			161.0	159.4	156.9	155.2	151.8	149.1	146.6	138.5	128.4
Add Total Costs	+										
Scenario Total Fuel Costs			**$39.9**	**$41.1**	**$42.2**	**$44.1**	**$44.4**	**$45.2**	**$45.7**	**$46.1**	**$46.5**
Add Total Emissions	+										
Scenario Total Fuel Emissions (Million Tons)			**178.5**	**176.2**	**172.6**	**169.8**	**164.4**	**159.9**	**154.7**	**147.5**	**140.0**
Multiply for Cost of Credits (in standard $)[67]				$16.58	$18.95	$17.41	$19.96	$22.48	$27.59	$30.01	$32.43
Total Cost of Credits				$2.9	$3.3	$3.0	$3.3	$3.6	$4.3	$4.4	$4.5
Scenario Freely Allocated Credits (millions)				*176.2*	*172.6*	*169.8*	*164.4*	*159.9*	*154.7*	*147.5*	*140.0*

65 U.S. Energy Information Administration, "Annual Energy Outlook," 2011
66 ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011
67 Appendix L

Multiply for Revenue from Free Credits (in standard $)[68]				*$16.58*	*$18.95*	*$17.41*	*$19.96*	*$22.48*	*$27.59*	*$30.01*	*$32.43*
Total Revenue of Credits				*$2.9*	*$3.3*	*$3.0*	*$3.3*	*$3.6*	*$4.3*	*$4.4*	*$4.5*
Scenario Cost of Credits			$0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

[68] Appendix L

Appendix F-8

BAU Diesel Fuel Costs and Emissions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU Demand[69] (million gallon equivalents)			3,370	3,445	3,565	3,655	3,730	3,795	3,875	3,940	4,010
BAU Effective Fuel Efficiency[70] (miles per gallon)						5.0					
Multiply Demand by Fuel Efficiency for Projected VMT						x					
BAU Projected VMT (millions)			16,601	17,054	17,649	18,094	18,465	18,787	19,183	19,505	19,851
BAU Biodiesel Consumption[71] (million gallons)						6.0					
Biodiesel Price[72] ($/gallon)			$4.4	$4.5	$4.5	$4.6	$4.8	$4.9	$5.1	$5.2	$5.3
Multiply Price by Consumption for Total Cost						x					
BAU Total Biodiesel Cost			$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03	$0.03
Emissions Rate[73] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions						x					
BAU Total Biodiesel Emissions (Million Tons)			0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Subtract Biodiesel Consumption from Total Demand for Diesel						÷					
BAU Diesel Consumption (million gallons)			3,370	3,445	3,565	3,655	3,730	3,795	3,875	3,940	4,010
Diesel Price[74] ($/gallon)			$2.9	$3.0	$3.0	$3.1	$3.2	$3.3	$3.4	$3.5	$3.5

69 ARB, “Low Carbon Fuel Standard 2011 Program Review Report: Final Draft,” 2011; Midpoint of high and low demand projections

70 National Highway Traffic Safety Administration, “Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards For Medium and Heavy-Duty Engines and Vehicles; Regulatory Impact Analysis,” 2011

71 ARB, “Low Carbon Fuel Standard 2011 Program Review Report: Final Draft,” 2011

72 California Energy Commission, “Low Carbon Fuel Standard Analysis and Compliance Costs,” 2011

73 ARB, “Proposed Changes to the LCFS Lookup Tables as of February 24, 2011,” 2011

74 U.S. Energy Information Administration, “Annual Energy Outlook,” 2011

Multiply Price by Consumption for Total Cost						x				
BAU Total Diesel Cost			$9.8	$10.2	$10.8	$11.3	$11.9	$12.5	$13.1	$13.7	$14.1
Diesel Emissions Rate[75] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions						x				
BAU Total Diesel Emissions (Million Tons)			46.4	47.5	49.1	50.4	51.4	52.3	53.4	54.3	55.3
Add Total Costs						+				
BAU Total Diesel Fuel Costs			**$9.9**	**$10.2**	**$10.8**	**$11.3**	**$11.9**	**$12.5**	**$13.1**	**$13.7**	**$14.2**
Add Total Emissions						+				
BAU Total Diesel Fuel Emissions (Million Tons)			**46.5**	**47.6**	**49.2**	**50.4**	**51.5**	**52.4**	**53.5**	**54.4**	**55.3**

Appendix F-9
Scenario Diesel Fuel Costs and Emissions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Initial Scenario Demand (million gallon equivalents)			3,370								
Prior Year Total Scenario Demand				3,370	3,424	3,497	3,518	3,504	3,483	3,492	3,504
Add Annual Percentage Change in BAU (%)				+ 2.2	+ 3.5	+ 2.5	+ 2.1	+ 1.7	+ 2.1	+ 1.7	+ 1.8
Subtotal of Scenario Demand (million gallon equivalents)			3,445	3,543	3,586	3,590	3,565	3,556	3,550	3,566	3,445
Change in Price (%)			2.4%	4.8%	7.0%	9.0%	8.3%	6.3%	4.2%	5.2%	6.5%
Multiply by Diesel Demand Elasticity of Price[76]						x 0.25					
Multiply Change in GSP by Diesel Demand Elasticity of Income[77]						x 0.4					

[75] ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011
[76] Appendix L
[77] Appendix L

Total Scenario Demand (million gallon equivalents)			3,370	3,424	3,497	3,518	3,504	3,483	3,492	3,504	3,510
Scenario Effective Fuel Efficiency[78] (miles per gallon)			4.9	5.0	5.0	5.0	5.1	5.1	5.1	5.1	5.1
Multiply Demand by Fuel Efficiency for Projected VMT	x										
Scenario Projected VMT (millions)			16,601	16,950	17,400	17,590	17,696	17,768	17,814	17,879	17,910
Multiply Demand by Biodiesel Blend Wall for Max Biodiesel[79] (%)	X 5.0										
Max Biodiesel (million gallon equivalents)			168.5	171.2	174.9	175.9	175.2	174.1	174.6	175.2	175.5
Biodiesel Price[80] ($/gallon)			$4.4	$4.5	$4.5	$4.6	$4.8	$4.9	$5.1	$5.2	$5.3
Multiply total Biodiesel by Price for Total Cost	x										
Total Cost of Biodiesel			$0.7	$0.8	$0.8	$0.8	$0.8	$0.9	$0.9	$0.9	$0.9
Used Cooking Oil Expended[81] (million gallons)			0.0	0.0	3.0	43.0	68.0	121.0	174.6	175.2	175.5
Emissions Rate[82] (tons/gallon)			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Multiply Rate by Consumption for Total Emissions	x										
Scenario Total Used Cooking Oil Biodiesel Emissions (Million Tons)			0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.4	0.4
Max Biodiesel (million gallon equivalents)			168.5	171.2	174.9	175.9	175.2	174.1	174.6	175.2	175.5
Used Cooking Oil Expended[83] (million gallons)			0.0	0.0	3.0	43.0	68.0	121.0	174.6	175.2	175.5
Subtract Used Cooking Oil Expended from Max Biodiesel for Soy Biodiesel Needed	-										

[78] National Highway Traffic Safety Administration, "Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards For Medium and Heavy-Duty Engines and Vehicles; Regulatory Impact Analysis," 2011
[79] Appendix L
[80] California Energy Commission, "Low Carbon Fuel Standard Analysis and Compliance Costs," 2011
[81] California Energy Commission, "Low Carbon Fuel Standard Analysis and Compliance Costs," 2011; the total is capped at the blend wall
[82] ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011
[83] California Energy Commission, "Low Carbon Fuel Standard Analysis and Compliance Costs," 2011; the total is capped at the blend wall

Soy Biodiesel Needed (million gallons)			34.3	70.4	104.5	132.9	107.2	53.1	0.0	0.0	0.0
Emissions Rate[84] (tons/gallon)			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Multiply Rate by Consumption for Total Emissions	x										
Scenario Total Soy Biodiesel Emissions (Million Tons)			0.4	0.9	1.3	1.6	1.3	0.6	0.0	0.0	0.0
Renewable Diesel Needed[85] (millions gallons)			20.2	41.1	57.3	52.1	73.6	89.3	104.4	169.7	252.9
Emissions Rate[86] (tons/gallon)			0.01	0.01	0.01	0.0	0.0	0.0	0.0	0.0	0.0
Multiply Rate by Consumption for Total Emissions	x										
Scenario Total Renewable Diesel Emissions (Million Tons)			0.1	0.2	0.3	0.2	0.3	0.4	0.4	0.5	0.7
Renewable Diesel Price[87] ($/gallon)			$4.9	$5.0	$5.0	$5.1	$5.2	$5.3	$5.4	$5.5	$5.5
Multiply total Renewable by Price for Total Cost	x										
Total Cost of Renewable Diesel			$0.1	$0.2	$0.3	$0.3	$0.4	$0.5	$0.6	$0.9	$1.4
Add Total Costs	+										
Scenario Total Diesel Fuel Costs			**$10.1**	**$10.7**	**$11.6**	**$12.1**	**$12.4**	**$12.5**	**$12.6**	**$13.1**	**$13.5**
Add Total Emissions	+										
Scenario Total Diesel Fuel Emissions (Million Tons)			**46.2**	**46.7**	**47.5**	**47.3**	**46.6**	**45.6**	**45.0**	**44.4**	**43.5**
Multiply for Cost of Credits (in standard $)[88]				$16.58	$18.95	$17.41	$19.96	$22.48	$27.59	$30.01	$32.43
Total Cost of Credits				$0.8	$0.9	$0.8	$0.9	$1.0	$1.2	$1.3	$1.4
Scenario Freely Allocated Credits (millions)				*46.7*	*47.5*	*47.3*	*46.6*	*45.6*	*45.0*	*44.4*	*43.5*

84 ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011
85 Assumes total volume of renewable diesel is available
86 ARB, "Proposed Changes to the LCFS Lookup Tables as of February 24, 2011," 2011; Emissions rate improves over time—nondescript due to rounding
87 California Energy Commission, "Low Carbon Fuel Standard Analysis and Compliance Costs," 2011
88 Appendix L

Multiply for Revenue from Free Credits (in standard $)[89]				*$16.58*	*$18.95*	*$17.41*	*$19.96*	*$22.48*	*$27.59*	*$30.01*	*$32.43*
Total Revenue of Credits				*$0.8*	*$0.9*	*$0.8*	*$0.9*	*$1.0*	*$1.2*	*$1.3*	*$1.4*
Scenario Cost of Credits			$0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0

[89] Appendix L

Appendix F-10
Scenario Fuel Revenues to CA

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario Change in Petroleum Spending			$0.0	-$0.6	-$1.4	-$1.8	-$2.5	-$3.2	-$3.8	-$5.9	-$8.5
Portion of Petroleum Revenue in State[90]	54%										
Multiply Change in Petroleum Spending by Portion in State for Change in Revenue to CA	x										
Change in Petroleum Revenue to CA			$0.0	-$0.3	-$0.7	-$1.0	-$1.4	-$1.7	-$2.1	-$3.2	-$4.6
Scenario Change in Yellow Grease Biodiesel Spending			$0.0	$0.0	$0.0	$0.2	$0.3	$0.6	$0.9	$0.9	$0.9
Portion of Yellow Grease Biodiesel Revenue in State	100%										
Multiply Change in Yellow Grease Biodiesel Spending by Portion in State for Change in Revenue to CA	x										
Change in Yellow Grease Biodiesel Revenue to CA			$0.0	$0.0	$0.0	$0.2	$0.3	$0.6	$0.9	$0.9	$0.9
Scenario Change in Other Renewable Spending			$0.2	$1.2	$2.1	$3.0	$4.8	$5.6	$6.6	$8.7	$11.1
Portion of Other Renewable Revenue in State	11%										
Multiply Change in Other Renewable Spending by Portion in State for Change in Revenue to CA	x										
Change in Other Renewable Revenue to CA			$0.0	$0.1	$0.2	$0.3	$0.5	$0.6	$0.7	$1.0	$1.2
Add change in revenue from petroleum, Yellow Grease Biodiesel and Other Renewable for Total Change in Transportation Fuel Revenue	+										
Total Change in Transportation Fuel Revenue			**$0.1**	**-$0.2**	**-$0.5**	**-$0.4**	**-$0.5**	**-$0.5**	**-$0.4**	**-$1.3**	**-$2.5**

90 Assumes 38% of crude oil cost stays in state and 100% of refining and distribution costs and California fees and taxes stay in state

Appendix G:
Water Model

(All Dollars in $2012 and $Billions, Unless Otherwise Stated)
Appendix G-1
Water Usage & Costs

