AN ASSESSMENT OF CALIFORNIA'S CAP-AND-TRADE REVENUE OPTIONS & FREE ALLOWANCE ALLOCATION METHODS

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AN ASSESSMENT OF CALIFORNIA'S CAP-AND-TRADE REVENUE OPTIONS & FREE ALLOWANCE ALLOCATION SCHEMES

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Department of Public Policy and Administration

Abstract

of

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Global climate change has caught the attention of climate scientists, the general public, and public officials over the past forty years. A relatively new policy instrument used to combat climate change and its negative effects is cap-and-trade. In 2006, California passed into law the landmark California Global Warming Solutions Act (AB 32) to reduce statewide greenhouse gas emissions over the 21st Century. The law authorizes the California Air Resources Board to setup and implement a cap-and-trade program intended to reduce greenhouse gas (GHG) emissions by allocating free and auctioning carbon allowances and using cap-and-trade auction revenues to fund programs fulfilling the goals of the California Global Warming Solutions Act. My questions are whether carbon allowances should be allocated freely or purchased at auction and how should California spend cap-and-trade revenues generated from the cap-and-trade auctions to meet the goals of AB 32?

I review the relevant literature on auctioning allowances, freely allocating allowances, and free allocation schemes. I detail five potential allocations of cap-and-trade revenues and evaluate them against seven criteria used to judge each revenue allocation. The five spending options include a K-14 energy efficiency program, supplementing funding for the implementation

of the Sustainable Communities and Climate Protection Act of 2008, expanding forestry efforts, increasing money to alternative fuel and vehicle efficiency research and development, and creating a Green Bank that finances various energy efficiency and alternative energy programs. The seven evaluative criteria are efficiency, equity, external environmental effect, transparency/ accountability, legality, robustness/improvability, and political acceptability.

A review of the literature I determine California should use an initial mix of allocating allowances for free and auctioning allowances that shifts toward an auctioning of allowances over time and the output-based updating allocation scheme is the best way to allocate free allowances. After analyzing the different spending alternatives against the seven criteria, I determine cap-and-trade revenue options should be spent on funding for research and development funding for alternative fuel and vehicle efficiency projects, with secondary emphasis on increased forestry and supplementing funding for the implementation of the Sustainable Communities and Climate Protection Act of 2008.

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CHAPTER 1

INTRODUCTION

The State of California sent a message to the rest of the county regarding the policy problem of climate change with its adoption of the landmark Global Warming Solutions Act of 2006, also known as AB 32. Passed by a Democrat-controlled State Legislature and signed by a Republican Governor, AB 32 established the goal of reducing statewide greenhouse gas (GHG) emissions to 1990 levels by the year 2020 and then an 80 percent reduction below 1990 levels by 2050 (LAO, 2012b). Furthermore, AB 32 assigned the California Air Resources Board (ARB) to develop discrete and early actions to reduce GHGs, including the adoption of a market-based policy solution to diminish the annual aggregate emissions for various GHG emission sources (ARB, n.d. b). By 2011, ARB adopted the state's market-based solution to climate change cap-and-trade (ARB, 2011). Cap-and-trade is a market-based approach that provides economic incentives to major emission sources of sources of pollutant gases, including GHGs, to reduce their overall emissions of those gases. A cap-and-trade simultaneously offers an economic incentive for emission sources to reduce their GHG emissions and generate revenues for the governing body in charge of the program.

As ARB moved forward implementing AB 32, the state's immediate fiscal situation changed. The State of California suffered enormous fiscal challenges in between the signing of AB 32 into state law (2006) and the first fully year of cap-and-trade auction (2013). In the midst of the 2008-2009 Financial Crisis and the Great Recession, California faced an 18-month deficit of $41.8 billion from January 2009 through June 2010 (Lin, 2008). However, the LAO (2012c) recently projected only $1.9 billion in deficits from January 2013 through June 2014 and that the state could achieve a $1 billion surplus for the 2014-2015 fiscal year. In spite of the state's

improved short-term fiscal health, California faces long-term fiscal problems due to long-term debt obligations to K-12 schools and retiree pension and health benefits (Gonzales, 2013).

Decisions on whether allowances should be purchased at auction or allocated freely, how free allowances should be allocated among entities covered under the cap-and-trade program, and how to spend the new revenue from cap-and-trade to achieve AB 32 goals remains. Currently, there are divergent opinions on whether allowances should be allocated for free or purchased at quarterly auctions. Legal interpretations of state law and recently passed legislation limit possible spending options with any cap-and-trade revenue. For example, legal experts warn spending cap-and-trade revenues to close the state's deficit or for most non-climate change related programs would likely violate state law (Lambe and Farber, 2012). Thus, the purpose of this thesis is to examine in greater detail the important questions of whether carbon allowances should be allocated freely or purchased at auction and how should California spend cap-and-trade revenues generated from the cap-and-trade auctions to meet the goals of AB 32?

CLIMATE CHANGE

Climate change presents one of the greatest public policy problems facing California and the world. The United States Environmental Protection Agency (U.S. EPA) (2013a) defines climate change as any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other weather patterns, that occur over several decades or longer. Factors influencing climate change include solar radiation, plate tectonics, and volcanic eruptions, and man-made GHG emissions into the atmosphere (National Research Council, 2010). Scientists attribute the last factor as the primary cause of the recent trend of climate change.

Greenhouse Gases & Greenhouse Effect

Scientific studies classified various gases compounds as GHGs due to their ability to prevent heat from escaping a planetary atmosphere. Ledley et al (1999) listed carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons (CFCs), ozone (O_3), and water vapor (H_2O) as the primary GHGs contributing to the greenhouse effect. Other gases typically classed as a GHG include hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (U.S. EPA, 2013a). Among all known GHGs, CH_4 N_2O, and CO_2 in particular are considered the primary contributors due their ability to last longer in the atmosphere before breaking down (U.S. EPA, 2013a). The ice core measurements of CO_2, CH_4, N_2O, and CFC concentrations show each GHG's atmospheric concentration increased dramatically in the second half of the 20th century (Ledley et al, 1999). These GHGs all contribute to the greenhouse effect.

The greenhouse effect is the process of GHGs capturing heat within a planetary atmosphere that normally escape back into space. Natural phenomena (i.e. water evaporation, volcanic eruptions) and human activities (i.e. burning of fossil fuels for energy) produce GHGs (LAO, 2012b). Scientific experts have voiced concerns that higher concentrations of GHGs resulting from human activities will ultimately increase the potency of the greenhouse effect and as such global temperature increases will eventually cause significant problems (LAO, 2012b). An extreme example of the greenhouse effect on the planet Venus creates the hottest planetary temperatures within the solar system.

Climate Change Impacts on California

The trend of temperatures increases will continue for the next century. California's overall temperatures have increased over the past century. Statewide average temperatures increased by about 1.7°F from 1895 to 2011, with warming being greatest in the Sierra Nevada

Mountains (Moser, Ekstrom, & Franco, 2012). Temperature projections predict California's average temperature will increase by approximately 2.7°F above 2000 levels in 2050 and by 4.1 to 8.6°F above 2000 averages in 2100 (Moser, Ekstrom, & Franco, 2012). The varied temperature projections for the second half of the 21st Century depends based on actual GHG emission levels made in the early part of the century. Temperature increases will be more pronounced in the summer months and within the inland areas of California compared to the coastal region of the state. The choices society makes today and in the near future will have larger impacts on future temperature changes in the latter part of the 21st Century (Moser, Ekstrom, & Franco, 2012).

Increased temperatures will limit the state's overall water sources and increase the potential for wildfires. Earlier and more pronounced springtime temperature increases lead to a quicker melting of the state's snowpack, the state's largest source of freshwater. Warmer summer temperatures will evaporate a larger portion of moisture within mountain and non-irrigated soil (Moser, Ekstrom, & Franco, 2012). Projections showed decreased precipitation leading to an extremely drier climate in the central and southern portions of California. Earlier snowmelt, higher temperatures, and longer dry periods increase wildfire risk. Furthermore, more wildfires can increase particulate air pollution in the major air basins of California, offsetting air quality improvements made over the 20th and 21st centuries. (Moser, Ekstrom, & Franco, 2012)

A decrease of available water sources would further complicate California's water system. By the latter half of the 21st Century, critically dry years could occur more often (8 percent more frequently in the Sacramento Valley and 32 percent more often in the San Joaquin Valley), compared to the second half of the 20th Century (Moser, Ekstrom, & Franco, 2012). Satisfying the state's water needs, particularly for agricultural and environmental purposes during such critically dry years would become difficult. Climate change can exacerbate ongoing conflicts over water by increasing demand and decreasing supply (Moser, Ekstrom, & Franco,

2012).

The state's current utility infrastructure must cope with the growing demand of energy in a future affected by climate change. Climate change will increase demand for cooling systems in the increasingly hot and longer summer season and decrease demand for heating in the cooler season. California's families and businesses will either use their air conditioners more frequently or will purchase an air conditioner unit if they do not already own one. Energy usage is expected to grow at a faster rate in areas populated by Latino and low-income families compared with predominantly Caucasian and wealthier areas of California (Moser, Ekstrom, & Franco, 2012). Increased temperatures will add stress on the state's electrical grid. An estimated 17 gigawatts (38% of additional capacity) will likely be needed by 2100 due to higher temperatures alone (Moser, Ekstrom, & Franco, 2012). At the same time transmission lines lose seven to eight percent of transmitting capacity in high temperature conditions (Moser, Ekstrom, & Franco, 2012). More electricity must be produced to make up for both the loss in capacity and growing demand.

Climate change is expected to exacerbate current stresses on the state's agricultural sector. Changes in temperature and water availability — annual and seasonal shifts as well as extremes — affect both crop yield and quality, making the agriculture highly sensitive to climate change. Indirect impacts will also take a toll, including a further decrease of insect pollinators and an in increase of pests and disease (Moser, Ekstrom, & Franco, 2012). Climate change impacts on perennial crops (i.e. peaches, strawberries, and almonds) vary by crop, while nearly all annual crops (i.e. wheat and sunflowers) are expected to decline under climate change (Moser, Ekstrom, & Franco, 2012).

The public problem posed by climate change does not limit itself to California, the United States, or North America alone. The Earth's atmosphere is a public good. It is impossible

for any person to be excluded from using the atmosphere without paying for it, making it non-excludable and from using the atmosphere without limiting the atmosphere from any other individual, making it non-rivalrous. Despite the limited worldwide impact of California's GHG reduction measures, the decision to proceed with landmark GHG reduction programs may encourage the public within and outside the United States to follow in combating climate change. In the next section, I discuss possible policy measures to combat climate change.

RESPONDING TO CLIMATE CHANGE

Regulatory Measures vs. Market-Based Mechanisms

The primary policy categories to combat the negative externalities, costs not borne by the person or firm engaging in economic activity, of GHGs are regulatory measures and market-based mechanisms. Regulatory measures typically require specific actions from individuals or firms to achieve certain goals. For example, a regulation may require a building to meet a specified energy efficiency performance standard as a means to reduce energy consumption. However, regulatory measures usually have higher compliance costs than market-based mechanisms (LAO, 2012b). Individuals and firms typically do not like regulatory measures because they do not offer a choice of how to meet a specific goal (i.e. reduce GHG emissions) but instead direct they follow exact procedures to achieve said goal. Alternatively, market–based mechanisms offer firms and individuals the choice of how to achieve the desired outcome of reducing GHG emissions. Beside the advantage of choice, market-based mechanisms achieve desired GHG reductions at the lowest overall efficiency cost to society (LAO, 2012b). The two most commonly discussed market-based mechanisms to reduce GHG emissions are a carbon tax and a cap-and-trade program. Instead of emissions sources facing a requirement to meet specific GHG reductions under regulatory measures, they may choose to decrease their GHG emissions or pay a penalty in the form of a tax or purchasing allowances (LAO, 2012b).

Carbon Tax

A carbon tax levies a tax on GHG emissions, intended to reduce the emission of CO_2 and other GHGs. A direct tax on GHGs emissions follows the policy idea of Arthur G. Pigou by creating a Pigouvian Tax. The purpose of Pigouvian Tax is to raise the price of a product to account for the product's total cost to society and discourage the production of the product (Mankiw, 2009). A carbon tax amounts to a tax on each ton of CO_2 equivalent emitted, thereby placing a new cost on emitting GHGs into the atmosphere. Thus, an emissions source would experience greater costs in the form of taxes as it continues to emit GHGs. The tax on GHGs could be expanded or reduced to include any gas classified as a GHG. Under a tax, the regulator does not directly limit the amount of emissions any source may emit. Rather, the regulator would set the tax on GHGs such that the resulting amount of GHG emissions would be lower than previous projections (LAO, 2012b). GHG sources would reduce its emissions so as long as the cost of achieving the reductions is less than the cost of paying the tax on those emissions (LAO, 2012b). Therefore, an emission source would pay the tax if it were less than the cost of reducing GHG emissions. The overall level of emissions reductions can be achieved, in theory, at the least cost possible because the tax provides an economic incentive to all emissions sources subject to the tax to find the most economically beneficial mix of emissions reductions and tax payments that minimizes their costs (LAO, 2012b).

Cap-and-Trade

The second market–based mechanism to reduce GHG emissions is a cap–and–trade program. As with a carbon tax, a cap-and-trade program does not directly require an emissions source to reduce its emissions. However, under a cap-and-trade program, the regulator auctions carbon allowances at a cap-and-trade auction and/or allocates them for free to entities under the cap-and-trade program (LAO, 2012b). An emissions source regulated under the program must

possess an allowance for each ton of CO_2 equivalent emissions it releases into the atmosphere in order to comply with the market system (LAO, 2012b). Ideally, the amount of allowances issued is less than the amount of GHG emissions that would otherwise be produced because the goal of the program is to lower overall emissions. A cap-and-trade program differs from a carbon tax in that the regulator does not decide the cost of emitting each ton of CO_2 equivalent. Rather, the cost is determined by the supply and demand of allowances and trading between emission sources within the allowance market (LAO, 2012b). Emission sources that can reduce their emissions are likely to do so as long as it is cheaper than buying allowances at the market price (LAO, 2012b). When emissions reductions result in an entity possessing more allowances than it needs for compliance, excess allowances can be sold to entities that find it less costly to buy allowances rather than reduce their emissions. As with the carbon tax, the level of overall emissions reductions is achieved, in theory; at the least cost possible (LAO, 2012b). The governing body in charge of the allowances market will reduce the overall of carbon allowances available to the market over time (LAO, 2012b). The reduced supply of allowances will raise the price of emitting GHGs, creating additional costs to emitting GHGs and ultimately creating an economic incentive for all regulated emissions sources to find an efficient mix of emissions reductions and allowance purchases.