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Energy Usage from Identified Sources[1] (GWh)			23,729	23,729	23,729	23,729	23,729	23,729	23,729	23,729	23,729
Total Water Usage[2] (million acre feet)			41	41	42	42	42	43	43	42	44
Total Water from Identified Sources[3] (million acre feet)			25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
Divide Usage from Identified Sources for Project Energy Usage	÷										
Ratio Between Identified Sources and Usage			1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7
Multiply Ratio with Energy Usage for Total Usage	X										
Total Energy Usage (GWh)			37,262	37,579	37,895	38,212	38,584	38,955	39,326	39,671	40,069
BAU Annual Average Cost of Electricity ($/GWh)			$84,418	$85,509	$86,764	$87,560	$87,982	$88,481	$88,850	$89,597	$90,580
Multiply Average Cost of Electricity by Usage	x										
BAU Total Cost of Energy for Water			**$3.1**	**$3.2**	**$3.3**	**$3.3**	**$3.4**	**$3.4**	**$3.5**	**$3.6**	**$3.6**
Scenario Annual Average Cost of Electricity ($/GWh)			$86,486	$89,297	$90,806	$94,274	$97,014	$100,625	$104,511	$108,295	$112,503
Multiply Average Cost of Electricity by Usage	x										
Scenario Total Cost of Energy for Water			**$3.2**	**$3.4**	**$3.4**	**$3.6**	**$3.7**	**$3.9**	**$4.1**	**$4.3**	**$4.3**

[1] NRDC, “Energy Down the Drain,” 2004; Environmental Working Group, “Power Drain: Big Ag’s $100 Million Energy Subsidy,” 2007
[2] California Department of Water Resources, “20x2020 Water Conservation Plan,” 2010, calculated based on per capita water consumption, prorated based on urban portion of state water
[3] NRDC, “Energy Down the Drain,” 2004; Environmental Working Group, “Power Drain: Big Ag’s $100 Million Energy Subsidy,” 2007

Appendix H:
Non-Utility Industries Model

(All Dollars in $2012 and $Billions, Unless Otherwise Stated)
Appendix H-1
Non-Utility Industries Cost

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU Emissions[195] (Million Tons)			73.7	74.0	74.1	74.1	74.2	74.2	74.2	74.2	74.2
Change in GSP[196] (%)			0.0%	-0.2%	-0.3%	-0.3%	-0.5%	-0.6%	-0.6%	-0.6%	-0.8%
Multiply BAU Emissions by Change in GSP for New Emissions	x										
BAU New Emissions (Million Tons)			73.7	74.0	73.9	73.6	73.3	72.9	72.4	71.9	71.3
Baseline Emissions[197] (Million Tons)			73.7	74.0	74.0	73.8	73.6	73.2	72.8	72.4	72.0
Base Emissions Cap[198] (Million Tons)			36.3	36.3	36.3	73.7	73.7	73.7	73.7	73.7	73.7
Offsets Used[199] (Millions)			36.3	35.6	34.9	70.0	67.9	65.9	63.9	62.0	60.1
Shift from Prior Over/Under Compliance (Million Tons)			0.0	2.8	2.8	5.6	5.4	5.3	5.1	5.0	4.8
Add Credits and Subtract Shift to Calculate Final Emissions Cap	-										
Final Emissions Cap (Million Tons)			36.3	38.4	37.7	79.5	77.3	75.1	70.0	67.9	65.9

195 ARB, "Greenhouse Gas Inventory – 2020 Emissions Forecast," 2010
196 Appendix C
197 First three years does not include refineries (consistent with statute) and the latter years operate at the 2012 initial emissions
198 ARB, AB 32 Scoping Plan, 2008
199 Appendix I

Exempted Refinery Emissions[200] (Million Tons)			37.3	37.3	37.3						
Subtract Cap from BAU Total for Emission Reduction	-										
Scenario Emission Reduction[201] (Million Tons)			**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**2.8**	**4.5**	**6.0**
Cost of Reductions[202] ($/ton)			$0	$8.3	$9.5	$8.7	$10.0	$11.2	$13.8	$15.0	$16.2
Multiply Cost of Reductions by Reductions for Total Cost	x										
Scenario Cost of Reductions			$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$0.1	$0.1
Offsets Used[203] (Millions)				2.8	2.8	5.6	5.4	5.3	5.1	5.0	4.8
Multiply for Cost of Offsets (in standard $)[204]				$16.58	$17.21	$17.41	$18.22	$18.75	$19.29	$19.85	$20.43
Total Cost of Offsets				$0.0	$0.0	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Subtract Offsets from Emissions for Total Credits	–										
Scenario Total Credits (millions)				36.3	38.4	37.7	79.5	77.3	75.1	70.0	67.9
Multiply for Cost of Credits (in standard $)[205]				$16.58	$18.95	$17.41	$19.96	$22.48	$27.59	$30.01	$32.43
Total Cost of Credits				$0.0	$0.6	$0.7	$1.3	$1.4	$1.6	$1.8	$1.9
Scenario Freely Allocated Credits (millions)				*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Multiply for Revenue from Free Credits (in standard $)[206]				*$16.58*	*$18.95*	*$17.41*	*$19.96*	*$22.48*	*$27.59*	*$30.01*	*$32.43*

200 *ibid*
201 2012-2014 totals exempting oil refinery emissions
202 Appendix I
203 Appendix I
204 Appendix L
205 Appendix L
206 Appendix L

Total Revenue of Credits				*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Add Cost of Credits, Cost of Offsets and Cost of Reductions for Total Costs						+					
Scenario Total Costs			**$0.0**	**$0.6**	**$0.7**	**$1.4**	**$1.5**	**$1.7**	**$1.9**	**$2.1**	**$2.2**

Appendix I:
Cap-and-Trade Model

(All Dollars in $2012 and $Billions, Unless Otherwise Stated)
Appendix I-1
Cap-and-Trade Emissions Reductions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BAU Electricity Emissions (Million Tons)[207]			89.4	91.0	92.5	94.0	95.7	97.5	99.2	100.9	102.8
Scenario Electricity Emissions (Million Tons)[208]			87.4	84.0	82.9	79.4	76.1	72.1	67.5	63.8	60.1
Subtract Scenario Emissions from BAU Emissions	-										
Electricity Reductions (Million Tons)				**7.0**	**9.6**	**14.6**	**19.7**	**25.4**	**31.7**	**37.1**	**42.7**
BAU Natural Gas Emissions (Million Tons)[209]			48.7	49.1	49.5	50.0	50.4	50.8	51.2	51.7	52.1
Scenario Natural Gas Emissions (Million Tons)[210]			48.7	49.1	49.5	50.0	50.4	50.8	48.0	46.6	45.3
Subtract Scenario Emissions from BAU Emissions	-										
Natural Gas Reductions (Million Tons)				**0**	**0**	**0**	**0**	**0**	**3.2**	**5.0**	**6.9**
BAU Transportation Emissions (Million Tons)[211]			225.3	227.8	230.0	231.0	231.2	231.6	232.3	232.8	233.8
Scenario Transportation Emissions (Million Tons)[212]			224.7	222.9	220.1	217.1	211.0	205.5	199.7	192.0	183.5
Subtract Scenario Emissions from BAU Emissions	-										

[207] Appendix D
[208] Appendix D
[209] Appendix E
[210] Appendix E
[211] Appendix F; total of gasoline and diesel emissions
[212] Appendix F; total of gasoline and diesel emissions

Transportation Reductions (Million Tons)				**4.9**	**10.0**	**13.9**	**20.2**	**26.1**	**32.6**	**40.8**	**50.3**
BAU Industry Emissions (Million Tons)[213]			73.7	74.0	74.0	73.8	73.6	73.2	72.8	72.4	72.0
Scenario Industry Emissions (Million Tons)[214]			73.7	74.0	74.0	73.8	73.6	73.2	70.0	67.9	65.9
Subtract Scenario Emissions from BAU Emissions	-										
Industry Reductions (Million Tons)				**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**2.8**	**4.5**	**6.0**
Offset Reductions (Million Tons)				**27.4**	**27.0**	**33.2**	**32.1**	**31.1**	**30.0**	**28.8**	**27.6**
Sum of Program Reductions	+										
Total Program Reductions (Million Tons)				39.3	46.6	61.7	72.0	82.6	100.3	116.3	133.4
AB 32 Anticipated Reductions (Million Tons)[215]				18.2	35.7	52.7	69.2	85.6	102.3	118.8	136.5
Subtract Program Reductions from Anticipated Reductions	-										
Over/Under Compliance (Million Tons)				-21.1	-10.9	-9.0	-2.9	3.0	2.0	2.5	3.1
Adjust Future Compliance Periods for prior shifts	Sum of shift from preceding compliance period, divided by three, added to each year in next compliance period										
Shift in Cap-and-Trade reductions in future compliance periods (Million Tons)						-11.3	-11.3	-11.3	-3.0	-3.0	-3.0
Electricity Portion of Emissions[216]			0.57	0.57	0.57	0.36	0.36	0.36	0.36	0.36	0.36
Multiply Shift by Portion of Emissions	x										
Apportion to Electricity (Million Tons)						**-4.8**	**-4.8**	**-4.8**	**-1.2**	**-1.2**	**-1.2**

213 Appendix H
214 Appendix H
215 Appendix I
216 Appendix I; apportioned by share of Baseline Emissions

Industry Portion of Emissions[217]			0.43	0.43	0.43	0.42	0.42	0.42	0.42	0.42	0.42
Multiply Shift by Portion of Emissions	x										
Apportion to Industry (Million Tons)			-	-	-	**-3.9**	**-3.9**	**-3.9**	**-1.0**	**-1.0**	**-1.0**
Natural Gas Portion of Emissions[218]			.22	.22	.22	.22	.22	.22	.22	.22	.22
Multiply Shift by Portion of Emissions	x										
Apportion to Natural Gas (Million Tons)			-	-	-	**-2.6**	**-2.6**	**-2.6**	**-0.7**	**-0.7**	**-0.7**

Appendix I-2
<u>Cap-and-Trade Emissions Reductions</u>

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Base Credit Price[219] (in regular $)				$12.50	$14.29	$16.07	$17.86	$19.64	$21.43	$23.21	$25.00
Adjust for Sustainable Banking[220]	x 1.33										
Total Cap-and-Trade Reductions[221] (Million Tons)				18.2	35.7	52.7	69.2	85.6	102.3	118.8	136.5
Shift in C&T Reductions in Future Compliance Periods (Million Tons)				0	0	-11.3	-11.3	-11.3	-3.0	-3.0	-3.0
Divide Shift in C&T by Total Reductions	÷										
Adjustment for Shift in Reduction Requirement (%)				0	0	-18.4%	-15.7%	-13.7%	-2.9%	-2.5%	-2.2%
Multiply Base Credit Price by Adjustments	Base Credit Price x Adjust for Sustainable Banking x Adjustment for Shift in Reduction Requirement										

217 Appendix I; apportioned by share of Baseline Emissions
218 Appendix I; apportioned by share of Baseline Emissions
219 Appendix L
220 ARB, Updated Economic Analysis, March 2010; average of calculated shifts to account for sustainable banking
221 ARB, Updated Economic Analysis, March 2010

Credit Price (in regular $)				**$16.58**	**$18.95**	**$17.41**	**$19.96**	**$22.48**	**$27.59**	**$30.01**	**$32.43**
Calculate Average Cost of Reductions[222] (%)	x 50.0										
Average Cost of Reductions				**$8.3**	**$9.5**	**$8.7**	**$10.0**	**$11.2**	**$13.8**	**$15.0**	**$16.2**

[222] See Appendix L; half of credit price

Appendix I-3

Cap-and-Trade Offset Reductions

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Multiply Emissions by 8 percent statutory offset limit						x 8%					
Electricity Emissions				84.0	82.9	79.4	76.1	72.1	67.5	63.8	60.1
Electricity Offsets				6.7	6.6	6.4	6.1	5.8	5.4	5.1	4.8
Industry Emissions				35.6	34.9	70.0	67.9	65.9	63.9	62.0	60.1
Industry Offsets				2.8	2.8	5.6	5.4	5.3	5.1	5.0	4.8
Transportation Emissions				222.9	220.1	217.1	211.0	205.5	199.7	192.0	183.7
Transportation Offsets				17.8	17.6	17.4	16.9	16.4	16.0	15.4	14.7
Natural Gas Emissions				49.1	49.5	48.1	46.6	45.2	43.9	42.5	41.3
Natural Gas Offsets				0.0	0.0	3.8	3.7	3.6	3.5	3.4	3.3
Add Offsets						+					
Total Emissions				**495.5**	**492.8**	**484.2**	**472.8**	**461.5**	**449.4**	**436.2**	**422.5**
Total Offsets				**27.4**	**27.0**	**33.2**	**32.1**	**31.1**	**30.0**	**28.8**	**27.6**

Appendix J:
AB 32 Mandates

AB 32 Mandates
Develop and approve a scoping plan for achieving the maximum technologically feasible and cost-effective reductions in GHG emissions by 2020
Appoint an Economic and Technology Advancement Advisory Committee (ETAAC) to provide recommendations for technologies, research and greenhouse gas emission reduction measures
Convene an Environmental Justice Advisory Committee (EJAC) to advise the Board in developing the Scoping Plan and any other pertinent matter in implementing AB 32
Identify the statewide level of GHG emissions in 1990 to serve as the emissions limit to be achieved by 2020
Adopt a regulation requiring the mandatory reporting of GHG emissions;
Identify and adopt regulations for discrete early actions that could be enforceable on or before January 1, 2010
Adopt a regulation that establishes a system of market-based declining annual aggregate emission limits for sources or categories of sources that emit GHG emissions, applicable from January 1, 2012, to December 31, 2020

Appendix K:
Electricity Policy Levers

Police Lever	Δ Price/Unit	Δ Quantity	Δ Emissions Intensity
	Comment	Comment	Comment
RPS	▪ Shifts electricity to more expensive renewables	▪ Lowers demand due to higher costs	▪ Replaces emitting natural gas plants with non-emitting renewables
CHP	▪ Lowers demand for energy from traditional sources, which lowers the price	▪ Lowers demand for energy form traditional sources	▪ Lowers emissions by replacing demand from traditional sources
Efficiency	▪ Lowers demand, which lowers the price	▪ Lowers demand	▪ No impact
C&T	▪ Limited impact, generally not binding due to RPS	▪ Limited impact, generally not binding due to RPS	▪ Limited impact, generally not binding due to RPS

Appendix L:
Natural Gas Policy Levers

Police Lever	Δ Price/Unit	Δ Quantity	Δ Emissions Intensity
	Comment	Comment	Comment
Efficiency	▪ Lowers demand, which impacts price	▪ Lowers demand	▪ No impact
C&T	▪ Mandates reductions and associated payments, which increase price	▪ Increased price may lower demand	▪ Lowers emissions intensity

Appendix M:
Transportation Fuels Policy Levers

Police Lever	Δ Price/Unit	Δ Quantity	Δ Emissions Intensity
	Comment	Comment	Comment
LCFS	▪ Mandates use of fuels that are currently more expensive, increasing price	▪ Increased price may lead to lower demand	▪ Lowers emissions intensity by moving consumption from gasoline to lower intensity fuels
Pavley II	▪ Decreased demand may lower price slightly	▪ Decreases demand due to more fuel efficient vehicles	▪ No impact
VMT (SB 375)	▪ Decreased demand may lower price slightly	▪ Decreases demand due to fewer vehicle miles traveled	▪ No impact
C&T	▪ Mandates lower emissions from fuel production, with associated costs, as well as spending on compliance credits, increasing price	▪ Increased price may lead to lower demand	▪ Lowers emissions intensity by decreasing the emissions of refineries

Appendix N:
Water Policy Levers

Police Lever	Δ Price/Unit	Δ Quantity	Δ Emissions Intensity
	Comment	Comment	Comment
RPS	▪ Shift in electricity price shifts the price for water	▪ Change in price may change consumption, *not modeled*	▪ No impact
CHP	▪ Shift in electricity price shifts the price for water	▪ Change in price may change consumption, *not modeled*	▪ No impact
Efficiency	▪ Shift in electricity price shifts the price for water	▪ Change in price may change consumption, *not modeled*	▪ No impact
C&T	▪ Shift in electricity price shifts the price for water	▪ Change in price may change consumption, *not modeled*	▪ No impact

Appendix O:
Non-Utility Industries Policy Levers

Police Lever	Δ Price/Unit	Δ Quantity	Δ Emissions Intensity
	Comment	Comment	Comment
RPS	▪ Shift in electricity price may impact costs for industry, not modeled	▪ Shift in electricity price may impact costs for industry, *not modeled*	▪ No impact
Efficiency	▪ Shift in electricity price may impact costs for industry, not modeled	▪ Shift in electricity price may impact costs for industry, *not modeled*	▪ No impact
C&T	▪ Mandates reductions and associated payments, which increase price	▪ Increased price may lower demand, *not modeled*	▪ Lowers emissions intensity

Appendix P:
Assumptions

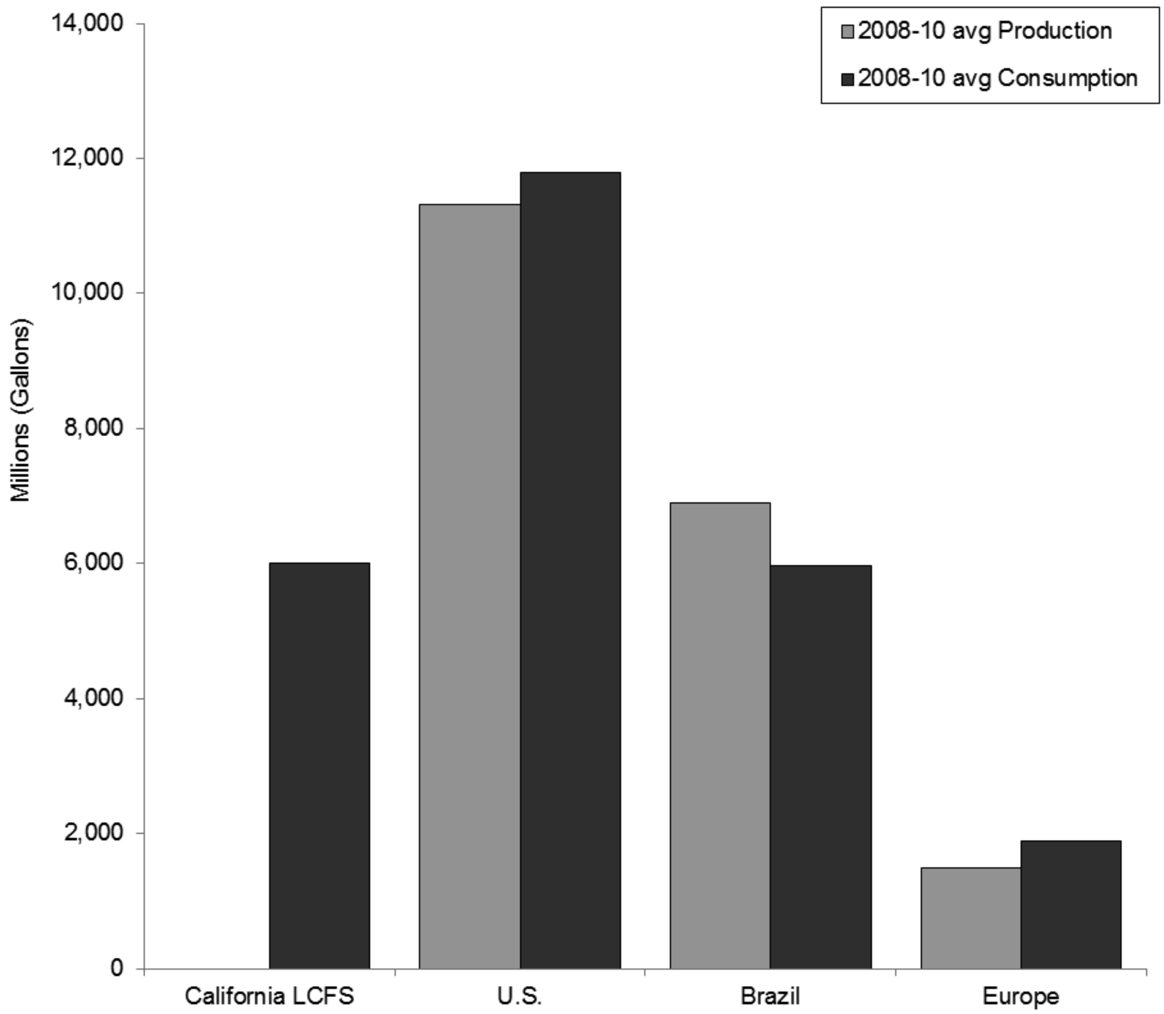
Figure	Assumption ($ in $2012)	Comments
Avg Per Capita Economic Growth '11-12	2.00%	Approximately matches ARB
Avg Per Capita Economic Growth '13-15	2.90%	Approximately matches ARB
Avg Per Capita Economic Growth '16-20	2.90%	Approximately matches ARB
Efficiency Growth	2%	Historical average from 2001-10
Credits (Base Price)	$25	Matches ARB
2012 Offsets Price	$16.25	Current market price
% from Offsets	8%	ARB Scoping Plan
Backup Needed for Renewables	10%	California Public Utilities Commission
Portion of Credits Freely Allocated -- Electricity	100%	As indicated by ARB
Portion of Credits Freely Allocated -- Natural Gas	100%	As indicated by ARB
Portion of Credits Freely Allocated -- Industry	0%	ARB has indicated that the great majority will be auctioned
Current RPS	17%	Estimated from PUC data
Baseline RPS	20%	Preexisting policy
Elasticity of natural gas	0.3	Literature review median
Elasticity of gasoline (Price)	0.25	Literature review median
Elasticity of gasoline (Income)	0.4	Literature review median
Elasticity of diesel (Price)	0.25	Matched to gasoline, due to lack of literature

Elasticity of diesel (Income)	0.4	Matched to gasoline, due to lack of literature
BAU VMT Growth	2.20%	Per ARB
Ethanol Cost Decrease due to investment/technology (annual)	1%	Optimistic assumption
Ethanol Decrease in Carbon Intensity (annual)	1%	Optimistic assumption
Brazilian Ethanol Cost Change (annual)	1%	Optimistic assumption
2nd Gen Cost Decrease due to investment/technology (annual)	2%	Optimistic assumption
2nd Gen Fuels Decrease in Carbon Intensity (annual)	2%	Optimistic assumption
Transportation/Other import costs of BZ Ethanol (per gallon)	$0.16	http://www.dennishalcoussis.com/media/ch2.pdf
Ethanol Energy Percentage	67%	Per ARB
Portion of U.S. 2nd Gen Delivered to CA	50%	Optimistic assumption
New Vehicle Amortization Years	5	Standard loan length
Biodiesel Cost Decrease due to investment/technology (annual)	2%	Optimistic assumption
Biodiesel Decrease in Carbon Intensity (annual)	5%	Optimistic assumption
BAU 2020 Gasoline Ethanol %	10%	Preexisting policy
Surplus Energy Needed	10%	Consistent with recent history
People Per Household	2.89	U.S. Census
Baseline Fleet Fuel Efficiency (mpg)	25.8	ARB
Portion of Marginal Reduction Cost Paid	0.5	Generous estimate
Cost of Transit VMT	$1.04	Calculated from National Transportation Database data

Portion of Lost VMT replaced by Transit	33%	Literature review
Max Biodiesel Blend	5%	Consistent with current warranties
Electric Market Elasticity	0.795	Median of literature review, long run
Availability of 2nd Gen (relative to OECD projection)	575%	Calculated to match ARB
Biodiesel Price Premium	$2.00	Low estimate

Appendix Q:
Low Carbon Fuel Standards

Appendix Q-1
Ethanol 2008-2010 Average Production and Consumption



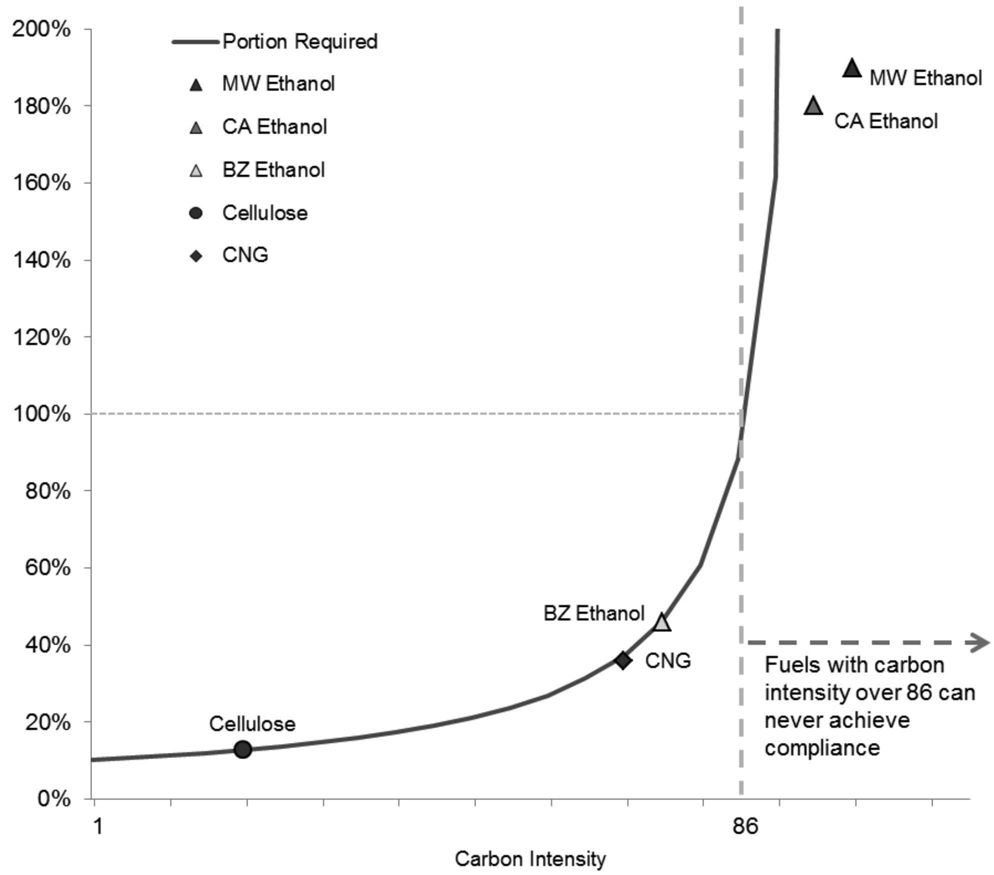
SOURCE: OECD-FAO Agricultural Outlook 2011