Carbon Tax vs. Cap-and-Trade

A carbon tax offers certain benefits not available when implementing a cap-and-trade program. Under a carbon tax, an emission source will have greater certainty over the price of their GHGs, because a governing body establishes the tax in advance and will only change if the governing body determines the tax rate should change (Avi-Yonah and Uhlmann, 2009). This certainty allows businesses to plan ahead; secure in the knowledge that raising the tax rate requires another vote from the governing body (Avi-Yonah and Uhlmann, 2009). A carbon tax is

easier to enforce compared to the inherent complexities of establishing and enforcing a new carbon market in a cap-and-trade program (Avi-Yonah and Uhlmann, 2009). The tax rate on carbon can be adjusted accordingly if GHG reduction benchmarks are not or if they are being met to quickly to the detriment of the economy. Lastly, a carbon tax sends a clear signal to polluters: pollution imposes a negative externality on others, and entities should be forced to internalize that cost by paying the tax.

Implementing a cap-and-trade has its own benefits compared to levying a tax on GHG emissions. A cap-and-trade program can have provisions for borrowing and banking allowances which permit firms burdened with sudden cost increases (e.g. as a result of a spike in the price of allowances) to alleviate that cost without affecting the overall cap (Avi-Yonah and Uhlmann, 2009). Despite the lest cost certainty of allowances in a cap-and-trade program, the overall "cap" and planned reduction of that cap guarantees GHGs will be reduced over time. The cap-and-trade program provides relative certainty to the regulator about the reduction in GHG emissions that will be achieved. The total quantity of CO_2 equivalent emitted by regulated entities cannot exceed the amount of allowances issued by the regulator (LAO, 2012b). Additionally, imposing a carbon tax poses the problem of setting the price of carbon (through the tax) at the wrong price. If regulators set the carbon tax rate too low, emission levels will continue to exceed regulatory targets (LAO, 2012b). If regulators set the tax rate too high, regulated emissions sources will pay unnecessary costs to meet GHG reductions benchmarks (LAO, 2012b). Lastly, the political feasibility of passing a cap-and-trade program is usually easier due to the fact the program itself does not impose a tax(Avi-Yonah and Uhlmann, 2009).

ASSEMBLY BILL 32

The final legislative language of AB 32 tasked ARB to administer the statewide reduction of GHG through regulatory and market-based mechanism measures. The primary GHG reduction

goals are to lower total GHG emissions within California to 1990 emissions levels by 2020 and 80 percent below 1990 levels by 2050. This would be an overall reduction of statewide GHG emissions by 25% by 2020 (Ross, 2006). AB 32 placed the discretion of how to achieve the 2020 and 2050 goals with ARB. ARB's responsibilities under AB 32 included: adopting a statewide emissions limit, adopting the maximum feasible and cost-effective reductions in GHG emissions for emission sources and categories of emission sources subject to AB 32, the authority to adopt a market-based compliance mechanisms, specially a cap-and-trade system, provided it complies with specified conditions, adopting a list of discrete early action emission reduction measures that can be achieved prior to the adoption of market-based compliance mechanisms and other measures, and the authority to impose administrative, civil, and/or criminal penalties consistent with its authority under air quality statutes for violations of any rule, regulation, order, or standard adopted by the board pursuant to the bill's provisions (Ross, 2006).

The State Senate approved the final legislative language by a vote of 23-14, with three Senators not recording a vote (Official California Legislative Information, 2006a). The State Assembly followed suit with a vote of 47-32, one seat remained vacant at the time (Official California Legislative Information, 2006b). Support and opposition to AB 32 fell almost exclusively along partisan lines.

California Air Resources Board

ARB's responsibility is to protect Californians from the harmful effects of air pollutants through the enforcement of state regulations and administering programs to reduce pollutants in the air. The Mulford-Carrell Act merged the Motor Vehicle Pollution Control Board and the Bureau of Air Sanitation to form ARB in 1967 (ARB, 2010). Today, ARB's mission is to promote and protect public health, welfare and ecological resources through the effective and efficient reduction of air pollutants, while recognizing and considering the effects on the state's

economy. ARB's (2012a) primary goals include: providing and sustaining clean air in California, protecting the public from exposure to toxic air contaminants, reducing California's emission of GHGs, and lead in the implementation and enforcement of air pollution rules and regulations. The governing board of ARB includes eleven members. Five members must serve on a major regional air quality board within the state, three members must be qualified in the fields of automotive engineering, science, agriculture, law, and/or health, two members work as public members, and the Governor appoints the Board's Chairman (ARB, 2008a).

Scoping Plan

ARB's AB 32 Scoping Plan outlined how AB 32's 2020 can be achieved. Key recommendation to achieve 2020 GHG reduction targets included: decreasing GHG emission from light-duty vehicles, increasing energy efficiency programs, raising renewable energy's share of statewide energy production 33 percent, establishing targets for transportation-related GHG emissions for regions throughout California, and preserving carbon sequestration though sustainable land management practices (ARB, 2008b). The bulk of GHG reductions would come reducing. Vehicle emission reductions, energy efficiency, and increased renewable energy make up the largest portions of the scoping plan's anticipated GHG reductions.

ARB's CAP-AND-TRADE PROGRAM

ARB will administer California's cap-and-trade program to reduce GHG emissions. The cap-and-trade program covers several dozens of industries within California including utilities, electricity importers, refineries, and industries that produce cement, glass, hydrogen, iron, steel, lime, nitric acid, and paper (ARB, n.d. c). GHGs covered under the cap-and-trade program are CO_2, CH_4, N_2O, SF_6 HFCs, PFCs, nitrogen trifluoride (NF_3), and other fluorinated GHGs (ARB, n.d. c). Allowances to emit covered GHGs are sold at quarterly auctions throughout the year (LAO, 2012b). Each allowance sold will include a serial number, like any product purchased at a

market or store, which will be tracked by the Compliance Instrument Tracking System Service (CITSS) (ARB, 2012b). CITSS facilitates compliance with the cap-and-trade program through its web-based reporting tool that tracks the ownership of every allowance previously purchased by a GHG emission source covered under cap-and-trade (ARB, 2012b). Every entity covered by AB 32 must report their GHG emission levels on an annual basis by to ARB's California Electronic Greenhouse Gas Reporting Tool (ARB, 2013a).

The phase-in of the cap-and-trade program will expand into different sectors of the economy in the upcoming years. Not all GHG emitting entities covered by the cap-and-trade program would need to participate immediately. Starting in 2013, major GHG-emitting sources, such as electricity generation (including imports), and large stationary sources (e.g., refineries, cement production facilities, oil and gas production facilities, glass manufacturing facilities, and food processing plants) that emit more than 25,000 metric tons of CO_2 equivalent per year have to comply with the cap-and-trade program (ARB, 2012b). In 2015, fuel distributors (natural gas and propane fuel providers and transportation fuel providers) will fall under cap-and-trade to address emissions from transportation fuels, and from the combustion of other fossil fuels not directly covered at large emission sources during the program's initial phase (ARB, 2012b). All covered entities under cap-and-trade must meet a compliance obligation under a three-year time frame, known as a compliance period, in order to comply with ARB's cap-and-trade regulation (ARB, 2012b). However, California's efforts to reduce GHGs will no longer occur in conjunction with other western states. California entered the Western Climate Initiative (WCI) to partner with neighboring states in order to evaluate and reduce each state's emissions of GHGs (WCI, 2012). Efforts were underway to design and implement a multi-sector, market-based program (i.e. cap-and-trade program) between western states within the United States and a number of Canadian provinces (WCI, 2012). However, all states within the United States, save California, formally

exited WCI in November of 2011; leaving California, British Columbia, Manitoba, Ontario, and Quebec as the remaining members of WCI. The potential for carbon leakage remains a large threat due to the lack of cap-and-trade programs in any western state surrounding California.

ARB ran its first cap-and-trade auction in 2012 to begin California's cap-and-trade programs. On November 2012, the first auction of carbon allowances commenced. The auction concluded with 23,126,110 allowances for 2013 sold and an additional purchase of 5,576,000 advance allowances for 2015 (ARB, 2012a). The mean prices for purchased allowances were $13.75 for 2013 allowances and $11.07 for 2015 advance allowances (ARB, 2012a). Comparatively, allowance within the Regional Greenhouse Gas Initiative (RGGI) in the northeastern United States and the European Trading Scheme sold for $1.93 and 7.30 Euros ($9.63) respectively during the same time period (RGGI, 2012 & European Energy Exchange, 2013). Allowance auctions will occur ever February, May, August, and November for subsequent years.

Limits on How Cap-and-Trade Revenues May Be Spent

Voter-approved legislation limits the discretion of how cap-and-trade revenues may be spent, especially toward General Fund spending. Taking into account the opinion of the Legislative Counsel and AB 32's passage into law with fewer than a two-thirds majority in both houses of the state legislature, cap-and-trade revenues are unlikely to be spend towards the State of California's short- or long-term fiscal challenges. Proposition 13 requires all statewide tax increases for general spending be approved by a two-thirds supermajority of both houses of the State Legislature. Since AB 32 was not passed by two-thirds of the State Legislature, the cap-and-trade program may be at risk if the auction proceeds are spent in a manner similar to a general tax. However, if a legally permissible way to spend cap-and-trade revenues towards the state General Fund was found, Proposition 98 would require at least 40% of the cap-and-trade revenue

be spent towards K-14 education.

A previous case in the California Supreme Court involving the Sinclair Paint Company set the standard of how mitigation fees, such as cap-and-trade revenue may be legally spent. California began charging a fee on paint companies and other businesses that made or previously made products containing lead and used the fee revenue on lead poisoning programs (LAO, 2012a). The Sinclair Paint Company sued and argued the charge was a tax because the program provided a broad public benefit, not a benefit to the regulated business, and the companies that pay the fee have no duties regarding the lead poisoning program other than payment of the fee (LAO, 2012a). The California Supreme Court ruled that the fee on businesses was a mitigation fee (requiring only a majority vote in each house of the State Legislature) not a tax. The court confirmed that government could impose mitigation fees on companies that make contaminating products (in our case, GHGs) and use those proceeds for broad public purposes in order to mitigate the adverse effects related to those products (LAO, 2012a). The Legislative Counsel of the State Legislature determined revenues generated from ARB's cap-and-trade auctions would constitute a mitigation fee (LAO, 2012a). Since GHG's are the adverse product being regulated, the Legislative Counsel determined the Sinclair Nexus Test requires cap-and-trade revenues must be spent on purposes related to mitigating the effects of GHGs. Lambe and Farber (2012) specified the four components of the Sinclair Nexus Test that determines if the spending of mitigation fees is legal. They include:

- **Nexus Requirement:** there is a causal connection or nexus between the product regulated and its adverse effects.
- **Reasonable Cost Requirement**: the amount of money raised is limited to the "amounts necessary to carry out the regulation's purpose."
- **Fair Allocation Requirement**: there is a "fair or reasonable" relationship between the

allocation of costs among payers and the benefits received or the burdens imposed by the payer.

- **No Unrelated Spending Requirement:** the fees may not be used for "unrelated revenue purposes."

So long as cap-and-trade revenues are spent to mitigate the effects of GHGs and satisfy all four components of the Sinclair Nexus Test, legal action against the spending plans of cap-and-trade revenues would have a diminished chance of succeeding.

CHAPTER 1 SUMMARY & REST OF THESIS

California's cap-and-trade program from AB 32 presents the ARB and California's state government the question of whether to allocate or auction allowances, how to allocate free allowances, and how to spend incoming billion of dollars in programs or projects to achieve AB 32 goals. The first half of the following chapter will summarize relevant literature on allocating and auctioning allowances, the different methods of allocating free allowances, my final recommendation on distributing allowances to entities under cap-and-trade. The second half of the chapter will summarize categories of how California may spend cap-and-trade revenues to meet the goals of AB 32. The third chapter will describe and explain my methodology for finding optimal spending proposals. The fourth chapter will analyze five spending proposals. The fifth chapter will summarize the policy implications of my analysis from Chapter 5.

CHAPTER 2

LITERATURE REVIEW

This section of the paper offers a summary of the literature related to the thesis question. The literature review is broken into two halves. The first half focuses allocating free allowances versus auctioning allowances to firms under cap-and-trade, the different allocation schemes for free allowances, and my recommendations on how allowances should be distributed. The second half of the literature review explores the various ways cap-and-trade revenue may be spent to accomplish the 2020 and 2050 GHG reduction benchmarks from AB 32. The purpose of the literature review is to provide a summary of all literature I found on the distribution of allowances and the various ways cap-and-trade revenues may be spent in a manner that does not violate the precedent set by the Sinclair Nexus Test. Following the conclusion of the literature review, the methodology of the paper is explained.

FREE ALLOWANCE ALLOCATION SCHEMES

Allowances may be distributed to firms under a cap-and-trade program via a free allocation scheme or regularly held auctions directed by the governing body in charge of the program. I discuss the auctioning of allowances later in the chapter. The ways of allocating allowances for free can be broken down in the following two categories: fixed allocation and updated allocation. Under fixed allocation, the allocation of carbon allowances to covered entities is not adjusted in response to current or future behavior. Under updated allocation, the allowances allocated adjust over time in response to behavior and market conditions.