Key Observations:

- Ethanol is primarily produced in the United States and Brazil, but Europe, China and Japan are working to develop their capabilities, but are unlikely to have significant capacity by 2020
- Due to expanding demand in Brazil and renewable/low carbon standards world-wide, the ethanol market is projected to be in deficit before accounting for California's low carbon fuel standard
- California's low carbon fuel standard leaves the world ethanol market substantially out of balance
- Only a small portion of America's ethanol production is adequate for California's low carbon fuel standard

Appendix Q-2

Portion of Alternative Fuel Mix Necessary to Meet 2020 Standard



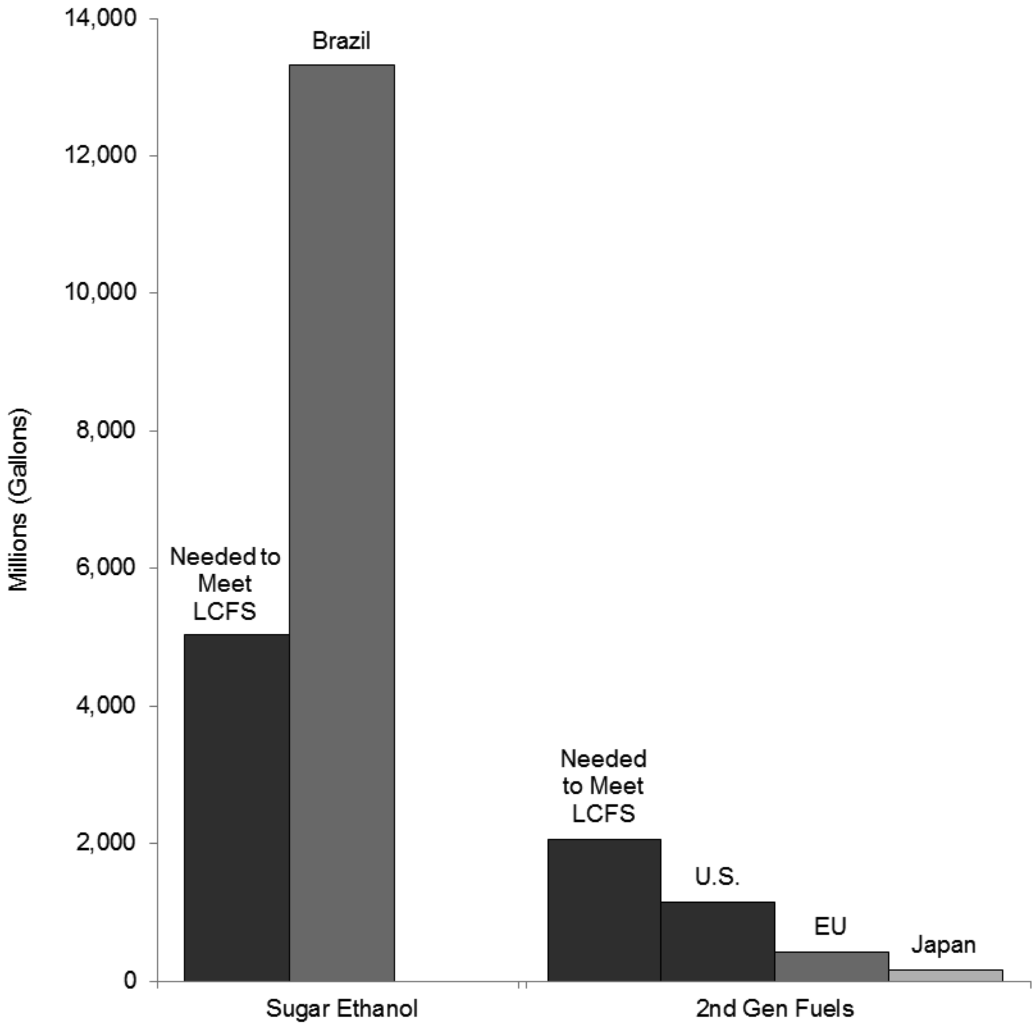
SOURCE: ARB and Farrell Data and Andrew Chang and Co Calculations

Key Observations:

- The only currently commercially available fuel with adequately low carbon intensity is Brazilian ethanol
- California and Midwest ethanol and electricity have carbon intensities above the 2020 standard
- Other potential sources, like cellulose ethanol have lower carbon intensities but are not currently adequately developed to be produced at scale and are unlikely to be adequately implemented by 2020

Appendix Q-3

Ethanol 2020 Projected Production and Consumption

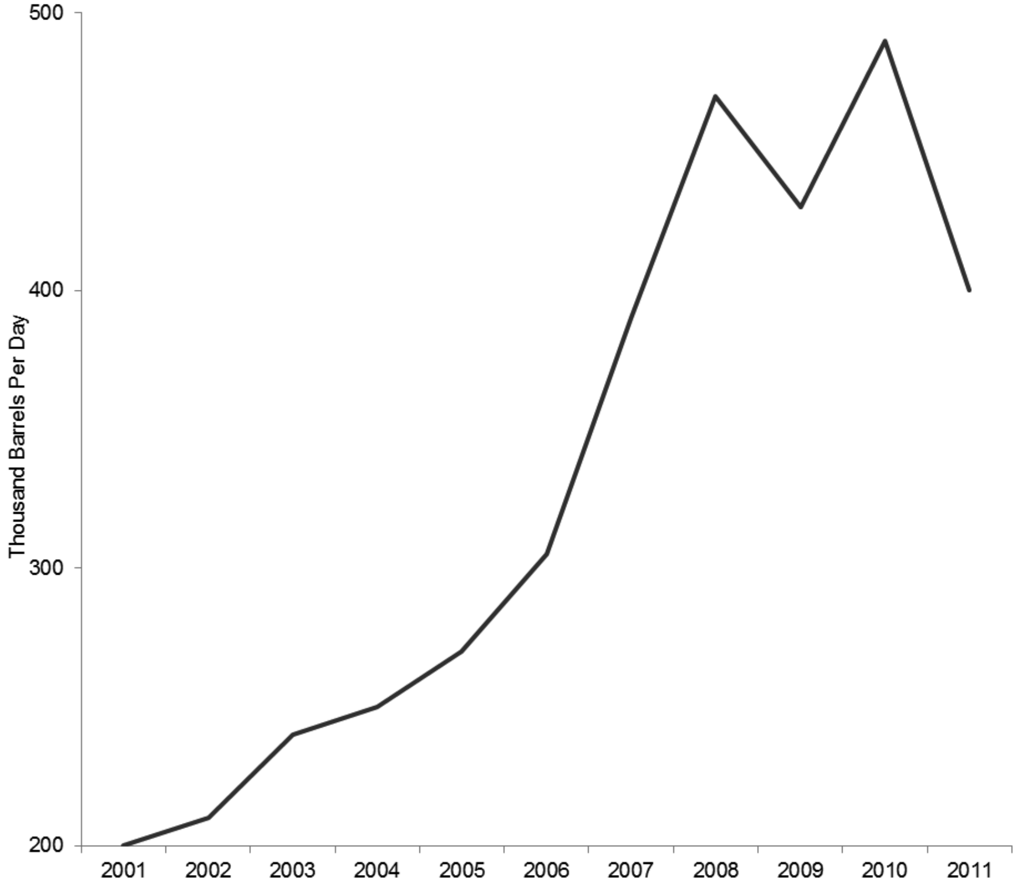


SOURCE: OECD-FAO Agricultural Outlook 2011

Key Observations:

- The Energy Independence and Security Act of 2007 mandates that virtually all of America's 2nd generation fuel supply be consumed by other state
- To date, producers have been completely unable to achieve mandated 2nd generation production, forcing the regulation to be lowered dramatically
- Brazil's demand for transportation fuel is increasing rapidly. Most analysts do not expect ethanol production to meet domestic demand
- Ethanol produced in Europe is needed to fulfill their own mandates

Appendix Q-4
Brazilian Ethanol Production

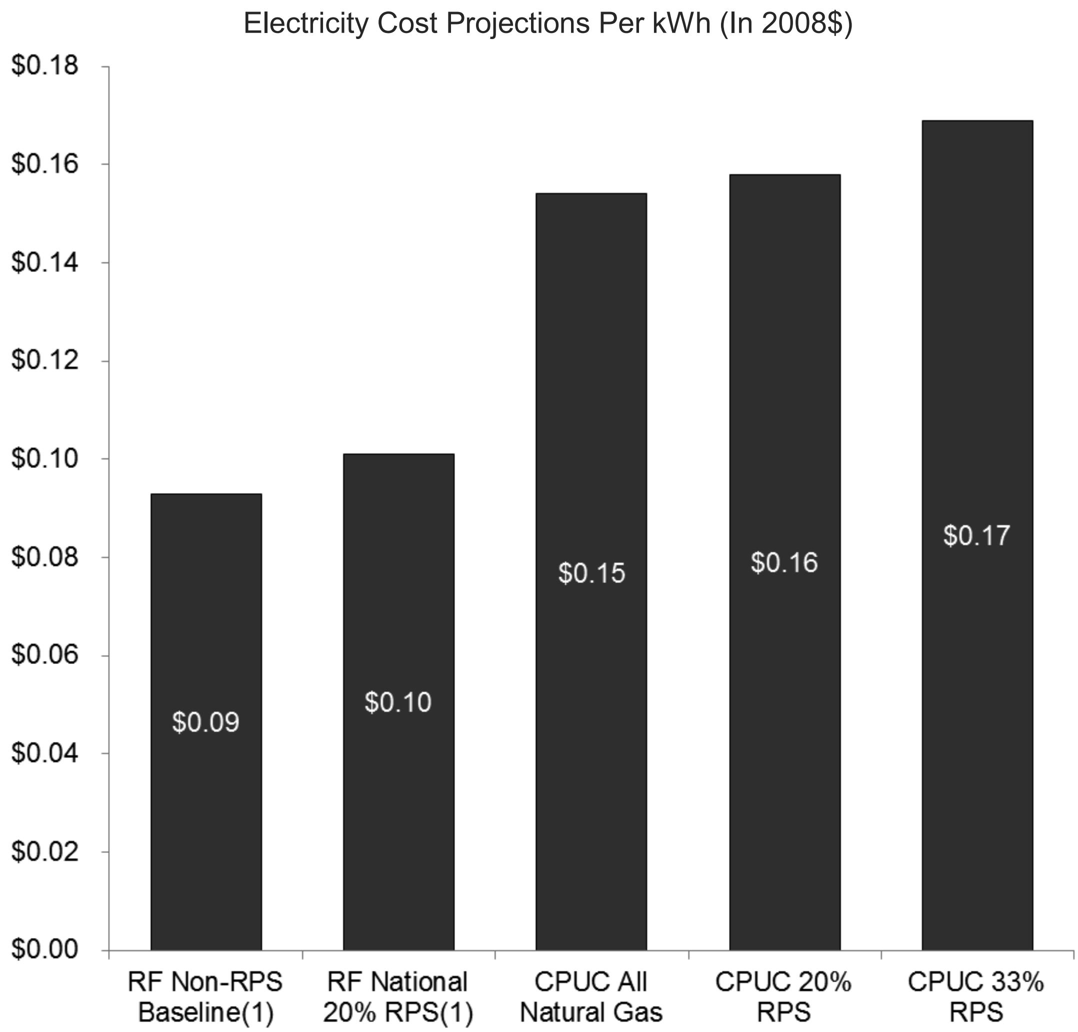


SOURCE: U.S. Energy Information Administration, International Energy Statistics

Key Observations:

- Brazilian ethanol production has grown substantially over time, but has been subject to significant swings from year-to-year
- The volatility of crop production would lead to unstable and unpredictable fuel prices

Appendix R:
Renewable Portfolio Standard



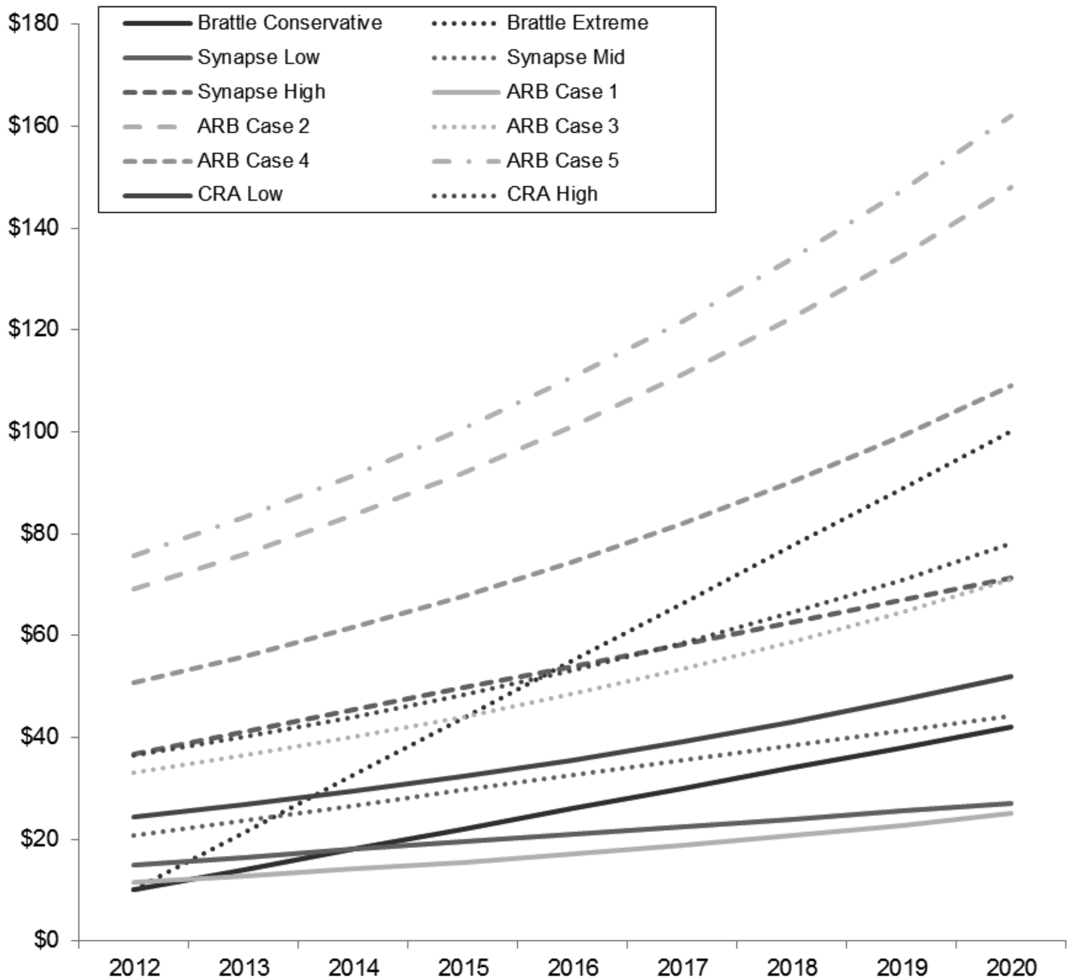
[1] Adjusted for 2008 dollars.

Key Observations:

- The CPUC analysis predicts that by 2020, the cost of a 33 percent RPS standard will be approximately $0.17 per kilowatt-hour in 2008 dollars
- The report itself assumes a 16.7 percent growth in the cost of electricity, regardless of RPS, between 2008 and 2020
- Baseline analysis from the CPUC study also showed higher costs for all-gas production and the existing 20 percent RPS standard
- A national study conducted by Resources for the Future also found that the national cost of energy would increase from a non-RPS baseline in a 20 percent RPS standard

Appendix S:
Cap-and-Trade

Appendix S-1
Price Per Ton Of Carbon Emissions

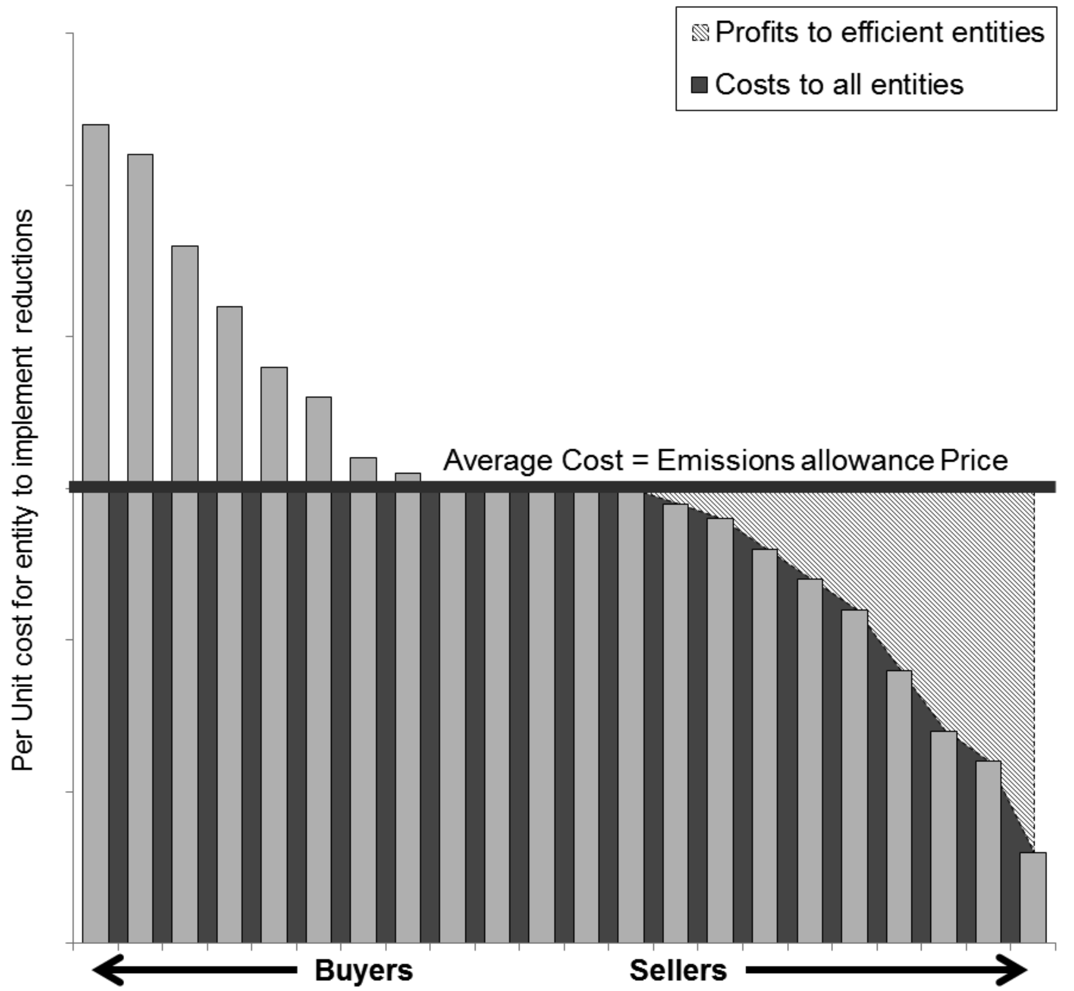


Key Observations:

- In addition to those shown, other analysts project carbon prices to range from negligible to as high as $214
- ARB and CRA scenarios assume 10 percent annual growth rate
- Synapse projections adjusted for AB 32 rollout timeframe

Appendix S-2

Carbon Allowance Model



Key Observations:

- Entities with an above average per unit reduction cost will buy allowances from entities with a below average per unit reduction cost
- The emissions allowance price will naturally be established at the average cost of per unit reductions
- This diagram assumes a static model. In reality, some entities would also produce less or shut down, reducing demand and modestly lowering the allowance price, but also harming the economy and eliminating jobs
- The relative availability of offsets can lower the effective average cost of making reductions

Appendix T:
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The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006

Local Case Studies

June 2012

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The Fiscal and Economic Impact of the
California Global Warming Solutions Act (AB 32): Local Case Studies
(Table of Contents)

The Fiscal and Economic Impact of the California Global Warming Solutions Act (AB 32): Local Case Studies (Key Findings)

- AB 32 will negatively impact local governments by $3.0 billion annually and $18.6 billion cumulatively by 2020.
- AB 32 will reduce local tax revenue by $646.8 million annually in 2020 and $1.9 billion cumulatively by 2020.
- Total local costs for electricity, transportation fuel and water will increase by $2.3 billion annually in 2020 and by $16.7 billion cumulatively by 2020.
- Local governments will face an additional $711.2 million cost annually in 2020 and local schools will have $36.7 million in additional costs in 2020 in the Optimistic Case.
- Additional costs for local water districts due to electricity costs will reach $1.6 billion in the year 2020 for the state in the Optimistic Case.
- The Los Angeles Unified School District will face cumulative costs of $27.3 million, with an annual impact of $5.5 million in 2020, or the equivalent of more than 80 teachers.

1. Introduction

"The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006," by Andrew Chang & Company, LLC measured the total fiscal and economic impacts of AB 32 as it has been specified by the California Air Resources Board. In an effort to highlight the impacts to local governments, this report contains several case studies to isolate the direct fiscal impact to agencies in local government, including city and county governments, school districts, local transit agencies and local water providers.

The main report found that the cumulative GSP loss between 2012 and 2020 will be $85 to $245 billion between the Low and High Case. In the Optimistic Case, the total impacts to California consumers and the economy in the year 2020 are significant:

- Direct cost to California consumers is $35.3 billion
- Net effect on Gross State Product is a 5.6 percent loss with 262,000 jobs lost
- $7.4 billion in lost state and local revenue
- $12.3 billion in lost statewide earnings
- Average family costs of over $2,500 a year, in addition to over $900 in lost annual family earnings

This report details the impacts these policies will have on specific public agencies. This includes the impact of increased commodity costs (electricity, transportation fuel and water) and lost local tax revenue from decreased economic activity. We also illustrate the impact to specific agencies, including the Los Angeles Unified School District (LAUSD).

2. AB 32's Impact on Local Government

AB 32 will increase the cost of electricity, transportation fuel and water for all consumers, including local agencies. Moreover, the economic slowdown caused by AB 32 will reduce the revenues to local governments, such as regional governments, school districts, public transit and local water agencies. The cumulative impact to local public entities from 2012 to 2020 will be $18.6 billion, or the equivalent of the entire collected tax and fee revenues from corporations, tobacco, insurance, alcohol, and motor vehicle fuel statewide in 2010. Table 2.1 details the additional costs and lost revenues resulting from AB 32.

Table 2.1
2012 - 2020 Cumulative Costs of AB 32 to Local Governments
(Optimistic Case)

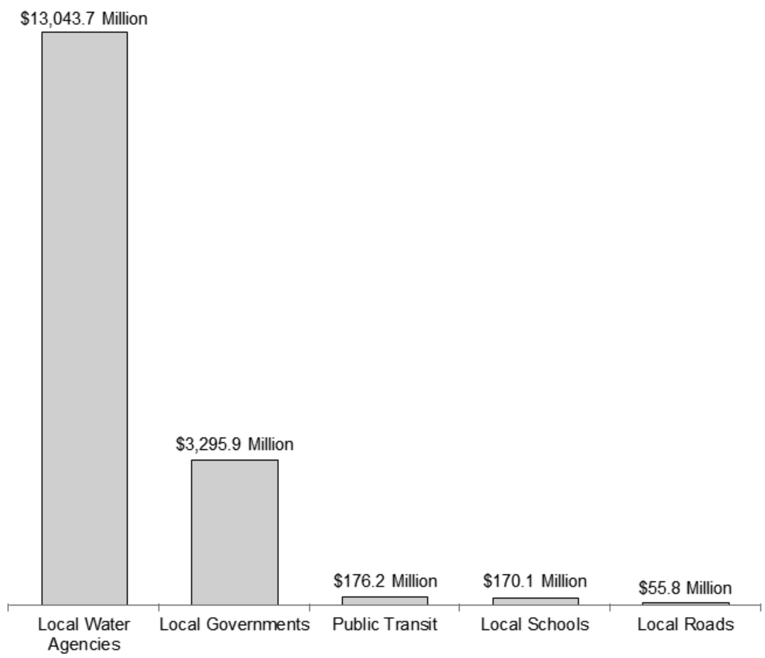
	Electricity	Transport Fuel	Total
Local Water Agencies	$13.0 Billion	n/a	$13.0 Billion
Cities Counties Special Districts	$3.3 Billion	n/a	$3.3 Billion
Public Transit	$27.9 Million	$148.3 Million	$176.2 Million
School Districts	$170.1 Million	n/a	$170.1 Million
Roads	$55.8 Million	n/a	$55.8 Million
Lost Revenue	n/a	n/a	$1.9 Billion
Total	$16.7 Billion	$148.3 Million	$18.6 Billion

SOURCE: U.S. Census Bureau, Table 1. State and Local Government Finances by Level of Government and by State: 2008-09, 2009 Annual Surveys of State and Local Government Finances, October 24, 2011; Main Report, Appendix C, G

Local water authorities will bear cumulative costs amounting to $13.0 billion in 2020, which represents the single greatest cost category. The cumulative costs for electricity to cities, counties and special districts will reach $3.3 billion by 2020, which is nearly the total that all cities in California spent on fire protection and services, special districts spent on waste disposal services, or counties spent on public health in fiscal year 2009-10. The cumulative lost revenue is the third largest cost driver at approximately $1.9 billion.

The increased commodity costs will significantly increase costs for local governments, as shown in Figure 2.1.