Fixed Free Allocation

Fixed allocation establishes the distribution of allowances in ways that are independent of the actions of entities under a cap-and-trade program (EAAC, 2010). One fixed allocation approach, grandfathering, is an allocation based on a metric, such as the emissions or activity

levels of entities and sectors covered under cap-and-trade during a previous baseline timeframe (EAAC, 2010). The avoidance of unproductive changes in a firms GHG emission reductions is an advantaged of fixed allocation relative to updated allocation (EAAC, 2010 & Kopp, 2007). Åhman, Burtraw, Kruger, and Zetterberg (2005) found a cap-and-trade program in which covered entities alter behavior in order to influence the future allocation of allowances is likely to lead to additional costs for the overall program (as cited by EAAC, 2010). Under a fixed free allocation scheme firms will have no incentive to change their current behavior because they cannot affect their future allocation of free allowances. Therefore, a fixed allocation plan is viewed as the most economically efficient form of free allocation, with regard to the costs of complying with the emissions cap (EAAC, 2010).

Critics claim fixed allocation as unfair. Under a fixed allocation scheme, certain firms may receive more or less allowances than needed based on a change in the scale of the firm. For example, a firm may continue to receive a large windfall of allowances despite reducing its scale of operations while a firm may receive relatively little allowances despite increasing its scale of production. However a windfall of allowances is unlikely to occur if only modest fractions of all allowances are freely allocated. Fixed allocation is sometimes criticized as being unnecessarily rigid. Fixed allocation can tie the hands of regulators, as they may be too slow in response to unanticipated outcomes in the market by revising previously pledged allocations of free allowances (EAAC, 2010).

Updated Free Allocation

Under updated free allocation, regulators revise the allocation of free carbon allowances in response to economic or emission market conditions. The entry and exit of entities within an emissions market is usually treated as the basis for updating (EAAC, 2010 & Kopp, 2007). For example, the closure of a factory would lead to forfeiture of future free carbon allowances, while

the construction of a new factory could bring with it additional free allowances. However updated allocation methods create inefficiencies because firms can alter their behavior in order to influence future allocations. These alterations distort methods and levels of production away from a cost-minimizing outcome (Åhman, Burtraw, Kruger, and Zetterberg, 2005 as cited by EAAC, 2010). However, the updating allocation method possesses two appealing attributes, political appeal and updating allocation's ability to reduce emissions leakage from area under the cap-and-trade's jurisdiction (EAAC, 2010). Updated allocation can be accomplished through schemes named output-based updating and benchmarking.

A typical approach to updated free allocation is to base allocations for a future time period on the production level of a firm's factory in the current time period. This approach is usually called output-based updating (Kopp, 2007). For example, in the electricity sector, this means each electrical firm receives an allocation proportional to the electricity it generates while holding the overall emissions cap intact (EAAC, 2010). One justification for output-based updating is it addresses carbon leakage. Carbon leakage is an increase in CO_2 emissions in one jurisdiction as a result CO_2 emissions reduction by a second jurisdiction with stricter climate policies. This would be of particular importance to carbon intensive industries and/or subject to exposure from unregulated competition in their export or import markets, referred to as "trade exposed" (EAAC, 2010). However, output-based updating is not the only method to address the issues of carbon leakage.

Benchmarking is an updated free-allocation approach based on specified engineering or technological criteria. It aims to encourage best-practice emissions rates for given entities (EAAC, 2010). Under the benchmarking approach, the regulator establishes a baseline emissions rate for an industry (i.e. utilities) or process (i.e. coal-fired electricity generation) and awards allowances to all facilities in that industry according to the "benchmark" GHG content of their

output (EAAC, 2010). Simulation research indicates benchmarking as less effective in mitigating carbon leakage among electricity generation compared to output-based updating (Bushnell and Chen, 2009*)*. This results because emission rates for electricity generation from outside the cap-and-trade's jurisdiction are greater than for generation within the cap-and-trade jurisdiction the state.

Further Literature on Free Allocation of Carbon Allowances

Allocating allowances for free in a cap-and-trade program can be an expedient way to provide compensation to entities regulated under cap-and-trade. If the governing body in charge of cap-and-trade determines the economic conditions warrant entities and firms under cap-and-trade to receive some compensation due to the increased costs of adhering to the program, it would be best to reward those entities and firms with free allowances than with revenue generated from allowance auctions. When all allowances are auctioned, providing compensation to regulated entities involves both an auction and a subsequent recycling of auction revenue to those same entities (EAAC, 2010). Allocating allowances for free would eliminate the need to recycle auction revenue to these entities. Past cap-and-trade programs have precedent for allocating emissions allowances for free. The United States' cap-and-trade programs for SO_2 and NO_x allocated allowances for free (Kopp, 2007).

The value of free allowances automatically adjusts as the price of auctioned allowances change over of time at different auctions (EAAC, 2010). If the governing body in charge of a cap-and-trade market prioritizes compensating impacted entities for their increased costs arising from climate policy, this automatic adjustment might be an advantage because compliance costs tend to be closely related to allowance prices (EAAC, 2010). Thus, the amount of compensation awarded in a free allowance will rise in conjunction with higher compliance costs (EAAC, 2010).

Allocating allowances for free can curbs the economic problem posed by carbon leakage.

Carbon leakage occurs when an environmental regulation (in this case, cap-and-trade) in one jurisdiction can cause production the costs and prices of carbon in that jurisdiction to increase relative to the cost of carbon in jurisdictions that do not have comparable regulations (EAAC, 2010 & Bushnell and Chen, 2009 & Pew Center on Global Climate Change, 2007). This can precipitate a shift in goods produced in the jurisdiction implementing cap-and-trade toward goods produced outside the jurisdiction, such a shift results in reduced GHG emissions in the implementing jurisdiction being offset by increased production and GHG emissions in areas outside the implementing jurisdiction (EAAC, 2010 & Bushnell and Chen, 2009 & Pew Center on Global Climate Change, 2007). One particular form of free allocation—output-based updated free allocation—can mitigate carbon leakage by keeping prices low for firms within the implementing jurisdiction and thereby helping those firms maintain their share of the larger market. Output-based updated allocation offers firms free allowances as a function of their levels of production in the current or in a recent time period. As a result, it can help in-state firms maintain their output levels and thereby retain market share (EAAC, 2010 & Bushnell and Chen, 2009).

Despite the claimed drawback that free allocation of allowances reduces a firm's incentive to reduce emissions; the number of free allowances a firm receives does not reduce incentives to abate emissions or to invest in new, low-emissions technologies. Firms minimize their costs by reducing emissions up to the level where the incremental cost of further emissions abatement just equals the allowance price (EAAC, 2010). This level is largely unaffected by the number of allowances the firm receives for free (EAAC, 2010).

Free allocation can shield consumers from the additional costs a cap-and-trade program places on every unit of emissions. This price would be included to some extent in energy intensive goods (i.e. electricity) causing the price of those goods to rise. This is especially true in

regulated electricity markets where local regulators are likely to require utilities to pass along savings from their free allocation (Pew Center on Global Climate Change, 2007). Allowances could be distributed to non-regulated entities for free in order to achieve other policy goals. For example, allowances could be given to local governments, which could then sell them and use the proceeds to subsidize energy costs or efficiency investments for low-income customers (Pew Center on Global Climate Change, 2007). Allowances could also be allocated to a trust fund and proceeds from the allowance sales used for technology programs, to mitigate the economic costs of the cap-and-trade program to affected firms, workers, or other entities, or to address the consequences of climate change. (Pew Center on Global Climate Change, 2007). By helping to ease transition, free allocation can help achieve buy-in of newly regulated firms to a climate change policy.

AUCTIONING OF ALLOWANCES

Several cap-and-trade programs employ auctioning as a method of distributing allowances. Several rationales for the use of an auction for the initial distribution of emissions allowances exist. At least a small percentage of all allowances under a cap-and-trade program should be auctioned to determine price discovery, ensuring the smooth functioning of the market, especially when the market is in its infancy (EAAC, 2010). Under the Acid Rain Program 1990, a small portion of SO_2 emissions allowances were auctioned, and played a valuable role in identifying the market-clearing price in the early years of the program (EAAC, 2010). One attraction of auctioning is that it can make the assignment of allowance value more transparent. By allocating free allowances, administrative approaches can involve complicated formulas that obscure the identities of the true recipients of the allowance's value or the magnitude of the value being distributed (EAAC, 2010). The assignment of value raised through an auction is more accessible to observers because it involves a direct transfer of dollar value (EAAC, 2010). A cap-

and-trade program in which all compliance entities must obtain allowances through an auction eliminates the need to adjust an allocation scheme to deal with emission sources entering and exiting the market (EAAC, 2010). New entrants would see the same cost as their competitors when entering the market (EAAC, 2010). Auctioning allowances provides a better signal of a firm's true costs of GHG abatement than free allocation. When allowances are introduced through a competitive auction, the market price of allowances indicates the costs that firms bear to reduce emissions (EAAC, 2010).

Economic analyses indicate that in many cases, a large majority of the cost of allowance purchases will be passed on to consumers. This occurs because a firm would be able to recover the cost of allowance purchases even before the firm is actually required to surrender allowances at the end of a compliance period (EAAC, 2010). Also, free allocation might be more unwieldy when used to provide allowance value to other entities (EAAC, 2010). For example, when free allocation is given to entities such as local governments or community-based organizations, or to individuals directly, there is an added transaction cost imposed on these parties (relative to the case where the parties receive auction proceeds) as these parties would subsequently need to sell the allowances to convert them to cash (EAAC, 2010). A proposed solution to this problem would be to enable allowance sellers to participate in the auction along with buyers (EAAC, 2010).

Auctioning is preferable to free allocation because auctioning rewards firms that reduce their emissions through investment in cleaner fuels or low-carbon technologies. Such firms would have to purchase fewer allowances compared to firms that have not made these investments (EAAC, 2010). In contrast, free allocation may fail to reward firms that invest in these technologies (EAAC, 2010). Consequently, firms that have relatively high emissions would continue to receive high level of free allowances (EAAC, 2010). This is actually an argument

against a particular form of free allocation, fixed-free allocation (EAAC, 2010). As discussed below, many existing cap-and-trade programs with free allocation are designed to avoid rewarding firms that have failed to make earlier investments in cleaner production methods (EAAC, 2010). Revenues resulting from auctions can also be used to fund environmentally desirable programs and policy objectives similar to the five policy alternatives described in Chapter 4.

Revenues from cap-and-trade auctions create opportunities to achieve greater economic efficiencies. Goulder, Perry, Roberton, and, Burtraw (1998) & Dinan and Rogers (2002) found using auction revenues to reduce preexisting taxes on labor and capital would create efficiency benefits for an entire economy and mitigate the economic hindrances caused by cap-and-trade (as cited by Åhman, Burtraw, Kruger, and Zetterberg, 2005). On a larger scale Bohringer and Lange (2004) found transitioning away from freely allocating carbon allowances towards auctioning them is the only way to achieve efficiency in the apportionment of GHG emission reductions within and outside the cap-and-trade system (as cited by Åhman, Burtraw, Kruger, and Zetterberg, 2005). However, due to the Sinclair Paint decision discussed in the introductory chapter, spending cap-and-trade revenues for such a purpose would face a high probability of failing the Sinclair Nexus Test. Lastly, auctioning allowances is in keeping with the polluter pays principle. Emission sources bearing responsibility for the effects of climate change should pay for the damage done to the natural environment and efforts to repair the damage (Pew Center on Global Climate Change, 2007).

ALLOCATE FREE ALLOWANCES VS. AUCTIONING ALLOWANCES

What Do Others Say?

Other groups have reviewed the issue of free allowances versus auctioning allowances for potential cap-and-trade programs and issued their own recommendations. The U.S. Climate

Action Partnership recommended initially allocation a significant portion of allowances for free to entities and economic sectors particularly disadvantaged by the secondary price effects of a cap on GHGs (Pew Center for Global Climate Change, 2007). Over time, the share of allowances allocated for free would diminish. The National Commission on Energy Policy proposed an initial 50/50 split between free allowances and auctioning allowances (Pew Center for Global Climate Change, 2007). The Commission believed allocating emissions in at 50/50 manner would effectively direct substantial resources to aid in the transition to a low-carbon economy and at the same time fairly compensate major affected industries for short-term economic dislocations incurred as a result of the policy (Pew Center for Global Climate Change, 2007). ARB's Market Advisory Committee (2007) recommended that over time auctioning should be a key part of allowance allocation under the cap-and-trade program. However, the state should retain flexibility to allocate a share of allowances for free to certain sectors in the near term. RGGI (n.d.) auctions approximately 90 percent of its allowances over four quarterly auctions a year.

Recommendation

I recommend an initial mix of allocating allowances for free and auctioning allowances that shifts toward an auctioning of allowances over time. Choosing to freely allocate or auction 100% of all allowances ignores valid issues raised by previous literature on both free allocation and auctioning allowances. Certain carbon-intensive industries (e.g. cement manufacturing, energy production) will require free allowances for some time to mitigate price impacts, provide sufficient transition time, and maintain a level playing field for those industries compete with out-of-state competitors. However, I would increase the share of allowances sold at auction over time to avoid over compensating firms with too many free allowances and to encourage the installation of GHG reduction measures to meet the goals of AB 32. How to distribute free allowances

becomes another an importance question once it is determined a certain share of allowances will be allocated for free.

REVIEW OF FREE ALLOWANCE ALLOCATION SCHEMES

The allocating schemes for free allowances are broken down into two categories: fixed allocation and updated allocation. Under fixed allocation, the allocation of allowances to entities under cap-and-trade does not adjust in response to current or future behavior. Under updated allocation, the free allowances allocated adjust over time in response to behavior and market conditions. Two sub-categories of updated allocation include output-based updating and benchmarking. Output-based updating means each firm covered by cap-and-trade receives an allocation proportional to the GHGs it emits, while holding the overall emissions cap intact (EAAC, 2010). Under the benchmarking approach, the regulator establishes a baseline emissions rate for an industry (i.e. utilities) or process (i.e. coal-fired electricity generation) and awards carbon allowances to all facilities in that industry according to the benchmark (EAAC, 2010).