Figure 2.1
Cumulative Commodity Cost for Local Entities
(Optimistic Case)

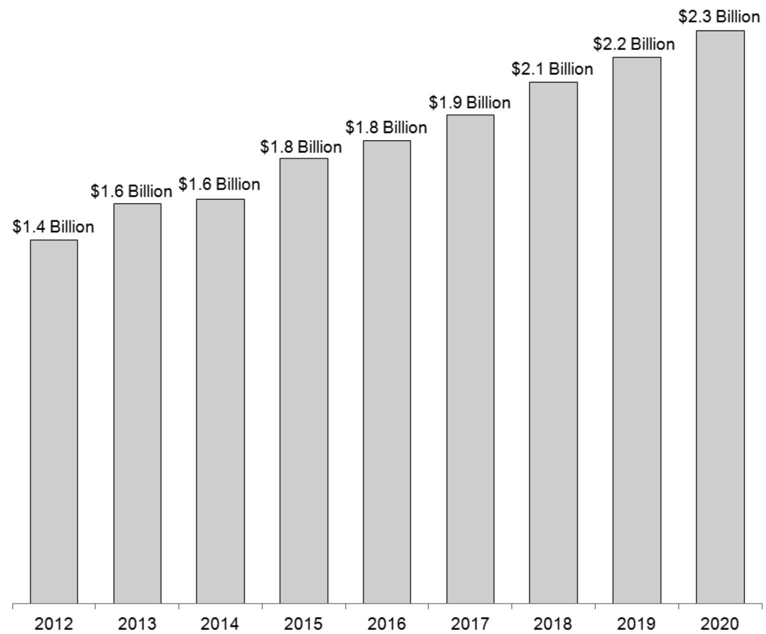


SOURCE: U.S. Census Bureau, Table 1. State and Local Government Finances by Level of Government and by State: 2008-09, 2009 Annual Surveys of State and Local Government Finances, October 24, 2011; California Department of Education, "DataQuest," Educational Demographics Unit, accessed June 2012; California Energy Commission, "California Energy Consumption Database," Energy Consumption Data Management System, accessed June 2012; U.S. Department of Transportation, National Transit Database, Federal Transit Administration, accessed in June 2012

The largest commodity impact comes from the increased cost to local water agencies, with an annual impact of $1.6 billion in 2020 and $13.0 billion impact cumulatively, which is almost double the total operating expense of all state water agencies in 2009-10. Local governments will face an additional $711.2 million cost annually in 2020 and more than $3.3 billion in cumulative costs. Public transit, local schools and local roads will bear $176 million, $170 million and $55 million respectively.

As shown in Figure 2.2, costs grow from $1.4 billion in annual commodity costs in 2012 to $2.3 billion in annual costs by 2020.

Figure 2.2
Annual Commodity Costs for Local Entities
(Optimistic Case)



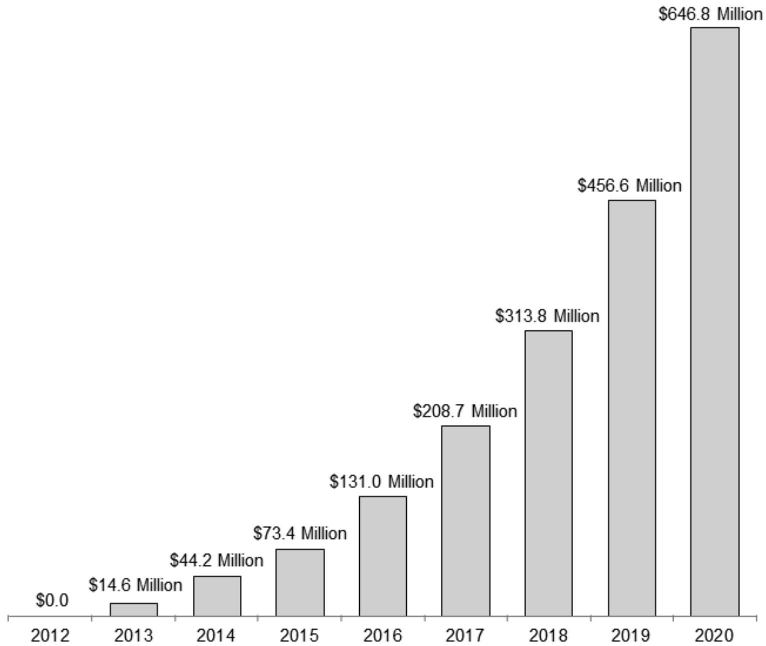
SOURCE: U.S. Census Bureau, Table 1. State and Local Government Finances by Level of Government and by State: 2008-09, 2009 Annual Surveys of State and Local Government Finances, October 24, 2011; California Department of Education, "DataQuest," Educational Demographics Unit, accessed June 2012; California Energy Commission, "California Energy Consumption Database," Energy Consumption Data Management System, accessed June 2012; U.S. Department of Transportation, National Transit Database, Federal Transit Administration, accessed in June 2012

In 2020, annual additional electricity costs will be $765.9 million, $1.6 billion for local water costs and transportation costs in local transit of $25.8 million. The $2.3 billion annual cost in 2020 is approximately the total amount that California cities spent on parks and recreation in 2009-10.

The Impact of AB 32 on the Local Revenues

Lost local revenue in the form of sales and transportation taxes, as well as special districts such as regional governments, will create a significant burden on local governments, as seen in Figure 2.3. The cumulative impact amounts to approximately $1.9 billion by 2020. AB 32 will reduce local tax revenues by over $646.8 million annually by 2020 as well.

Figure 2.3
Lost Local Revenues
(Optimistic Case)



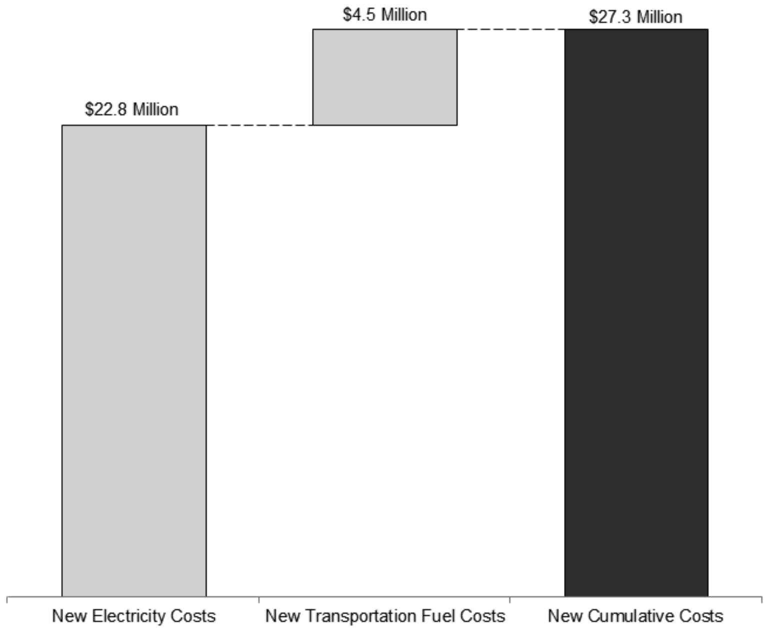
SOURCE: Main Report, Appendix C

This decrease in local revenues offsets gains in local revenue over the previous decade. The cumulative impact of $1.9 billion more than offsets the growth in total California county revenues over a four-year period, from fiscal years 2006-07 to 2009-10.

The Impact of AB 32 on the Los Angeles Unified School District

The Los Angeles Unified School District (LAUSD) is the largest school district in California several times over. During the 2010-11 school year, LAUSD had over 750,000 students and more than 35,900 teachers. More than 1 out of every 10 students in California attended a school in the district.

Figure 2.4
Cumulative Commodity Costs for LAUSD



SOURCE: Los Angeles Unified School District, Public Records Act request, Office of the General Counsel, accessed June 2012

As seen in Figure 2.4, cumulative costs of AB 32 to LAUSD will amount to $27 million by 2020. Costs will be driven by added costs of electricity which will reach $23 million and additional transportation fuel costs which will exceed $4 million. The 2020 annual impact from commodities alone would be the equivalent of the salaries of more than 80 teachers.

The cumulative impact is also the more than the total spending on school librarians, equipment replacement, and buildings and building improvements in fiscal year 2010-11. The annual impact of just new transportation fuel costs alone is more than the annual expenditures on superintendent and food service employee salaries.

Table 2.2
Cumulative Additional Cost for Select Local Agencies

Local Agency	Electricity	Transport Fuel	Total
Chico Unified School District	$0.3 Million	n/a	$0.3 Million
Clovis Unified School District	$1.7 Million	n/a	$1.7 Million
County of Kern	$3.4 Million	n/a	$3.4 Million
County of Humboldt	$0.4 Million	n/a	$0.4 Million
San Diego County Water Authority	$0.4 Million	n/a	$0.4 Million
Bakersfield Fire Department	n/a	$0.2 Million	$0.2 Million
Ventura County Fire Department	n/a	$0.4 Million	$0.4 Million
Total	$6.3 Million	$0.6 Million	$6.8 Million

SOURCE: Chico Unified School District, Electric and Natural Gas Usage 2008-2011, Maintenance, Operations, Transportation, accessed June 2012; County of Kern, Electric and Natural Gas Usage 2009-2011, accessed June 2012; County of Humboldt, Electric and Natural Gas Usage 2008-2011, accessed June 2012; San Diego County Water Authority, Electricty Usage 2009-2011, accessed June 2012; Bakersfield Fire Department, Gasoline and Diesel Usage 2009-2011, accessed June 2012; Ventura Fire Department, Gasoline and Diesel Usage 2009-2011, accessed June 2012

3. Conclusion

The increased cost of commodities coupled with the significant decrease in local revenues from economic loss upon fully implementing AB 32 will create a $18.6 billion cumulative impact to local public entities over the length of the implementation period, with a $3.0 billion impact in the year 2020. It will also reduce local tax revenues by $646.8 million annually in 2020 and $1.9 billion cumulatively in the Optimistic Case.

Local governments will face an additional $711.2 million cost annually in 2020 and local schools will have $36.7 million in additional costs in 2020 in the Optimistic Case. Additional costs for local water districts due to electricity costs will reach $1.6 billion in the year 2020 for the state. Individual state entities will also bear a burden. One such local entity, the Los Angeles Unified School District, will face cumulative costs of $27.3 million with an annual impact of $5.5 million in 202, or the equivalent of more than 80 teachers.

Appendix A:
Electricity Usage

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Additional Electricity Cost per GWh[1] (Real $)	$1,121.2	$2,509.0	$2,300.2	$4,093.2	$4,847.7	$6,117.7	$7,819.1	$9,006.8	$11,313.8
Local Government Total Usage[2] (in GWh)	76,971.7	75,047.4	73,171.2	71,341.9	69,558.4	67,819.4	66,123.9	64,470.8	62,859.0
School District Total Usage[3] (in GWh)	3,971.9	3,872.6	3,775.8	3,681.4	3,589.3	3,499.6	3,412.1	3,326.8	3,243.7
Public Transit Total Usage[4] (in GWh)	651.0	634.8	618.9	603.4	588.3	573.6	559.3	545.3	531.7
Local Roads Total Usage[5] (in GWh)	1,303.9	1,271.3	1,239.5	1,208.5	1,178.3	1,148.9	1,120.1	1,092.1	1,064.8

[1] See Main Report, Appendix D
[2] U.S. Census Bureau, Table 1. State and Local Government Finances by Level of Government and by State: 2008-09, 2009 Annual Surveys of State and Local Government Finances, October 24, 2011
[3] California Department of Education, "DataQuest," Educational Demographics Unit, accessed June 2012; California Department of Education, "Number of Students in Private Schools," Ed-Data, accessed June 2012
[4] U.S. Department of Transportation, National Transit Database, Federal Transit Administration, accessed June 2012
[5] California Energy Commission, "Electricity Consumption by Entity," Energy Consumption Data Management System, accessed June 2012; Department of Transportation, "2010 California Public Road Data," Division of Transportation System Information, October 2011

Appendix B:
Transportation Fuel Usage

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Additional Per Unit Cost per Gallon of Gasoline[6] (Real $)	$ -	$0.04	$0.08	$0.09	$0.16	$0.23	$0.35	$0.54	$0.73
Additional Per Unit Cost per Gallon of Diesel (Real $)	$0.07	$0.15	$0.30	$0.36	$0.35	$0.31	$0.25	$0.30	$0.36
Public Transit Total Usage of Gasoline[7] (in GWh)	53.0	51.7	50.4	49.1	47.9	46.7	45.5	44.4	43.3
Public Transit Total Usage of Diesel[8] (in GWh)	17.4	16.9	16.5	16.1	15.7	15.3	14.9	14.5	14.2

[6] See Main Report, Appendix F
[7] U.S. Department of Transportation, National Transit Database, Federal Transit Administration, accessed June 2012
[8] U.S. Department of Transportation, National Transit Database, Federal Transit Administration, accessed June 2012

Appendix C:
Water[9]

(All Dollars in $2012 and $Millions, Unless Otherwise Stated)

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Energy Usage from Identified Sources (GWh)	23,729	23,729	23,729	23,729	23,729	23,729	23,729	23,729	23,729
Total Water Usage (million acre feet)	41	41	42	42	42	43	43	42	44
Total Water from Identified Sources (million acre feet)	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
Divide Usage from Identified Sources for Project Energy Usage	÷								
Ratio Between Identified Sources and Usage	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7
Multiply Ratio with Energy Usage for Total Usage	x								
Total Energy Usage (GWh)	37,262	37,579	37,895	38,212	38,584	38,955	39,326	39,671	40,069
BAU Annual Average Cost of Electricity ($/GWh)	$84,418	$85,509	$86,764	$87,560	$87,982	$88,481	$88,850	$89,597	$90,580
Multiply Average Cost of Electricity by Usage	x								
BAU Total Cost of Energy for Water ($Millions)	**$3.1**	**$3.2**	**$3.3**	**$3.3**	**$3.4**	**$3.4**	**$3.5**	**$3.6**	**$3.6**
Scenario Annual Average Cost of Electricity ($/GWh)	$85,539	$88,018	$89,064	$91,653	$92,830	$94,599	$96,669	$98,604	$101,893
Multiply Average Cost of Electricity by Usage	x								
Scenario Total Cost of Energy for Water ($Millions)	**$3.2**	**$3.3**	**$3.4**	**$3.5**	**$3.6**	**$3.7**	**$3.8**	**$3.9**	**$4.0**

[9] See Main Report, Appendix G

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The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006

State Case Studies

June 2012

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The Fiscal and Economic Impact of the
California Global Warming Solutions Act (AB 32): State Case Studies
(Table of Contents)

The Fiscal and Economic Impact of the California Global Warming Solutions Act (AB 32): State Case Studies (Key Findings)

- AB 32 will negatively impact the state budget by $7.2 billion annually and $22.1 billion cumulatively by 2020.
- AB 32 will reduce state tax revenues by $6.8 billion annually in 2020 and $19.7 billion cumulatively by 2020.
- Total state costs for electricity, transportation fuel and water will increase by $485.6 million annually in 2020 and by $2.4 billion cumulatively by 2020.
- The State Executive branch and its agencies will have $48.8 million in additional costs in 2020.
- The State Water Project will face an additional $48.1 million cost annually in 2020
- Departments that buy bulk fuel, such as the California Department of Transportation, will face an additional $22.4 million in cumulative costs by 2020.
- The State Center Community College District in Fresno County will face $1.0 million in cumulative increased costs from electricity alone, or an increase of 6.3 percent from their current electricity costs by 2020.
- The California Highway Patrol will bear an additional $5.3 million in costs due to electricity and transportation fuel costs by 2020.