Recommendation

I recommend allocating free carbon allowances using the output-based updating allocation scheme. The output-based updating allocation scheme's best attribute compared to the other allocation schemes is its ability to prevent carbon leakage (EAAC, 2010). Carbon leakage of carbon-intensive firms would offset GHG reductions accomplished from AB 32. Instead of firms remaining in California and reducing their overall GHG emissions, they would leave the state but continue to emit similar amounts of GHGs into the atmosphere. Accomplished GHG reductions within California would be offset by increased GHG emissions outside California. Unless cap-and-trade auction revenues are dedicated to programs and projects designed to prevent carbon leakage, output-based updating can serve as an initial policy tool to perform the task. The threat of carbon leakage and output-based updating's ability to prevent it from happening is why I

choose this method. Benchmarking is also known to help prevent carbon leakage. However, the benchmarking method is less effective in its execution of preventing carbon leakage than the output-based updating allocation scheme (EAAC, 2010). The rest of the literature review will focus on the how cap-and-trade revenues may be spent.

POTENTIAL REVENUE SPENDING OPTIONS

California's cap-and-trade revenue may be spent toward a variety of public policy related areas, so long as it passes the Sinclair Nexus Test. As discussed in the introduction, the Sinclair Nexus Test requires the spending of cap-and-trade revenues toward purposes related to mitigating the effects of GHGs. In this section of the literature review, I review previous literature and testimony on how cap-and-trade revenues may be spent. I divided the ways of spending cap-and-trade revenues into six categories energy efficiency, water usage, natural resources management, transportation infrastructure, research and development, and green financing.

Energy Efficiency

Increasing the efficient usage of energy is a consistently touted category of reducing GHG emissions. Increased energy efficiency in reduces society's energy needs from fossil fuels, helping control GHGs released into the atmosphere. Creyts, Derkach, Nyquist, Ostrowski, and Stephenson (2007) suggest there are many cost-effective GHG reduction measures that can be implemented or expanded upon. The relative energy inefficiencies and projected growth of residential and commercial buildings provides numerous opportunities to institute and build in durable energy efficient products and structures, to reduce energy usage of fossil fuels.

Energy Efficiency in Buildings

Among the potential energy efficiency possibilities within commercial and residential buildings include the efficient usage of lighting, Heating, Ventilation, and Air Conditioning (HVAC) equipment, building insulation, and water heating (Creyts, Derkach, Nyquist, Ostrowski,

and Stephenson, 2007). Replacing incandescent light bulbs with compact fluorescent or LED lighting saves energy used towards lighting residential and commercial buildings. New homes and offices buildings can be installed with air conditioners containing higher seasonal energy efficiency ratios and fueled by less carbon-intensive natural gas instead of liquefied petroleum or fuel oil (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). Similarly, energy efficiency in water heaters would improve with natural gas water heaters replacing heating oil water heaters (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). Tankless and condescension water heaters also achieve the same results as heating oil water heaters with less energy needed. Energy retrofits better insulate residential homes from losing heat during cooler temperatures and losing cold air during warmer temperatures by installing tighter-fitting and better-insulated windows and doors, leak proof ducting, additional attic and wall insulation, and commercial grade house wrap (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). Despite the better insulation of commercial buildings compared to residential buildings, the installation of programmable thermostats and energy management systems serve as the best ways to improve insulation of commercial buildings (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007).

Energy Efficiency in Vehicles

Cost-effective energy efficiency spending can also be found in making vehicles more efficient. Biofuel replacement of current carbon-intensive fuels is considered one of the most cost-effective solutions, followed by technology upgrades to improve energy efficiency in light-duty vehicle fuel economy cars, trucks, medium-heavy truck fuel economy, and light duty plug-in hybrids (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). Energy efficiency improvements within in light-duty vehicle fuel economy cars include dual-cam phasing, improved alternators, vehicle weight reduction, lower rolling resistance tires, and turbo charging

(Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). Improved aerodynamics, advanced transmissions, fuel cell operated auxiliaries, and improved thermal management are considered optimal ways of improving efficiency within medium- to heavy- weight vehicles, particularly trucks (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). The rise of biofuels must be preceded by considerable enzyme innovation to improve yield rates and shorten process times (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007).

Various non-price market barriers inhibit energy efficient projects and programs. Split incentives occur when the potential purchaser of an energy efficient product does not consume and therefore receive the benefits of reduced energy consumption and lower utility payments (EAAC, 2010 & Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). For example, a landlord would have to bear the cost of purchasing the efficient energy system as the renter receives benefit of a reduced energy bill. An energy efficient product's higher upfront costs combined with a lower rate of future cost savings cost-savings would also inhibit a potential consumer from purchasing the product (EAAC, 2010). A lack of information on energy efficiency products and how their lifecycle costs compare to less efficient products lowers the likelihood consumers will purchase energy efficient products (EAAC, 2010 & Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). The transaction costs of time and effort are required to analyze alternative projects and install energy efficiency measures (EAAC, 2010). Cavanagh (2004) found these sorts of market barriers cause consumers nationally to use at least 20 – 40 percent more electricity than they would in a well-functioning, cost-minimizing market (as cited by EAAC, 2010). Energy efficiency purchases would occur at a quicker pace if the previously described market barriers could be overcome with public or private help, or if energy costs (i.e. gas and heating oil prices, utility rates) remained relatively high.

Water Usage

California's large and costly water system holds potential investment opportunities for cap-and-trade revenues. The amount of energy required moving, treating, and managing California's water supply opens the door for investments in reducing energy consumption. Pumping stations move much of California's water supply from the northern portion of California to communities and large farms of the San Joaquin Valley and to the metropolitan areas of southern California. Water treatment plants must continuously clean wastewater to be reused for safe commercial, agricultural, or residential usage. Approximately 20% of electricity and 30% of non-power producing gas consumed in California is used in some form the management of the state's water supply (Snow, 2012). The replacement of hardware water machines (i.e. washing machines, water heaters, groundwater pumps) with energy efficient models would reduce water and energy usage (Snow, 2012 & Creyts, Derkach, Nyquist, Ostrowski, & Stephenson, 2007). Funding Council of Governments and Metropolitan Planning Organizations (MPOs) could allow for the full integration of water management into community designs and development. A portfolio approach to water management named Integrated Regional Water Management has potential to reduce the required energy used in water management. Cap-and-trade funds would sustain the progress of Integrated Regional Water Management projects to meet specific GHG reduction targets (Snow, 2012). However, due to the very fragmented governing structure over California water, energy savings will be difficult to register due to different institutions along the water chain and energy chain that do not investments to make energy savings.

Natural Resources Management

Managing, maintaining, and restoring particular natural environments within the state will increase the ability of California's natural resources to remove CO_2 from the atmosphere, reducing statewide GHG levels. The Conservation Reserve Program within the United States

Department of Agriculture is cited as carrying out the foremost example of national public efforts of natural resource management and conservation (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). The photosynthetic process within all plants absorbs CO_2 to create its own energy (Nelson et al, 2009). This process of absorbing CO_2 to create reservoirs of carbon in the ground, known as carbon sinks, is called carbon sequestration. Natural carbon sequestration requires plants within forests, wetlands, and riverbanks, grasslands, and agricultural lands using the photosynthetic process to build up massive reservoirs of carbon that would otherwise remain in the atmosphere as CO_2 (Passero, 2012). An example of a state-specific carbon sequestration project would include a wetlands restoration project within the California Delta region and the funding of state conservancies (Snow, 2012 & Passero, 2012). Other examples of creating carbon sinks are urban forestry, open space, and working lands and maintain ongoing climate benefits (Passero, 2012).

As plants die or lie dormant during colder months, the carbon absorbed by plants may be converted back into CO_2 or CH_4 (Nelson et al, 2009). Agricultural practices of planting winter cover crops such as legume or a grass cover over a dead or dormant area of plants during the winter months can preserve the carbon residue within the soil (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007).

Changes in land and soil use can trigger changes in soil carbon accumulation. The process is dynamic, involving plant growth above the soil surface and organic carbon sequestration below the surface (Nelson et al, 2009). Eventually, the system reaches a new soil carbon stock equilibrium or saturation point, and no new carbon is absorbed or lost (Nelson et al, 2009). This sequestration process can continue for 50 years or longer (Nelson et al, 2009). Under constant conditions, the amount of soil organic carbon eventually stabilizes, but changes in land management practices can bring soil organic carbon stocks to a new equilibrium, with more or

less carbon sequestered than under old practices (Nelson et al, 2009).

Afforesting pasture and farmlands covert land used for animal grazing and growing crops into forests, allowing the land to consume larger amounts of CO_2 than it did before. The costs of afforestation come in the form of opportunity costs of lost farm/pastureland productivity, the seed, labor and equipment costs to convert the land to forest, and cost to maintain the forest over a period of time (Creyts, Derkach, Nyquist, Ostrowski, & Stephenson, 2007). Opportunity costs are generally smaller when converting pastureland compared to farmland due to fewer nutrients in the ground of pastures. Reduced-till and no-till farming practices store carbon within the ground by preventing the disruption of organic matter in the soil, allowing the carbon-based organic matter to accumulate in the ground rather than be released as CO_2. Carbon would continue to build up in until the soil reaches a saturation point (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). Active forest management (improving timber stands), passive forest management, (allowing natural regeneration by measures such as restricted grazing) reforestation (planting additional trees in low-density or recently harvested forests) are low-cost resource management opportunities (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). However, these solutions produce a relatively small level of carbon sequestration compared to other natural resource management projects.

Only so much carbon may be stored within the surface and the involvement of several stakeholders is required. Like a sponge soaking up water, undisturbed soil can only absorb so much carbon before it reaches a saturation level and can no longer absorb any more carbon (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007). The wide distribution of natural resource management stakeholders, the regions the cover and, self-interest motives makes it difficult to create an incentive program that balances development and conservation of natural resources (Creyts, Derkach, Nyquist, Ostrowski, and Stephenson, 2007).

Transportation Infrastructure

Several stakeholders in the AB 32 implementation process stressed the importance of investing in various forms of infrastructure as a means to limit statewide GHG emissions. Despite a total of $10 billion spent per year on transportation infrastructure for the first decade of the 21st Century, the California Transportation Commission (2012) projected an estimated $29.6 billion/year infrastructure-funding shortfall from 2013-2022 as federal transportation and infrastructure funding have not met California's growing demand for infrastructure spending (LAO, 2011 & Earp, 2012). Such a backlog of funding for transportation creates inefficiencies in the transportation of goods and people throughout the state, resulting in wasted energy and carbon-intensive fuels. Experts and stakeholders cite a better-funded transportation infrastructure as a means to improve the performance of vehicles, reduce inefficient portions of transportation system, and reduce overall GHG emissions resulting from transportation. Such transportation funding could go towards the smoothening of roadways, maintenance of the state's bridges, and carrying out the implementation of SB 375 though maintaining local street, road and bike lanes, expanded funding for bus and rail lines, and a funding the Sustainability Communities Strategies of MPOs needed to implement the Sustainable Communities and Climate Protection Act of 2008, also known as SB 375 (Earp, 2012 & Burtraw, 2012 & Davis, G. 2012 & Hanak, 2012). SB 375 required the state's eighteen MPOs to meet GHG reduction targets through infrastructure planning integrated with local land use and housing policies (Institute of Local Government, n.d.).

Research and Development

There are several reasons for public sector involvement in research and development. Private companies typically underinvest in research and development for new low- and zero-carbon technologies while studies suggest that obtaining funding is particularly difficult for

projects in the development phase due to knowledge spillover (EAAC, 2010). Economists often refer to knowledge spillover as a main source of underinvestment in research, development or innovation. That is, entrepreneurs under invest because they cannot appropriate all of the social return from their efforts; some of the knowledge they generate spills over to and benefits other parties (EAAC, 2010 & Popp, 2006). Cap-and-trade revenues could be channeled into programs and policies targeted at overcoming the market barriers impeding private investment in research and development. In particular, revenues could be deployed during the technology demonstration/pre-commercialization phase in a product's life cycle, which the Economic and Technology Advancement Advisory Committee, (2008) identified as the critical stage for public financing. Private investors may be less willing to invest in technologies as they advance from invention to commercialization because of the difficulty of managing market, regulatory and other risks (Brown, Chandler, Lapsa, and Sovacool, 2008). At this point, when return on investment cannot be readily projected, additional funding is necessary to see if the technology has commercial promise (EAAC, 2010). Modest investments in research and development have been described as key to transforming the state's energy supply from carbon-based to renewable-based, with spillover benefits that benefit the rest of the economy (Burtraw, 2012 & Hanak, 2012). Dooley (2012) of the University of California recommended any cap-and-trade revenues toward research and development should go through a competitive peer-reviewed process to improve the overall quality of the research conducted.

Still there is a divide on just how much government should fund research and development relative to other carbon abatement policies. Wigley, Richels, and Edmonds (1996) argued that the prospect of technological change though research and development justifies relatively little current abatement of CO_2 emissions (as cited by Goulder and Mathai, 2000). In effect, it is better to wait for scientific advances make GHG abatement efforts less costly. In

contrast, Ha-Duong, Grubb, and Hourcade (1997) maintained that the potential for induced technological change though research and development funding justifies relatively more abatement in the near term, in light of the ability of current abatement activities to contribute to learning by doing (as cited by Goulder and Mathai, 2000).

Popp's (2006) use of the ENTICE model to project how government funding of research and development through both subsidizes. Results showed research and development subsidies have a significant effect on the long run levels of energy consumption (Popp, 2006). However, it was also found spending on research and development on low- and zero-carbon technologies alone does not provide enough incentive to adopt new emissions technologies. GHG emissions do not fall unless research and development spending are accompanied by policies to address the negative externality created by GHG emissions, such as regulations or market-based mechanisms (Popp, 2006).

Research and development to produce technological change and innovation would affect the outcome of other abatement strategies. Goulder and Mathai (2000) found cost-effective abatement is achieved by a price of CO_2 equivalent set equal to the marginal abatement cost at the desired level of abatement. Additionally, technological progress from research and development lowers marginal cost of abating GHG emissions (Goulder and Mathai, 2000). When knowledge is gained through publicly funded research and development, the presence of that knowledge and subsequent change in technologies justifies shifting the implementation of certain abatement policies from the present to the future, because the cost of those programs will decrease (Goulder and Mathai, 2000). However, when the government employs the benefit-cost policy criterion, the presence of induced technological change justifies greater overall GHG abatement than would be warranted in its absence (Goulder and Mathai, 2000).

Goulder and Schneider (1999) used analytical and numerical general equilibrium models in studying research and development investments. Their models found the presence of research and development induced technological change. This strengthens the case for GHG abatement because it implies larger net benefits for any given specification of abatement costs, environmental benefits from abatement, and the productivity of research and development expenditures (Goulder and Scheider, 1999). If a threshold of net benefits from GHG abatement policies needs to be met due to administrative, political, and distributional costs that must be obtained before implementing an abatement policy, technological change from research and development could help GHG abatement policies overcome that hurdle (Goulder and Scheider, 1999). Panelists before the ARB argued in favor of money toward research and development as a means to assist in the early process of transformative clean energy and green technology systems (Burtraw, 2012 & Hanak, 2012 & Dooley, 2012).

Green Financing

A discussed solution to aid private sector innovations and advancements in green technology and energy efficiency includes various forms of government-assisted financing. One such example, a "green bank," is modeled after the public-private partnership employed by the Federal Export Import Bank and the Quasi-Public Clean Energy Finance and Investment Authority (CEIFA) in Connecticut (Mielke, 2012). A green bank would leverage private sector capital to drive investment and scale up green energy and energy efficiency projects from California's clean energy companies (Mielke, 2012 & CEIFA, n.d.). Other suggested public-supported financing tools are using cap-and-trade funds as seed money for revolving loan fund to provide low-interest loans to firms, farms, and public agencies and/or a state-funded reinsurance program to mitigate the financial risk of private insurers of green energy programs (Mielke, 2012). Public-supported reinsurance for green technology and energy efficiency projects

encourages insurance firms to take part in the green economy by limiting the risk assumed by insurance firms should circumstances require the insurer to pay the insured party (Mielke, 2012). Both the revolving fund and re-insurance program would finance and support projects related to green energy, energy efficiency, or any program related toward the goals of AB 32. All such financing tools would be used to ease development of programs that might not otherwise have obtained capital without government intervention.

The ways of spending cap-and-trade auction revenues in pursuit of the goals of AB 32 are numerous. I divided potential spending options into the six different categories of energy efficiency, water usage, natural resources management, transportation infrastructure, research and development, and green financing. Energy efficiency projects include energy saving measures in buildings, household appliances, and vehicles; some of which have already been pursued by other public programs in California. Water usage deals exclusively with changes to the state's vast water supply and delivery system to use energy in a more efficient manner than used currently. The careful management of natural resources can reduce carbon in the atmosphere creating larger carbon sinks into the ground and greater usage of trees and other photosynthetic plants to break down CO_2. Spending on transportation infrastructure ideas can include expansion or renovation of public transportation, bicycle and walking roadways, and highways and freeways for private vehicle in order to decrease the per person and overall pollutions rate within the state. Research and development comes with a larger degree of risk as many investments into potentially new green or energy efficient technologies may not be brought to market for various reasons. Though relatively newer and fraught with risks, green financing puts money into private sector efforts to reduce GHG emissions by creating financial incentives and risk management options.

OVERCOMING INEQUITIES GENERATED BY CAP-AND-TRADE

Preventing Disproportionate Impacts on Low-Income Households

Cap-and-trade's placement of a price on GHG emissions will increase prices for California households directly (electricity, natural gas, and gasoline) and indirectly as businesses pass the costs of GHG abatement on to consumers (EAAC, 2010). Boyce and Riddle (2009) found a price on GHGs would have a regressive impact on prices, increasing prices on individuals and families earning less income at a relatively higher rate (as cited by EAAC, 2010). Recent research by Kunkel and Kammen (2009) suggests that preventing a disproportionate impact would not require a significant fraction of the total allowance value (as cited by EAAC, 2010). It is important to recognize that these estimates do not account for the impact of other AB 32 measures such as the Low Carbon Fuel Standard or the Renewable Portfolio Standard. However, even if these other measures were to double the impact on households, the overall impact would remain very small. Thus, there seems good reason to expect that, compared to the total allowance value generated, very little would be needed to prevent a disproportionate impact.

A disproportionate economic impact could be prevented in a number of ways. One is by using allowance value to finance targeted subsidies that prevent energy prices from rising for low-income households (EAAC, 2010). A downside to the subsidy approach is that it reduces incentives for consumers to reduce energy consumption. As a result, in order to meet the overall AB 32 cap, greater reductions are required from other entities, raising the overall cost of the cap-and-trade program (EAAC, 2010). An alternative to the subsidy measure would use cap-and-trade revenues to finance cash transfers. Such transfers could provide compensation without reducing incentives to conserve energy. A past proposal within federal the American Clean Energy and Security Act, would allow eligible households (with incomes at or below 150 percent of the official poverty line) to receive a monthly refund via the Electronic Benefit Transfer cards that

states already use to deliver food stamps and other benefits (EAAC, 2010).

Other existing programs to assist low-income consumers, such as low-income energy efficiency programs, transit passes, rate assistance and commuter checks that could be used as vehicles for compensating disproportionately impacted consumers, particularly if there funding levels are below an optimum level (EAAC, 2010).

Capital and Labor in Carbon Intensive Industries

Carbon-intensive firms and within a cap-and-trade program will face increased pressure from firms not regulated under the cap-and-trade program (Burtraw, McLaughlin, and Szambelan, 2012). This pressure may results in lost economic output and a reduction in payrolls, putting individuals out of work. One potential solution to the prospect of greater competitive disadvantages for firms inside the cap-and-trade programs is instituting an output-based allocation of free allowances to such firms, providing an incentive to keep jobs and economic activity within the jurisdiction of the cap-and-trade area (Burtraw, McLaughlin, and Szambelan, 2012). This problem was mentioned earlier in the chapter. Another mechanism discussed to level the economic playing field between firms under and not under a cap-and-trade program involves making border adjustments on certain carbon-intensive products made outside the cap-and-trade jurisdiction as it is transported within the jurisdiction under cap-and-trade (EAAC, 2010). Such a border adjustment would equalize prices between the same products despite being made in two areas with different environmental regulations.

For businesses that downsize or cease operations, their employees will require help in finding a new job and/or developing new skills to pursue a career in a different field. Fairness considerations suggest possibly using cap-and-trade revenues to fund worker transition assistance programs for employees who lose their jobs due cost increases perpetrated by the cap-and-trade program (EAAC, 2010). The assistance would be designed to give these displaced workers the

time and resources to carry out a job search and, if necessary, the training to find a new job in another industry. A model for this type of program already exists in the federal Trade Adjustment Assistance (TAA) program. TAA provides assistance to workers who lose their jobs or fulltime status, either because the firm's customers switched to foreign suppliers or because the firm relocated the production facility to a foreign location (EAAC, 2010).

CHAPTER 2 SUMMARY & NEXT CHAPTER

The first half of the following chapter summarized relevant literature on allocating and auctioning allowances, the different methods of allocating free allowances, my final recommendations on distributing allowances to entities under cap-and-trade. The second half of the chapter summarized categories of how California may spend cap-and-trade revenues to meet the goals of AB 32. The following chapter of the thesis explains the methodology of the paper. The foundation of the methodology section includes a process termed "The Eight-Step Path" and the Criteria-Alternatives Matrix. The matrix weighs a list of policy alternatives, in this case of cap-and-trade revenue spending options, against criteria to evaluate the projected outcomes of each spending option.

CHAPTER 3

METHODOLOGY

The chapter details a transparent methodology used to evaluate the different spending options for revenue raised through California's cap-and-trade auctions. I begin by explaining Bardach's (2009) Eight Step Path to Policy Analysis and how this can be formally translated, as described in Mintron (2012) into a criteria-alternative matrix (CAM) analysis. A description of what a final CAM would look like will follow. After a basic understanding of a CAM analysis and a CAM is presented, I present the positive and negative reasons for using a CAM analysis. Under certain circumstances CAM will require a researcher to assess the tradeoffs between different policy solutions and their outcomes. I explain what that entails as well. I will further delve into the development of criteria, its importance in determining the best alternative to pursue and the criteria I plan to use for my analysis. These criteria include efficiency, equity, external environmental effect, transparency/accountability, robustness/improvability, legality, and political acceptability.

THE EIGHTFOLD PATH

A CAM stems from a policy analysis of a larger scale that can be divided into eight separate steps. Bardach (2009) outlined eight potential steps from defining a policy problem to explaining the policy solution(s) decided upon as the best way to address the policy problem. This process was coined as "The Eightfold Path" (Bardach, 2009). The Eightfold Path can be divided into sections titled Define the Problem; Assemble Some Evidence; Construct the Policy Alternatives; Select the Criteria; Project Outcomes of Policy Alternatives; Confront the Trade-Offs; Decide Best Alternative(s); and Explain Why Alternative(s) Was/Were Chosen. These steps do not have to be followed in the order above, nor do all of them need to be followed for every policy problem before a policy analyst. For example, evidence gathering will likely occur

throughout the analysis, as the evidence gathered in the initial research phase will not contain all of the known literature on the topic. Within the Eightfold Path the alternatives and criteria selected may be used create a CAM.

CRITERIA-ALTERNATIVE MATRIX ANALYSIS

A decision-making framework to assess a public policy problem and potential policy alternatives in the manner previously described in a transparent way for an audience is through the use of a CAM analysis. A CAM analysis seeks to answer a public policy problem through various policy alternatives, projecting the outcomes of those policy alternatives, weighing the outcomes against selected criteria, and finally determining the best alternative(s) to pursue and move forward. It is recommended that CAM analyses limit themselves to a particular number of alternatives and criteria used in the analysis. Otherwise a CAM with too many alternatives criteria will become too large and complicated for the researcher and the researcher's audience to comprehend (Mintron, 2012). CAM analyses are intended to focus on the projected outcomes of policy alternatives, not the alternatives themselves. While an essential part of the CAM analysis, projecting outcomes of policy alternatives is considered among the most difficult portions to complete (Bardach, 2009). When analyzing complex policy issues it is sometimes advisable to stand back and assess complex and uncertain scenarios of three to six basic alternatives, combined with principle variants. A rule of thumb for eliminating alternatives are the ones that are obvious losers, much in a way that interviewers eliminate questions that, on the face, do not hold the same quality as other questions. Criteria that do not differentiate among projected outcomes of alternatives (that is, all the outcomes appear to do about as well or as poorly with respect to these criteria) should also be eliminated (Bardach, 2009). CAM analysis are typically structured and presented into accessible and easy to follow table.

Criteria-Alternatives Matrix

A CAM summarizes the entire CAM analysis in an understandable way for the audience that reads the policy research. When complete, a CAM will consist of a table of alternatives listed on the top row of the table and a list of criteria on the left-side column of the table. Each cell within the CAM contains the projected outcome of the alternative as assessed by the corresponding criterion within the left-side column (Bardach, 2009). Below is an example of a CAM.

Table 3.1 ***Example of Qualitative Criteria-Alternatives Matrix***

	ALTERNATIVES		
CRITERIA	**A tax or fee**	**A regulation**	**Provision of information**
Efficiency	Summary of evidence on efficiency of a tax or fee	Summary of evidence on efficiency of a regulation	Summary of evidence of provision of information
Equity	Summary of evidence on equity effects of a tax or fee	Summary of evidence on equity effects of a regulation	Summary of evidence on equity effects of provision of information
Simplicity	Summary of evidence on administrative simplicity of a tax or fee	Summary of evidence on administrative simplicity of a regulation	Summary of evidence on administrative simplicity of provision of information

Source: Mintron, 2012

CAMs offer a useful way to summarize evidence generated through use of the analytical strategies. The cells in the middle of the matrix must contain the researcher's assessments of expected outcomes. These matrices allow the researchers to keep track of what evidence he or she gathered on outcomes and where gaps remain to be filled. The matrices reduce the complexities of deciding what alternative seems most appropriate given the selected criteria, projected outcomes, and anticipated trade-offs (Mintron, 2012).

In contrast to qualitative CAMs, quantitative CAMs weigh criteria by placing a decimal for each criterion (all of which should ultimately add up to 1), and therefore weighing the criterion and its importance in evaluating the policy alternatives relative to the other criteria. The

reasoning behind establishing weights for each criterion in a CAM analysis is not well established and generates controversy (Fuguitt and Wilcox, 1999 as cited by Wassmer 2002). Assigning the same weight to each criterion implies each criterion is of equal importance: whereas assigning a higher weight to one criterion over the other implies the first criterion is of greater importance. Researchers should give explicit reasons for assigned differences in weights and to describe the remaining process of evaluation in a manner that allows readers to easily substitute alternative weights if they disagree with the researcher's chosen weights (Wassmer, 2002).

Criteria

To determine the overall quality of a policy alternative's outcomes, it must be measured against value judgments assigned by the researcher referred to as criteria. This portion of the Eightfold Path is referred as Selecting Criteria. Criteria introduce values and philosophical beliefs into the evaluation of policy alternatives (Bardach, 2009). Any policy will affect the world in desired, unwanted, predictable, and unpredictable ways. Researchers may use their own set of values, morals, and personal philosophy or the values commonly accepted by the society they reside in or the society under evaluation. Commonly used evaluative criteria in a CAM analysis of any policy area include efficiency, equity (also referred to as equality, fairness, and justice) and administrative simplicity (Bardach, 2009 & Mintron, 2012). Commonly used practical criteria include legality, political acceptability, robustness and improvability (Bardach, 2009). Criteria used less often in CAM analyses are freedom, human dignity, social harmony, and environmental sustainability (Mintron, 2012). When finalizing criteria before moving forward on the CAM analysis, it is best for the researcher to write the criteria as concise as possible and present them in a way that makes them understandable for policymakers and the general public (Bardach, 2009). Once the researcher selects the criteria to evaluate each policy alternative, he or she must decide how to weigh the criteria.