1. Introduction

"The Fiscal and Economic Impact of the California Global Warming Solutions Act of 2006," by Andrew Chang & Company, LLC measured the total fiscal and economic impacts of AB 32 as currently specified by the California Air Resources Board. In an effort to highlight the impacts to state public entities, this report isolates the direct fiscal impact to agencies in state government, including the executive branch of state government, higher education and community colleges.

The main report found that the cumulative GSP loss between 2012 and 2020 will be $85 to $245 billion between the Low and High Case. In the Optimistic Case, the total impacts to California consumers and the economy in the year 2020 are significant:

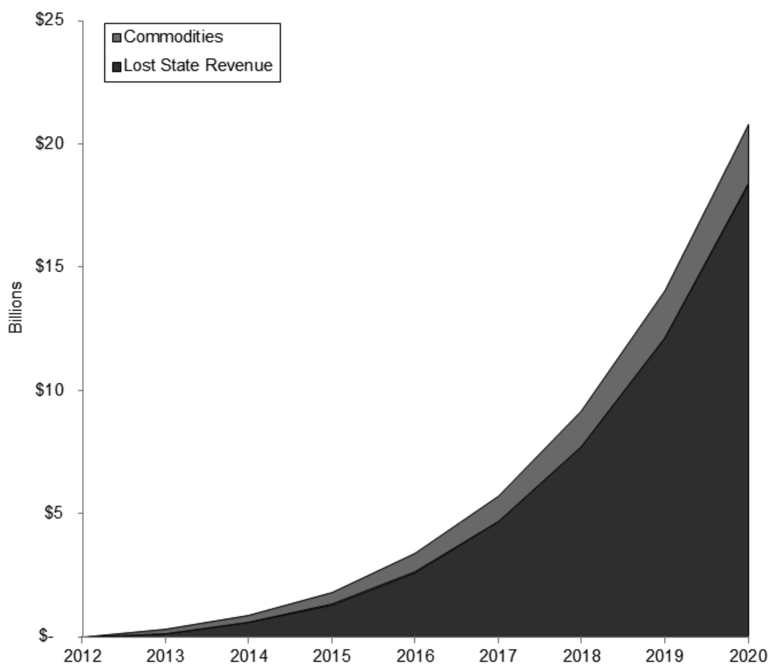
- Direct cost to California consumers is $35.3 billion
- Net effect on Gross State Product is a 5.6 percent loss with 262,000 jobs lost
- $7.4 billion in lost state and local revenue
- $12.3 billion in lost statewide earnings
- Average family costs of over $2,500 a year, in addition to over $900 in lost annual family earnings

This report details the impacts these policies will have on specific public agencies. This includes the impact of increased commodity costs (electricity, transportation fuel and water) and lost state tax revenue from decreased economic activity. We also illustrate the impact to specific agencies, including case studies of a community college and the California Highway Patrol.

2. AB 32's Impact on State Government

AB 32 will drive up the cost of electricity, transportation fuel and water for all consumers, including state agencies. Moreover, the economic slowdown caused by AB 32 will reduce the revenues to state government. The cumulative impact to state public entities from 2012 to 2020 will be $22.1 billion, driven largely by lost state revenue as shown in Figure 2.1. The cumulative lost revenue is approximately $19.7 billion. The second largest cumulative impact is from additional water costs which will total $1.8 billion in 2020, followed by the cumulative impact of electricity and transportation fuel will cost state government $488.9 million and $71.8 million respectively.

Figure 2.1
Cumulative State Costs
(Optimistic Case)

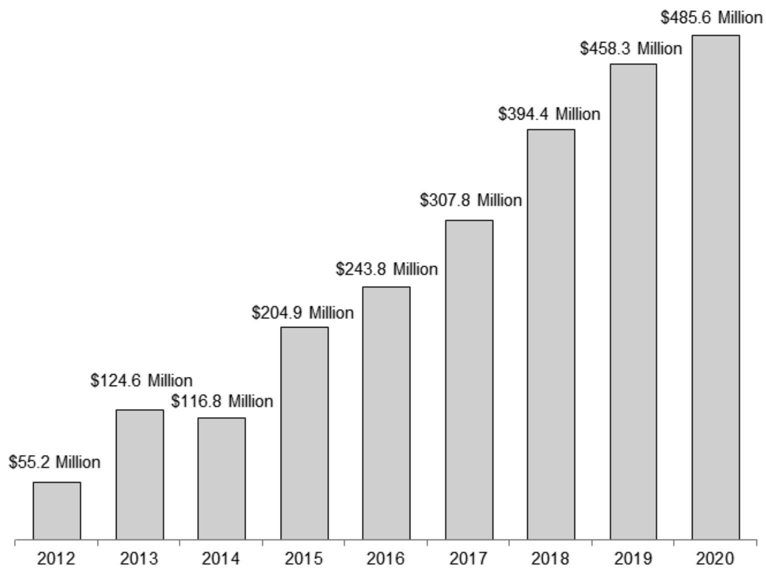


SOURCE: Appendix A, B, C

The cumulative impact of $22.1 billion is approximately the state's General Fund expenditures for Health Care Services and the Department of Social Services in 2010-11, or, when averaged, more than the annual budget of the Public Utilities Commission.

In Figure 2.2, we see the escalating annual costs of commodities for state public entities. Annual state costs grow from $55.2 million in 2012 to $485.6 million in 2020. In 2020, additional annual electricity, transportation fuel and water costs will total $105.5 million, $19.2 million and $360.9 million respectively. The 2020 commodity cost is greater than the 2009 total energy cost for the entire commercial sector of the state of Vermont.

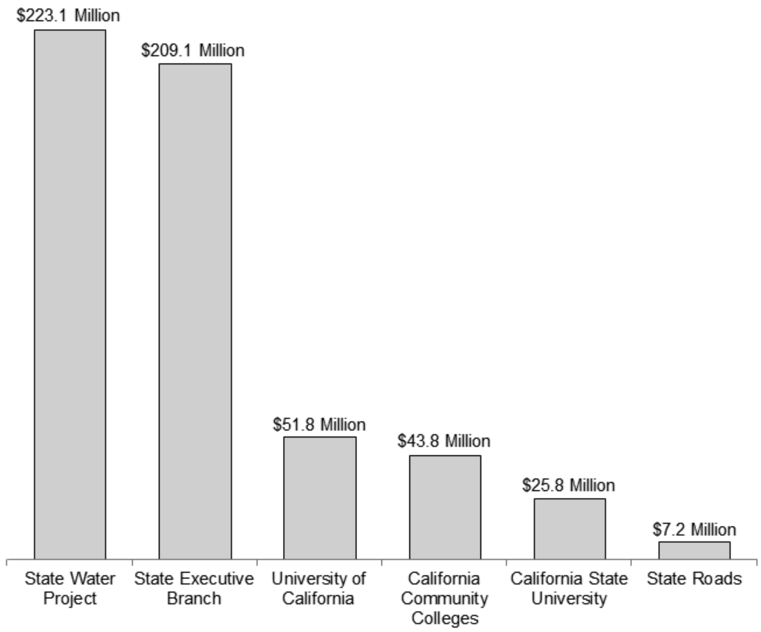
Figure 2.2
Annual Commodity Costs for State Entities
(Optimistic Case)



SOURCE: Appendix A, B, C

The increased commodity costs will significantly affect the ability of state entities to perform their functions and services. Figure 2.3, shows the projected cumulative costs of electricity, water and transportation fuel for the State Water Project, the Executive Branch, the University of California, California Community Colleges, California State University and state roads.

Figure 2.3
Cumulative Commodity Cost for State Entities
(Optimistic Case)



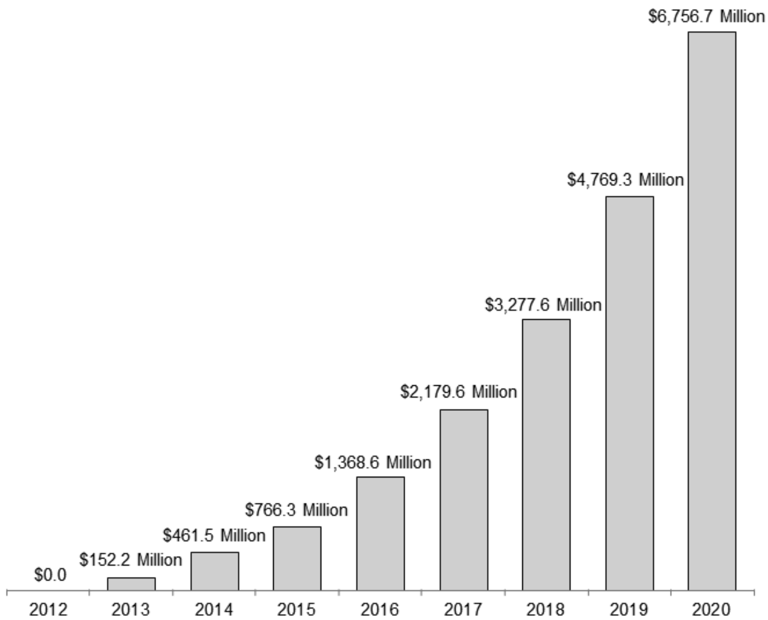
SOURCE: Appendix A, B, C

The State Water Project will face cumulative costs of more than $223 million by 2020. The State Executive branch, including all state departments and agencies, will incur over $209 million in cumulative costs by 2020. Higher education also bears a great deal of impact; the University of California system will have more than $51 million in cumulative costs, however the California Community College and California State University systems are close behind with additional cumulative costs of more than $43 million and $25 million respectively. Lastly, state roadways will incur more than $7 million in cumulative costs through 2020 as a result of AB 32.

The Impact of AB 32 on the State Revenues

The primary driver of increased costs in the Optimistic Case is lost state revenues from decreased economic activity in the state, as seen in Figure 2.4. Due to the slowdown in economic activity and lost earnings, AB 32 will reduce state tax revenues by over $6 billion annually by 2020. The annual loss in 2020 is more than the state's proposed total expenditures on the Departments of Public Health, Child Support Services, Managed Health Care, Developmental Services, and State Hospitals in Fiscal Year 2012-13.

Figure 2.4
Lost State Revenues
(Optimistic Case)



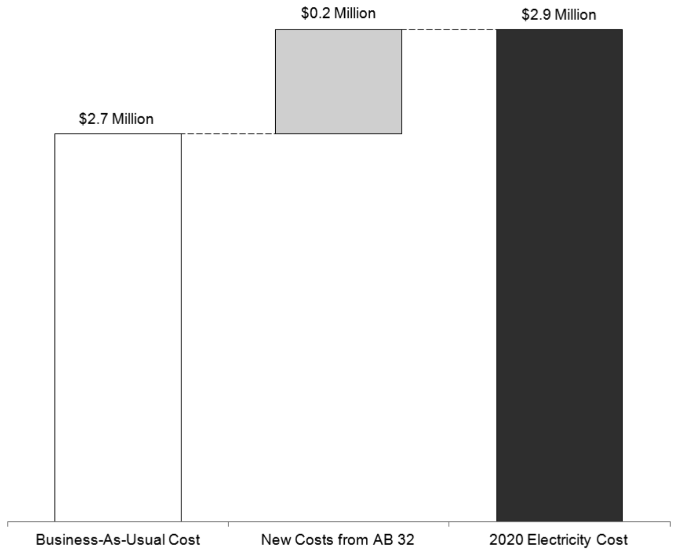
SOURCE: Main Report, Appendix C

Cumulatively, this amounts to over $19 billion in lost state tax revenues, or the approximate amount of money the state spent on all higher education during the previous two years. Additionally, since these revenues are placed into the General Fund, K-12 education stands to lose $2.7 billion annually by 2020, the equivalent of more than 45,000 teachers across the state.