Pros of CAMs

CAMs organize difficult and complex policy alternatives, and evaluative judgments help the researcher and the researcher's audience better understand the policy problem and potential solutions to address the problem. With any policy project, researchers will often find it helpful to develop tables, lists, or diagrams that allow them to summarize the collected information and other materials. A CAM is useful for the researcher(s) and their intended audience. One of the positive functions of a CAM is it allows the researcher and audience to help see what evidence is available and what requires additional information (Bardach, 2009). CAMs also serve as an invaluable presentational tool for researchers. A great benefit of working with a matrix as you proceed with your project work is that it allows a research to very rapidly assess where their needs for evidence on have been met and where information gaps remain to be filled (Mintron, 2012). Some version of them can usually be incorporated into a final policy report on various fields of policy analysis.

Cons of CAMs

Despite the advantages of using a CAM, it does not resolve every issue an analyst faces while researching a public policy problem. Real world settings rarely afford the time for a research effort that would please the careful academic researcher (Bardach, 2009). Projecting alternative outcomes opens the door for researchers to project with too much optimism and too little realism (Bardach, 2009). This sort of problem has occurred in other policy contexts. State budget analysts projected state revenue increases by several billions too much in the wake of Facebook offering company stock to the public. Policy alternative interventions in complex institutional systems populated by actors who adapt to interventions in surprising ways makes it difficult to predict. Surprising behavior may emerge from such dynamics (Bardach, 2009)

Another problem for CAM analysis researchers is they cannot expect to make up their own policy ideas than those that have already been advanced (Bardach, 2009)

Trade-Offs

The researcher must consider the trade-offs between two or more outcomes when deciding between seemingly equal outcomes within a CAM. When a policymaker is presented alternatives that produce equally successful outcomes, they must be presented with the trade-offs between them. A common trade-off is between money and a good or service received by some projection of the citizenry. A common trade-off in regulatory policies, involves weighing privately borne costs (a firm's installing pollution abatement equipment) against social benefits (improved health of the affected population and the protection of forests) (Bardach, 2009). From an economist's perspective a trade-off could be explained as spending an extra X dollars for an extra unit of Service Y, we can get an extra Z units of good outcome. This kind of analysis requires a policymaker to ask if Z is more valuable than X And then to follow the obvious implication of the answer: if yes, decide for another unit of Y, if no; do not (Bardach, 2009). A research must remember that trade-offs should be assessed against the outcomes and not the alternatives selected (Bardach, 2009). Researchers need to offer advice concerning the trade-offs associated with pursing one-policy options over others. CAMs, when used in combination with appropriately chosen analytical strategies allow us to assess the trade-offs among valued goals given the pursuit of each alternative (Minton, 2012).

Summarizing CAM Analysis

CAM analyses are among the research methods a policy analyst may use to find solutions to public policy problems. The analysis measures the outcomes of policy alternatives against the values, judgments, and morals of the researcher and/or society in general. CAM analysis may easily be presented using a CAM to an audience of the general public or policymakers, so long as

the number of alternatives analyzed and criteria used does not become too great. The remainder of the chapter will focus on the criteria I use for the CAM analysis for potential spending plans for cap-and-trade revenues.

CRITERIA USED

The criteria I use are efficiency, equity, external environmental effect, transparency/accountability, robustness/improvability, legality, and political acceptability. I selected the criteria based on several readings and remarks from various individuals. The words of Bardach and Mintron listed basic criteria that may be used under CAM analysis of any policy issue. I also reviewed the testimony made before ARB in 2012 by experienced individuals and relevant stakeholders within the cap-and-trade program and environmental policy in general. These individuals and stakeholders presented their thoughts on what criteria should be used in response the following question posed to them: "What criteria should be prioritized in the development of an investment plan for auction funds and why?" (ARB, 2012c) Below are the seven criteria I use in my analysis.

Efficiency

This first criterion is generally among the most important evaluative criterion for any public policy alternative (Bardach, 2009 & Minton, 2012). In economic terms, efficiency can be deemed as the efficient spending of cap-and-trade revenues to yield the greatest reduction in GHG emissions. Simply put, how much many fewer GHGs are emitted into the atmosphere per $1 million spent on a particular policy alternative. Efficiency seeks to maximize the public interest at the least possible cost. While the efficiency criterion may not sound as one that favors humanistic policy alternatives, failing to consider efficiency as a criteria often leads to a failure to account the welfare of the "little guy" of a society affected by the policy alternative. Efficiency can take into account the cost-effectiveness of policy alternatives. As discussed in subsection

5.2.1, of EAAC's (2010) research to evaluate the various options in terms of cost-effectiveness, the measure of (net) cost needs to be more comprehensive than what is sometimes applied. In addition to capturing the direct investment cost (the setup cost and present value of operating costs), it needs to account for the costs of removing the relevant market barriers as well as the various external benefits from the investment (EAAC, 2010). However, Hanak (2012) warned members of ARB that too much of a focus on the cost-effectiveness of a policy alternatives would limit the ability of project to be wide-ranging, transformative, and large enough to reach the 2020 and 2050 GHG reduction benchmarks.

Equity

In addition to considering the social net benefits in the aggregate, ARB should consider investments warranted by justice considerations. The equity criterion would measure how GHG abatement options minimize the effect on low-income communities and other environmentally disadvantaged areas. The location, demographics, and environmental measurements of the area determine whether a community is labeled as environmentally disadvantaged. AB 32 aims to help these communities while reducing GHG emissions (EAAC, 2010). However, there are a great many different, and often opposed, ideas about what fairness should mean (Bardach, 2009). For example, it could be argued a surcharge on gas prices that funds liability insurance of all drivers would disproportionately hurt the poor who would otherwise not purchase insurance in the first place, while others would say it is equitable as those who go without insurance impose unfair premium expenses and risk of under compensation on the rest of society, including poor individuals who are insured (Bardach, 2009). For the sake of this study, I define equity as assisting disadvantaged communities in their efforts to reduce the effects of global warming.

External Environmental Effect

This criterion refers to the environmental co-benefits of various spending plans. In

addition, it also considers the extent to which investments would help reduce or increase carbon leakage. If a policy alternative leads to the leakage of carbon into areas outside of California, then the program has not done its overall job in reducing GHG emissions (EAAC, 2010). Other environmental co-benefits that may come from particular GHG emission reduction measures would include pollution abatement, removal of toxic substances and other harmful substances that do not contribute to climate change but lead to other adverse environmental affects.

Transparency/Accountability

This criterion refers to the ability of a spending option that has transparent elements and potential outcomes. A spending option would be considered more transparent if the appropriation of cap-and-trade revenues may is relatively easy to describe, making it easy for the public to comprehend. This would favor money directed to established programs that already have experienced staff and administrative mechanisms in place. It should also look for programs that have an educational and training component to ensure continued human capital to carry out cost-effective GHG reductions in the future. The operation of cap-and-trade funds in full public view would sustain public support for any investments (EAAC, 2010). It is worth emphasizing that the investments promoted by the ARB and other California agencies should be those that the private market would not otherwise initiate (EAAC, 2010). The focus is to help the private market perform in way that is most beneficial to the state (EAAC, 2010).

Legality

Legality refers to the ability of a policy alternative to withstand legal challenges from parties claiming the policy alternative violates preceding constitutional or statutory language. The feasibility of any public policy decision would be ruined if it violated constitutional, statutory, or common law (Bardach, 2009). Legal counsel should always be sought to help craft policy in order to survive subsequent legal challenges in the judicial branch (Bardach, 2009). I decided to

use this as a criterion due to the general usage of legality as a criterion and because of the expressed opinions of various individuals tied to the cap-and-trade program. Cap-and-trade stakeholders expressed to ARB that any cap-and-trade spending plan must withstand serious legal challenges in the court system; otherwise public support for cap-and-trade would wane (Davis, G., 2012 & Mielke, 2012 & Passero, 2012). California Chamber of Commerce filed a lawsuit against ARB on the eve of the inaugural cap-and-trade auction, arguing ARB's establishment of a cap-and-trade allowance auction exceeded its authority granted under AB 32 (Davis, D., 2012).

Robustness/Improvability

A policy alternative should be robust enough that even if the implementation process encounters issues, the policy outcomes will still prove to be satisfactory. I chose this criteria because any policy alternative, no matter how well envisioned, will face implementation issues that may need fixing in the future. Adverse implementation outcomes that should be avoided include long delays, capture of program or policy benefits by a relatively undeserving and unintended constituency, excessive budgetary or administrative costs, scandal from fraud, waste, and/or abuse that undermines political support, and administrative complexities that leave citizens and program managers uncertain as to what benefits area available or what regulations must be compiled with (Bardach, 2009). The best policy planners cannot develop the perfect policy alternative in the design stage. Therefore, policy alternatives should allow room for improvement on the original design. Careful evaluations of personalities, institutional demands, and incentives are typically needed when considering the Robustness/Improvability criteria.

Political Acceptability

A viable policy alternative to address the defined policy problem must have enough support within the government and among the stakeholders involved with the policy problem. No matter how good a policy idea may sound to the policy analyst in his or her office, it will require

additional support from key individuals within and outside of government and relevant organizations to successfully become law. Political acceptably essentially asks whether or to what extent a proposed policy alternative will be acceptable to relevant decision makers, legislators, administrators, powerful groups, citizens, neighborhoods, unions, or other groups. To avoid political unacceptability, policy alternatives must avoid receiving excessively wide or intense opposition and/or insufficiently broad or intensive support (Bardach, 2009).

Criteria Not Used

Selecting the final seven criteria required the elimination of criteria I considered including. Criteria removed from my study were: advancement of technology, decrease carbon leakage, and ties with existing plans. Many of these criteria were found through the testimony given by selected individuals before ARB and other reviewed literature. However, it is suggested that the number of criteria not get out of hand or else the analysis and resulting CAM Table will look too cluttered (Bardach, 2009 & Mintron, 2012). I choose efficiency because the public expects and demands the delivery of public services in an efficient manner. Equity concerns needed to be included because of AB 32's efforts to prioritize disadvantaged communities when feasible. I included both transparency/accountability and robustness/improvability criteria because both focus squarely on the implementation and operations of a policy alternative. Legality is necessary because opponents of AB 32 and the cap-and-trade program will exploit any legal opening available to them in order to invalidate as much of AB 32's cap-and-trade program as possible. Political acceptability remained because unacceptability among key government officials or stakeholders will derail any policy alternative, no matter how sound the idea. Lastly, I chose to keep external environmental effect because the non-GHG related environmental consequences of each policy alternative could simultaneously solve other environmental problems or exacerbate them.

Sensitivity Analysis

An important part of CAM analyses is to perform a sensitivity analysis on the assigned criteria weights. The weights given to criteria in a CAM are subjective always changeable. Researchers evaluating subjectively weighted criteria should always reweigh criteria to ensure criteria's role does not overshadow the importance of the policy alternative's projected outcomes. I seek to discover if my original and subjective assignment of criteria weights lead to the results on Table 4.6.

CHAPTER 3 SUMMARY & NEXT CHAPTER

CAM analyses are among the research methods a policy analyst may use to find solutions to public policy problems. The analysis measures the outcomes of policy solutions, in this case, potential spending plans for cap-and-trade revenues, against the values and judgments summed up in the criteria previously mentioned in the chapter (efficiency, equity, external environmental effect, transparency/accountability, robustness/improvability, legality, and political acceptability). The entire analysis; including alternatives, criteria, and projected outcomes can be summarized on a CAM table. The next chapter of the thesis will focus on the CAM analysis. The following chapter will project the outcomes of five cap-and-trade spending options. These options include spending based on the Governor's recent energy efficiency proposal, supplementing funding for local SB 375 implementation efforts, expand forests in natural habitats and urban environments, add funding to a current research and development program, and using cap-and-trade auction revenues to plant seed funding for a green bank. Seven criteria will weigh the five alternatives' outcomes.

CHAPTER 4

ANALYSIS

I complete the CAM table below after completing my analysis in this chapter

Table 4.1 ***AB 32 Incomplete Qualitative CAM***

	ALTERNATIVES				
CRITERIA	**K-14 energy efficiency for school and community college districts**	**Supplement SB 375 funding**	**Increase reforestation and urban forestry**	**Supplement AB 118 research & development funding**	**Provide seed funding for a new green bank**
Efficiency					
Equity					
External Environmental Effect					
Transparency/ Accountability					
Legality					
Robustness/Improvability					
Political Acceptability					

Before beginning the CAM analysis, I summarize the five alternatives listed in the top row and the seven evaluative criteria in left hand column of Table 4.1. Following my analysis, I fill in Table 4.1 with grades of "does not" satisfy the criterion, "poorly" satisfies the criterion, "adequately" satisfies the criterion, or "strongly" satisfies regarding the policy alternative's satisfaction of the criterion. I also use a quantitative CAM to directly compare and evaluate the five alternatives and conduct sensitivity analyses to determine the result of a quantitative CAM under different criteria weights.

FIVE POLICY ALTERNATIVES

This chapter will evaluate five policy alternatives of spending cap-and-trade revenues to achieve the AB 32's 2020 and 2050 GHG reduction benchmarks. State GHG emissions must

reach 1990 emission levels by 2020 and then reduced 80 percent below 1990 levels by 2050. The five alternatives I evaluate spending based on the Governor Brown's recent energy efficiency proposal, supplementing funding for SB 375 implementation, increasing reforestation and urban forestry efforts, supplementing AB 118 research and development funding, and providing seed money for a new green bank.

K-14 Energy Efficiency Proposal

The energy efficiency alternative I evaluate is based on a recent proposal from Governor Brown. The Governor's 2013–14 budget includes a plan to spend approximately $2.5 billion in new corporate tax revenue over five years to fund energy efficiency projects in school districts and community college districts (LAO, 2013). This policy alternative allocates the initial $2.5 billion raised from cap-and-trade auctions to fund energy efficiency projects to fund to K-12 school districts and community college districts. All energy-related funds to schools and community colleges would count toward the Proposition 98 minimum guarantee. The California Department of Education (CDE) and the California Community Colleges (CCC) Chancellor's Office would receive and distribute the revenue to school districts and community college districts on a per–student basis.

SB 375 Implementation Funding

My second policy alternative is to fund implementation of the Sustainable Communities and Climate Protection Act of 2008 or SB 375. California passed SB 375 into law two years following AB 32. SB 375 mandates local governing bodies achieve GHG emissions reductions goals set by ARB. Reduction goals are met by the creation and implementation of sustainable community strategies (SCS) within the state's eighteen MPOs. MPOs are federally mandated and transportation policy-making organizations composed of representatives from local governments and government transportation authorities within the boundaries of the MPO. Below is a table of

California's eighteen MPOs. An SCS demonstrates how the MPO's region would meet its GHG reduction goals through integrated land use, housing, and transportation planning (ARB, 2013b & Institute for Local Government, n.d.).

Increase Reforestation and Urban Forests

The third policy alternative would allocate cap-and-trade revenues to California State Parks (State Parks) to reforest state lands laid barren by wildfire and the California Department of Forestry and Fire Protection's Urban Forestry Program (Forestry Program) for urban forestation efforts. Currently, California's forests remove greater amounts of CO_2 through the photosynthetic process than emit CO_2 though wildfires and the decomposition of wood. However, ARB's (2008b) AB 32 Scoping Plan projects a reduced statewide carbon sink by 2020 and 2050; and recommended the inclusion of forest saving practices as a part of achieving AB 32 goals. One of the tasks performed by State Parks is reforesting barren parklands. State Parks took the lead to reforest burned portions of Cuyamaca Rancho State Park following the 2003 Cedar Fire (California State Parks, n.d.). The Forestry Program leads and funds efforts to advance the development of sustainable urban and community forests in California. The Forestry Program's Urban Forestry Field Specialists provide urban forestry support to communities, non-profit groups, and other municipal governments to create and maintain sustainable urban forests (CalFire, 2012a).

AB 118 Research & Development Funding

The fourth policy alternative dedicates auction revenues towards the California Energy Commission's (CEC) Alternative & Renewable Fuel & Vehicle Technology Program (also known as AB 118) to finance alternative fuel and vehicle efficiency research and development projects. AB 118 supplies financial assistance for businesses, vehicle and technology manufacturers, workforce training partners, fleet owners, consumers and academic institutions for

research and development of alternative and renewable fuels and advanced transportation technologies (CEC, 2011a). AB 118 funds these programs though competitive grants and other means at an annual amount of $100 millon per year (CEC, 2011a). AB 118's investment plan for FY 2011-12 is listed below.

Table 4.2 ***AB 118 Investment Plan 2011-2012***

	Project /Activity	**Funding Allocation for FY (2011-2012)**
Plug-in Electric Vehicles	Plug-In Electric Vehicle Readiness	$1 Million
	Charging Infrastructure	$7 Million
	Subtotal	***$8 Million***
Hydrogen	Fuel Infrastructure	$8.5 Million
	Subtotal	***$8.5 Million***
Natural Gas	Fueling Infrastructure	$8 Million
	Subtotal	***$8 Million***
Propane	Light-Duty Vehicle Incentives	$1 Million
	Fuel Infrastructure	$.5 Million
	Subtotal	***$1.5 Million***
Gasoline Substitutes	Advanced Ethanol and Gasoline Substitute	$8 Million
	E85 Fueling Infrastructure	$5 Million
	Subtotal	***$13 Million***
Diesel Substitutes	Advanced Diesel Substitute Production Plants	$8 Million
	Subtotal	***$8 Million***
Biomethane	Pre-Landfill Biomethane Production	$8 Million
	Subtotal	***$8 Million***
Medium- and Heavy-Duty Vehicles	Deployment Incentives for Natural Gas Vehicle	$12 Million
	Deployment Incentives for Propane Vehicles	$3 Million
	Develop and Demonstrate Advanced Technology Medium- and Heavy-Duty Vehicles	$8 Million
	Subtotal	***$23 Million***
Innovative Technologies, Advancing Field, and Federal Cost Sharing	Innovative Technologies, Advanced Fuels, and Federal Cost-Sharing	$3 Million
	Subtotal	***$3 Million***
Manufacturing	Manufacturing Facilities and Equipment	$10 Million
	Subtotal	***$10 Million***
Workforce Training and Development	Workforce Training and Development Agreements	$6.5 Million
	Subtotal	***$6.5 Million***
Market and Program Development	Sustainability Studies	$.5 Million
	Technical Assistance and Analysis	$2 Million
	Subtotal	***$2.5 Million***
	TOTAL	**$100 Million**

Source: CEC, 2011d

Green Bank

The final policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that could leverage financing for California's clean energy companies, provide low-interest loans, and/or offer reinsurance to mitigate risk for private insurers of green technology loans. The closest real world example of to this policy alternative is Connecticut's CEFIA. CEFIA (n.d.) invests its resources in an array of enterprises, initiatives and projects aimed to attract and deploy capital to finance the clean energy goals of Connecticut, develop and implement strategies that lower the cost of clean energy to make it more accessible and affordable to consumers.

SEVEN EVALUATIVE CRITERIA

The seven criteria used to evaluate the five policy alternatives above are efficiency, equity, external environmental effect, transparency/accountability, legality, robustness/improvability, and political acceptability. Efficiency evaluates a policy alternative's ability to maximize the public interest (reduce GHG emissions) at the least possible cost. The equity criterion measures how the cap-and-trade spending alternative addresses the effects of global warming on low-income communities and environmentally disadvantaged areas. The external environmental effect criterion evaluates the environmental co-benefits (pollution abatement, water quality) associated with each cap-and-trade revenue spending alternative. In addition, it also considers the policy alternative's effects on carbon leakage. Transparency/accountability evaluates whether the cap-and-trade spending alternative is relatively easy for the public to understand and comprehend. Legality looks at the chances of a policy alternative to withstand legal challenges from outside parties claiming the spending violates constitutional or statutory law. Robustness/Improvability evaluates whether the cap-and-

trade spending alternative will produce a satisfactory outcome if implementation problems occur. Political acceptability evaluates the level of support and opposition within the government and the relevant stakeholders for the cap-and-trade spending proposal.

Criteria Weights

Before evaluating each policy alternative I prioritize each criterion relative to each other and assign appropriate weights. While each criterion has legitimate reasons to receive greater importance than others, I give more weight to the efficiency and legality criteria. I specifically chose these two criteria because of the public's high expectations for efficiently spending government revenues and the continued threat posed by current and potential future lawsuits against cap-and-trade. I assigned the following weights to each criterion efficiency (.5), equity (.05), external environmental effect (.05), transparency/accountability (.05), legality (.2), robustness/improvability (.05), and political acceptability (.1). All criteria weights add up to one. Below, I begin my evaluation with the efficiency criterion. I alter the initial set of criteria weights during my sensitivity analysis later in the chapter.

ANALYSIS

Efficiency

The energy efficiency proposal takes the initial $2.5 billion in cap-and-trade revenues to fund energy efficiency upgrades in K-12 schools and community colleges across the state. Energy efficiency upgrades would reduce energy consumed from carbon-intensive sources, lowering statewide GHG emissions. This policy alternative satisfies the efficiency criterion in a poor way. By allocating $67 to districts on an annual, per–student basis, the policy alternative, based on the Governor's proposal, would result in some school districts lacking enough funding to implement major energy–efficiency improvements in the first year of the program (LAO, 2013). For example, a school district having 100 students would receive $6,700 in funds during the one

school year. $6,700 is unlikely to be sufficient to undertake comprehensive energy efficiency improvements for a school facility. Given that approximately 10% of California's school districts have fewer than 100 students this problem would be notable (LAO, 2013). Additional information on project efficiency is limited. It takes approximately a savings of 1287-kilowatt hours to eliminate one ton of CO_2 equivalent emissions (U.S. EPA, 2013b). Additionally, the governing bodies in charge of allocating cap-and-trade revenues, the CDE and the CCC Chancellor's office, have yet to produce guidelines for spending new energy efficiency revenues in school districts and community college districts.

The SB 375 policy alternative dedicates cap-and-trade revenues to supplement SCS implementation. SCSs demonstrate how a MPOs region would meet its GHG emission reduction targets set by ARB through integrated land use, housing, and transportation planning. Both SB 375 and AB 32 aim to reduce GHG emissions. This policy alternative satisfies the efficiency criterion in an adequate way. The nature of ARB's GHG emission reduction targets for the eighteen MPOs and lack of available information on funding makes it difficult to project the efficiency of the proposal. ARB established regional GHG emission reduction targets for the years 2020 and 2035 relative to 2005 emission levels. However, the emission reduction targets do not set specific number of CO_2 equivalent to be eliminated. Instead, ARB set GHG reduction targets by the unit of measurement, GHGs emitted per capita. Below is a table listing all GHG reduction targets for California's MPOs.

Table 4.3 ***ARB Approved SB 375 GHG Emission Reduction Targets***

MPO Region	**Targets***	
	2020	**2035**
Southern California Association of Governments	-8	-13
Metropolitan Transportation Commission	-7	-15
San Diego Association of Governments	-7	-13
Sacramento Area Council of Governments	-7	-16
8 San Joaquin Valley MPOs	-5	-10
Other MPOs		

Tahoe Metropolitan Planning Organization	-7	-5
Shasta County Regional Transportation Planning Agency	0	0
Butte County Association of Governments	+1	+1
San Luis Obispo Council of Governments	-8	-8
Santa Barbara County Association of Governments	0	0
Association of Monterey Bay Governments	0	-5

*Targets are expressed as percent change in per capita GHG emissions relative to 2005 levels.

Source: ARB, n.d. a

Per capita emissions reduction is based on both the change of GHGs emitted into the atmosphere and the change in population within the MPO over a set time period. However, nearly 83% of the state's population lives within the four MPOs (Southern California Association of Governments, Metropolitan Transportation Commission, San Diego Association of Governments, and Sacramento Area Council of Governments) that must reduce at least 7% of its 2005 per capita GHG emissions by 2020 (Menzer & Trahan, 2010). Unfortunately, a search for current funding levels of SCS implementation did not come up with actual figures.

The forestry policy alternative allocates cap-and-trade revenues to State Parks to reforest state lands laid barren by wildfire and the Forestry Program for urban forestation efforts, maintaining the state's current carbon sink. This policy alternative satisfies the efficiency criterion in an adequate way. Increased forestry expands the statewide carbon sink by removing the GHG, CO_2, from the atmosphere. Extension Forestry Specialist Rick Hamilton (n.d.) estimated an initial cost range of $75-275 per acre of reforestation and minimal costs of tree and land maintenance. If using assuming the highest cost for reforestation it will cost approximately $400 over twenty years to reforest land. However, the planting of tree seedlings or more mature trees for reforestation or urban forestry does not reduce larger sources GHG emissions from manmade sources of GHGs, including vehicles and carbon-intensive industries. No matter how much CO_2 increased reforestation and urban forestry will sequester, it will reduce manmade GHG emissions.

The research and development policy alternative directs cap-and-trade revenues towards the CEC's AB 118 program to finance alternative fuel and vehicle efficiency research and development projects. Both alternative fuel and vehicle efficiency projects aim to reduce GHG emissions from the transportation sector, the largest source of GHGs in California. This policy alternative satisfies the efficiency criterion in a strong way. The available information of money allocated and predicted GHG reductions achieved from research and development funding shows AB 118 as an efficient program. Twenty-eight grants totaling $61,822,613 are projected to save 14,208,980 tons of CO_2 equivalent per year (CEC, 2011b). This translates to nearly a quarter ton (460 pounds) of CO_2 equivalent saved every year per dollar spent. Another twelve grants are expected to save a total of 100 pounds of CO_2 equivalent for every dollar spent (CEC, 2011b).

The green bank policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that provides low-cost financing and leverage additional funding for clean energy and energy efficiency projects. This policy alternative satisfies the efficiency criterion in an adequate way. Based on AB 118's ability to leverage outside funding for its research and development projects, I believe the same can happen with a new green bank. Two AB 118 grants leveraged $26.3 million out of an initial $5.6 million for a hydrogen fueling station and heavy-duty natural gas trucks (CEC, 2011a & CEC, 2011c). The ability for a single dollar to leverage $2-4 additional dollars toward a GHG reduction project maximizes the potential for green bank financing and loans to achieve significant GHG reductions at the lowest possible cost. Despite my optimism for a green bank's ability to leverage funding, I project it will only satisfy the efficiency criterion in an adequate manner.

Supplementing AB 118 research and development funding is the strongest policy alternatives with regards to criterion. Estimated GHG emissions reductions from AB 118 research and development grants showed one dollar spent could save several hundred pounds of CO_2 over

the course of a project's lifespan or on an annual basis. Despite the increased sequestration of CO_2 by increasing reforestation and urban forestry efforts, money dedicated towards those efforts will not mitigate larger sources off GHG emission. Meanwhile, a lack of information on efficiency and the relative novelty of the other alternatives prevented them from receiving the strongest grade possible.

Equity

The energy efficiency proposal takes the initial $2.5 billion in cap-and-trade revenues to fund energy efficiency upgrades in K-12 schools and community colleges across the state. Energy efficiency upgrades would reduce energy consumed from carbon-intensive sources, lowering statewide GHG emissions. This policy alternative does not satisfy the equity criterion. The per-pupil funding formula under the policy alternatives does not prioritize funding for California's environmentally disadvantaged areas or low-income communities. The per-student formula would allocate the same money ($268,000) to a middle-class environmentally healthy school district of 4,000 students as a low-income school district of 4,000 students within an environmentally unhealthy area.

The SB 375 policy alternative dedicates cap-and-trade revenues to supplement SCS implementation. SCSs demonstrate how a MPO's region would meet its GHG emission reduction targets set by ARB through integrated land use, housing, and transportation planning. Both SB 375 and AB 32 aim to reduce GHG emissions. This policy alternative satisfies the equity criterion in a poor way. The SB 375 fails to specifically address economically and/or environmentally disadvantaged communities. ARB's (2013) SB 375 website and relevant documents never single out any consideration for areas of the state under socioeconomic and/or environmental hardship. A panel of policy experts in environmental and environmental justice could not articulate specific

benefits SB 375 would provide for low-income communities (Urban Habitat, n.d.). Therefore, the policy alternative makes poor attempt to satisfy the equity criterion.