The Impact of AB 32 on the State Center Community College District

The State Center Community College District (SCCCD) includes Fresno City College, Reedley College, Willow International Community College Center, Madera Community College Center and Oakhurst Community College Center with a district-wide student enrollment of over 53,000 in the 2010-11 school year. The district is located in Fresno County and accounts for approximately 2.2 percent of the entire California Community College building space and used approximately 22.4 GWh of electricity in 2010.

Figure 2.5
SCCCD Electricity Costs in 2020, Comparison



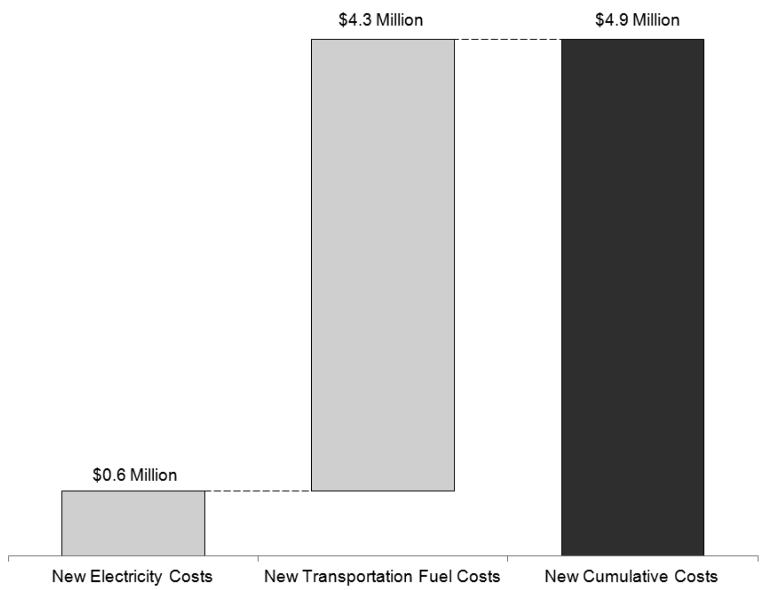
SOURCE: Appendix A

The district would bear additional annual costs of $200,000 in 2020, representing a 6.3 percent increase in its current costs and equivalent to the yearly tuition of more than 230 full-time students. 2020 cumulative costs would total $1.0 million in increased costs from electricity. The total annual costs in 2020 are also the equivalent of several budget items; the figure represents annual spending in the district's 2010-11 fiscal year for new vehicles, vehicle repair & maintenance, and architectural and engineering services.

The Impact of AB 32 on the California Highway Patrol

The core mission of the California Highway Patrol is to provide safety, service and security to the people of California through minimizing traffic collisions, maximizing service to the public and public agencies, managing traffic and emergency incidents, protect the public property, state employees and the state's infrastructure and collaborate with local, state and federal public safety agencies to protect California. The department has 11,101 total law enforcement employees, including 7,660 total officers and is the largest state law enforcement division in the nation.

Figure 2.6
Cumulative Electricity and Fuel Cost for CHP



SOURCE: Appendix A, C

As a percentage of total state law enforcement, the CHP makes up 9.3 percent of all state law enforcement personnel and 9.7 percent of all state officers. The California Highway Patrol operates approximately 1.2 million square feet of office and other building space, or 0.5 percent of the square footage of the entire state of California, and the total volume of bulk fuel purchased by the CHP is approximately 2.5 million gallons of gasoline and diesel per year.

CHP will bear $5.3 million in increased costs cumulatively from electricity and transportation fuels. The 2020 total additional cost of $1.6 million is equivalent to 0.1 percent of the Department’s FY 2010-11 budget and the equivalent to more than 23 full-time CHP officers. The cumulative cost for the department is also larger than the department's spending on their enhanced radio system in fiscal year 2010-11. The California Highway Patrol Enhanced Radio System (CHPERS) project's purpose is to provide for the development and implementation of an enhanced statewide radio communications system and as well as provide interoperability at the local, regional, and federal level.

3. Conclusion

The increased cost of commodities coupled with the significant decrease in state revenues from economic loss upon fully implementing AB 32 will create a $22.1 billion cumulative impact to state public entities over the length of the implementation period, with a $7.2 billion impact in the year 2020. It will also reduce state tax revenues by $6.8 billion annually by 2020 and $19.7 billion cumulatively in the Optimistic Case.

The State Water Project will face an additional $48.1 million cost annually in 2020 and the State Executive branch and its agencies will have $48.8 million in additional costs in 2020 in the Optimistic Case, while additional costs for water due to electricity costs will reach $360.8 million in the year 2020 for the state. Even individual state entities, such as the State Center Community College District and the California Highway Patrol, will face millions in additional cost that they will need to address.

Appendix A:
Electricity Usage

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Additional Electricity Cost per GWh[1] (Real $)	$1,121.2	$2,509.0	$2,300.2	$4,093.2	$4,847.7	$6,117.7	$7,819.1	$9,006.8	$11,313.8
State Water Project Total Usage[2] (in GWh)	5,211.3	5,081.0	4,954.0	4,830.1	4,709.4	4,591.6	4,476.8	4,364.9	4,255.8
State Buildings Total Usage[3] (in GWh)	3,204.3	3,124.2	3,046.1	2,969.9	2,895.7	2,823.3	2,752.7	2,683.9	2,616.8
University of California Total Usage[4] (in GWh)	1,209.4	1,179.2	1,149.7	1,121.0	1,092.9	1,065.6	1,039.0	1,013.0	987.7
California State University Total Usage[5] (in GWh)	601.6	586.5	571.9	557.6	543.6	530.1	516.8	503.9	491.3
California Community Colleges Total Usage[6] (in GWh)	1,023.0	997.5	972.5	948.2	924.5	901.4	878.8	856.9	835.5
Street Lighting Total Usage[7] (in GWh)	168.9	164.7	160.6	156.6	152.7	148.9	145.1	141.5	138.0
SCCCD Total Usage[8] (in GWh)	22.4	21.8	21.3	20.7	20.2	19.7	19.2	18.7	18.3

[1] See Main Report, Appendix D
[2] 2008 Management of State Water Project Bulletin, Department of Water Resources, accessed May 2012
[3] State Owned & Leased Building Energy Data, direct correspondence with Dan Burgoyne, DGS Sustainability Manager, accessed May 2012
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[7] State Center Community College District Energy Data, direct correspondence with Will Schofield, Director of Finance, accessed May 2012; FUSION statistics, Foundation for California Community Colleges, accessed June 2012
[8] State Center Community College District Energy Data, direct correspondence with Will Schofield, Director of Finance, accessed May 2012

Appendix B:
Transportation Fuel Usage

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Additional Per Unit Cost per Gallon of Gasoline[9] (Real $)	$ -	$0.04	$0.08	$0.09	$0.16	$0.23	$0.35	$0.54	$0.73
Additional Per Unit Cost per Gallon of Diesel (Real $)	$0.07	$0.15	$0.30	$0.36	$0.35	$0.31	$0.25	$0.30	$0.36
Total Agency Usage – Gasoline[10] (in million gal)	28.2	27.5	26.8	26.1	25.5	24.8	24.2	23.6	23.0
Total Agency Usage – Diesel[11] (in million gal)	8.6	8.4	8.1	7.9	7.7	7.5	7.4	7.2	7.0
Total Caltrans Bulk Usage – Gas[12] (in million gal)	3.0	2.9	2.8	2.8	2.7	2.6	2.6	2.5	2.4
Total Caltrans Bulk Usage - Diesel[13] (in million gal)	5.1	5.0	4.9	4.8	4.6	4.5	4.4	4.3	4.2
Total Fish & Game Bulk Usage - Gas[14] (in million gal)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Fish & Game Bulk Usage - Diesel[15] (in million gal)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total DWR Bulk Usage[16] (in million gal)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total CHP Bulk Usage[17] (in million gal)	2.5	2.4	2.4	2.3	2.3	2.2	2.1	2.1	2.0

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[9] See Main Report, Appendix F
[10] "2012 Progress Report For Reducing or Displacing the Consumption of Petroleum Products by the State Fleet," California Department of General Services, May 23, 2012
[11] *Ibid.*
[12] Caltrans Bulk Fuel Delivered by Calendar Year (gallons), Office of Fuel Programs Management, Divisions of Equipment and Maintenance, California Department of Transportation, 2009-2011, accessed June 2012
[13] Caltrans Bulk Fuel Delivered by Calendar Year (gallons), Office of Fuel Programs Management, Divisions of Equipment and Maintenance, California Department of Transportation, 2009-2011, accessed June 2012
[14] Bulk fuel usage, direct correspondence with Reginald Bohanan, Department of Fish and Game, accessed June 2012
[15] *Ibid.*
[16] "PRA Request Bulk Transportation Fuel Purchases," Procurement and Contracting Office, California Department of Water Resources, accessed June 2012
[17] Bulk fuel purchase orders, Business Services Section, California Highway Patrol, accessed June 2012

Appendix C:
Water[18]

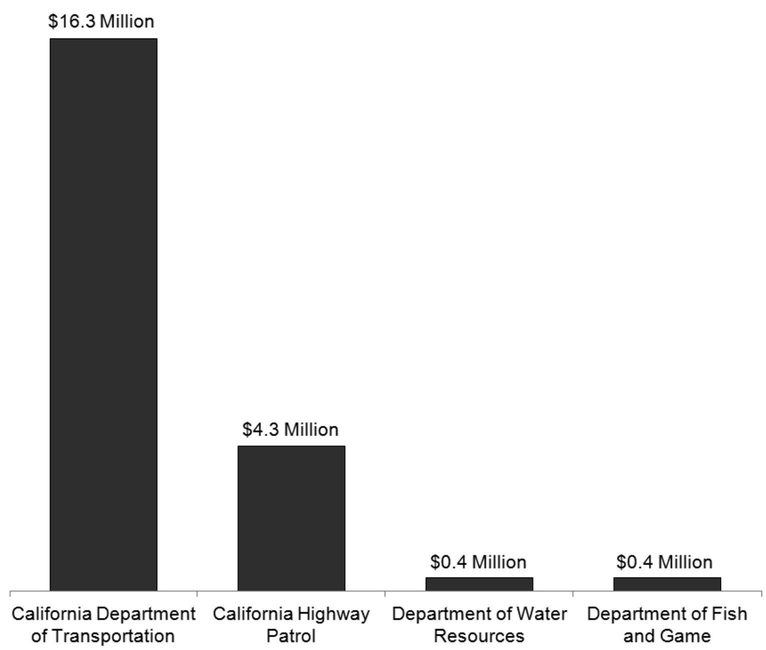
	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total Energy Usage from Identified Sources (GWh)	23,729	23,729	23,729	23,729	23,729	23,729	23,729	23,729	23,729
Total Water Usage (million acre feet)	41	41	42	42	42	43	43	42	44
Total Water from Identified Sources (million acre feet)	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
Divide Usage from Identified Sources for Project Energy Usage					÷				
Ratio Between Identified Sources and Usage	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7
Multiply Ratio with Energy Usage for Total Usage					x				
Total Energy Usage (GWh)	37,262	37,579	37,895	38,212	38,584	38,955	39,326	39,671	40,069
BAU Annual Average Cost of Electricity ($/GWh)	$84,418	$85,509	$86,764	$87,560	$87,982	$88,481	$88,850	$89,597	$90,580
Multiply Average Cost of Electricity by Usage					x				
BAU Total Cost of Energy for Water ($Millions)	**$3.1**	**$3.2**	**$3.3**	**$3.3**	**$3.4**	**$3.4**	**$3.5**	**$3.6**	**$3.6**
Scenario Annual Average Cost of Electricity ($/GWh)	$85,539	$88,018	$89,064	$91,653	$92,830	$94,599	$96,669	$98,604	$101,893
Multiply Average Cost of Electricity by Usage					x				
Scenario Total Cost of Energy for Water ($Millions)	**$3.2**	**$3.3**	**$3.4**	**$3.5**	**$3.6**	**$3.7**	**$3.8**	**$3.9**	**$4.0**

[18] See Main Report, Appendix G

Appendix D:
Bulk Fuel

In addition to the Voyager Fuel Card program that the state uses to provide transportation fuel to public agencies, several departments operate independent fueling stations across the state and would bear increased costs from bulk fuel purchases, as seen in Figure D.1.

Figure D.1
Cumulative Costs to Departments from Additional Bulk Fuel Costs



SOURCE: Appendix C

The California Department of Transportation (Caltrans) is the largest purchaser of bulk fuels and would face an additional $16.3 million in fuel costs over the implementation period. The California Highway Patrol would face $4.3 million in additional fuel costs, while the Department of Fish and Game and Department of Water Resources would face $0.4 million in additional cumulative costs.

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