The forestry policy alternative allocates cap-and-trade revenues to State Parks to reforest state lands laid barren by wildfire and the Forestry Program for urban forestation efforts, maintaining the state's current carbon sink. This policy alternative satisfies the equity criterion in an adequate way. Urban forestry and reforestation possess a chance of addressing equity concerns if there are significant reforestation and urban forestry projects near and around environmentally disadvantaged areas. The planting of trees in urban areas, particularly low-income urban areas that receive a large share of global warming effect and other pollutants will help those areas through the cool provided by the shade of trees and replacement of heat-capturing asphalt and concrete with the soil and roots of trees. The reforestation of trees in natural habitats situated in rural areas would have some equity benefits, because of the lower income-per capita levels of rural areas in California, including Madera, Glenn, and Del Norte counties (Department of Finance, n.d.).

The research and development policy alternative directs cap-and-trade revenues towards the CEC's AB 118 program to finance alternative fuel and vehicle efficiency research and development projects. Both alternative fuel and vehicle efficiency projects aim to reduce GHG emissions from the transportation sector, the largest source of GHGs in California. This policy alternative satisfies the equity criterion in an adequate way. Financing research and development projects usually prioritizes the likelihood of success relative to equity concerns. However, in compliance with the CEC (2011d) the program provides supplemental evaluations of localized health impacts for any projects requiring permits. These evaluations are to ensure that projects funded by the CEC do not result in disproportionate health impacts to low income or minority

communities. Most projects listed on AB 118's website focus on urban or suburban areas of California (CEC, 2011d).

The green bank policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that provides low-cost financing and leverage additional funding for clean energy and energy efficiency projects. This policy alternative does not satisfy the equity criterion. Extending a loan low-interest loan requires the green bank to assess the debtor has the means to pay back the principle and interest over an agreed upon time with high probability. However, if the green bank determines that a potential debtor has a lower probability to pay off the principle and interest; it will either decline the loan or require a higher interest rate. Since the green bank is supposed to provide easy access to capital relative to other financial institutions, it will likely be unable to make higher interest loans. Low-income businesses and communities, including communities with comparatively higher levels of environmental hazards will find it more difficult to access the capital available in a green bank.

Overall, the five policy alternatives fail to strongly satisfy the equity criterion. Only the increased forestry and supplementing AB 118 revenues policy alternatives achieved a grade of adequately satisfying the equity criterion.

External Environmental Effect

The energy efficiency proposal takes the initial $2.5 billion in cap-and-trade revenues to fund energy efficiency upgrades in K-12 schools and community colleges across the state. Energy efficiency upgrades would reduce energy consumed from carbon-intensive sources, lowering statewide GHG emissions. This policy alternative satisfies the external environmental effect criterion in an adequate way. The primary environmental benefit of the policy alternative, beyond GHG emissions reductions, is the overall reduction of non-GHG air pollutants in the atmosphere. Lower demand for energy will require less energy from fossil fuels sources, reducing the per

capita emissions of non-GHG pollution into the atmosphere. Consequently air quality would improve over time. Energy efficiency upgrades in schools and community colleges would neither inhibit nor encourage carbon leakage.

The SB 375 policy alternative dedicates cap-and-trade revenues to supplement SCS implementation. SCSs demonstrate how a MPO's region would meet its GHG emission reduction targets set by ARB through integrated land use, housing, and transportation planning. Both SB 375 and AB 32 aim to reduce GHG emissions. This policy alternative satisfies the external environmental effect criterion in an adequate way. The external environmental effect of achieving SB 375 goals though more integrated and sustainable communities envisioned would be increased air quality. An increased emphasis of non-automobile transportation (walking, bicycling, public transportation) would likely lead to reduced fossil fuel consumption from cars and a reduced per capita emission of non-GHG pollutants including ozone and hydrocarbons. SB 375 stakeholders and research have not addressed the issue of carbon leakage.

The forestry policy alternative allocates cap-and-trade revenues to State Parks to reforest state lands laid barren by wildfire and the Forestry Program for urban forestation efforts, maintaining the state's current carbon sink. This policy alternative satisfies the external environmental effect criterion in a strong way. The expansion of forests through reforestation in undeveloped areas and the planting of urban forests carry other environmental benefits beyond carbon sequestration. Forests support the necessary resources to provide a home for wildlife instead of living in developed suburbs and cities (Sustainable Cities Institute of the National League of Cities, 2012). Urban forests in cities improve water quality by redirecting large amounts rainwater into the ground through their root systems and canopies. Trees reduce the "urban heat island effect" by replacing heat-trapping concrete and asphalt with soil and a cooling shade from the branches and leaves of the trees (Sustainable Cities Institute of the National

League of Cities, 2012). Planting additional trees in rural, suburban, or rural, areas will not induce carbon leakage.

The research and development policy alternative directs cap-and-trade revenues towards the CEC's AB 118 program to finance alternative fuel and vehicle efficiency research and development projects. Both alternative fuel and vehicle efficiency projects aim to reduce GHG emissions from the transportation sector, the largest source of GHGs in California. This policy alternative satisfies the external environmental effect criterion in an adequate way. Increased funding for research and development of alternative fuels and advanced vehicles can reduce statewide air pollution. Over time, hybrid, natural gas, and hydrogen fuel-cell vehicles will increase their share of the market with the assistance of research and development projects funded by AB 118. As the share of alternative vehicles increase over time, the per-capita levels of pollution emitted from cars will decrease over time and air quality will improve.

The green bank policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that provides low-cost financing and leverage additional funding for clean energy and energy efficiency projects. This policy alternative satisfies the external environmental effect criterion in a strong way.
The total external environmental effects from a green bank would depend on the types of projects the bank would finance. A green bank can provide existing firms, including carbon-intensive firms, easy access to financial capital (low-interest loans) to incorporate GHG reduction measures within workplace practices. Low-cost financing to remove carbon-intensive procedures would serve as an incentive for certain carbon-intensive industries to remain in California, making it the only policy alternative with a strong potential to mitigate carbon leakage.

The forestry and green bank policy alternatives strongly satisfy the external environmental effect criterion among the quintet of policy alternatives. The positive effects of

reforestation and urban forestry on wildlife, the "urban heat island effect," and water quality earn the strongest grade for the policy alternative. The potential for a green bank to encourage carbon-intensive industries to remain in the state by providing low-cost financing for energy improvements is an attribute not projected for the other four policy alternatives and why I gave it the strongest grade possible.

Transparency/Accountability

The energy efficiency proposal takes the initial $2.5 billion in cap-and-trade revenues to fund energy efficiency upgrades in K-12 schools and community colleges across the state. Energy efficiency upgrades would reduce energy consumed from carbon-intensive sources, lowering statewide GHG emissions. This policy alternative satisfies the transparency/accountability criterion in a strong way. The CDE's lead in allocating the school district energy efficiency money and funding formula, borrowed from the Governor, to allocate cap-and-trade revenues makes the proposal easier to understand for the public. The CDE's website contains significant datasets on academic performance, demographics, and finances in K-12 education (CDE, 2013). I expect CDE to produce a similar dataset of what school received for energy efficiency improvements. The funding formula to allocate the $2.5 billion requires only simple arithmetic to determine the amount of money a school district or community college district would receive. The equations below show how much money a school district and community college district will receive.

(1) **$67 x # of students attending school(s) in school district = annual allocation to school district**

(2) **$45 x # of students attending community college(s) in community college district = annual allocation to community college district**

The formula would cease to be used once the initial $2.5 billion dollars is allocated.

The SB 375 policy alternative dedicates cap-and-trade revenues to supplement SCS implementation. SCSs demonstrate how a MPO's region would meet its GHG emission reduction targets set by ARB through integrated land use, housing, and transportation planning. Both SB 375 and AB 32 aim to reduce GHG emissions. This policy alternative satisfies the transparency/accountability criterion in a poor way. The potential for the public to comprehend the supplemental funding proposal for SB 375 is limited. MPOs, primarily responsible for planning, programming and coordination of federal highway and transit investments in urbanized areas, are required to carry out SB 375 (Bureau of Transportation Statistics, n.d.). Unfortunately, they are among the least known public sector organization in the general public. The GHG reduction targets set by ARB will likely complicate the general public. Instead of concrete GHG reduction numbers, such as the reduction goals of AB 32, SB 375 GHG reduction targets are based on per capita emissions. SB 375 remains overshadowed in the public's eye compared to AB 32. Voters had to decide whether to repeal AB 32 while no such vote has been held for SB 375.

The forestry policy alternative allocates cap-and-trade revenues to State Parks to reforest state lands laid barren by wildfire and the Forestry Program for urban forestation efforts, maintaining the state's current carbon sink. This policy alternative satisfies the transparency/accountability criterion in an adequate way. The two agencies tasked with carrying out the expanded forests policy alternative improve the transparency/accountability through the information it makes available online. Both the State Parks (n.d.) reforestation efforts and CalFire's (2012b) Forestry Program provide publicly available and detailed information on the operations of their respective reforestation and urban forestry programs. Both agencies go a long way in clarifying reforestation and urban forestry to a general public that would have likely remained unfamiliar with both terms.

The research and development policy alternative directs cap-and-trade revenues towards the CEC's AB 118 program to finance alternative fuel and vehicle efficiency research and development projects. Both alternative fuel and vehicle efficiency projects aim to reduce GHG emissions from the transportation sector, the largest source of GHGs in California. This policy alternative satisfies the transparency/accountability criterion in an adequate way. AB 118's publicly available annual investment plans and list of previous research and development grants improve the policy alternative's transparency/accountability (CEC, n.d.). Each investment plan summarizes the year's research and development investment plan and details the purpose and benefits of each project considered and funded (CEC, 2011d). AB 118's list of previous research and development categorizes includes the total money allocated to each projected, leveraged matching funding from other public and private sources, and estimated GHG reductions from the financed project (CEC, 2011b). However, not all previous projects are available to view online.

The green bank policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that provides low-cost financing and leverage additional funding for clean energy and energy efficiency projects. This policy alternative satisfies the transparency/accountability criterion in a poor way. The relative newness of the green bank policy idea will likely confuse many people. People are likely to be unfamiliar with the terms "green bank" or "quasi-public publication." Before CEIFA, no other attempt at a green bank has been attempted in the United States. The general public will also wonder what individuals, businesses, and public sector agency would eligible to receive loans, what interest rates would come with green bank loans, and what financial regulations a green bank must follow. All of these are currently undetermined.

The simple funding formula and successful transparency efforts of the CDE make the K-12 and community college energy efficiency program makes the it strongest policy alternative

with regards to the transparency/accountability criterion. A lack of public knowledge on MPOs, the governing bodies tasked with administering SB 375 and the uniqueness of the recently developed green bank policy idea caused both policy alternatives to receive poor grades.

Legality

The energy efficiency proposal takes the initial $2.5 billion in cap-and-trade revenues to fund energy efficiency upgrades in K-12 schools and community colleges across the state. Energy efficiency upgrades would reduce energy consumed from carbon-intensive sources, lowering statewide GHG emissions. This policy alternative does not satisfy the legality criterion. The decision to count all energy efficiency spending toward the Proposition 98 spending guarantee departs from the longstanding view that special revenues remain excluded from the Proposition 98 calculation (LAO, 2013). The Legislative Counsel's Office shared the same legal concerns expressed by the LAO. It concluded that money transferred into any special GHG reduction fund is special fund money and cannot count towards Proposition 98 (Chorneau, 2013). Pursuing this energy efficiency proposal with cap-and-trade auction revenue would likely invite a successful lawsuit due the opinions expressed by the LAO and the Legislative Counsel's Office.

The SB 375 policy alternative dedicates cap-and-trade revenues to supplement SCS implementation. SCSs demonstrate how a MPO's region would meet its GHG emission reduction targets set by ARB through integrated land use, housing, and transportation planning. Both SB 375 and AB 32 aim to reduce GHG emissions. This policy alternative satisfies the legality criterion in a strong way. Under a Sinclair Paint analysis, this program would be consistent with a regulatory fee. According to a UCLA report, there are four risk criteria: whether the spending proposal reduces GHG emissions permanently, whether the proposal advances other explicit AB 32 goals, whether there is a strong record demonstrating the proposal will achieve the purposes of AB 32, and whether the spending proposals avoids direct allocation of money for purposes

unrelated to AB 32 (Lambe and Farber, 2012). The state has developed a strong record demonstrating that the implementation of SB 375 will support the efforts of achieving the goals of AB 32. As long as auction proceeds are placed in a special GHG emission reduction account and not the general fund, legal risk will remain the very low (Lambe and Farber, 2012).

The forestry policy alternative allocates cap-and-trade revenues to State Parks to reforest state lands laid barren by wildfire and the Forestry Program for urban forestation efforts, maintaining the state's current carbon sink. This policy alternative satisfies the legality criterion in a strong way. The money to reforest natural lands and to fund urban forests fights climate change through the sequestration of the major GHG, CO_2. Increased forestry also fits because AB 32's Scoping Plan, continuously mentions carbon sequestration through increased forestry and forestry as a potential policy to limit GHGs (ARB, 2008b). The direct sequestration of carbon into the soil through forestry assures this policy alternative will avoid any problems from the Sinclair Nexus Test.

The research and development policy alternative directs cap-and-trade revenues towards the CEC's AB 118 program to finance alternative fuel and vehicle efficiency research and development projects. Both alternative fuel and vehicle efficiency projects aim to reduce GHG emissions from the transportation sector, the largest overall source of GHGs in California. This policy alternative satisfies the legality criterion in a strong way. Alternative fuel and vehicle efficiency projects that receive AB 118 fall under the transportation sector of the state economy. The transportation sector of the state's economy is largest contributor to GHG emissions in the state (Brown, 2013). Therefore, funding of research and development to reduce carbon-based fuels and to make vehicles run as efficiently as possible, works toward the GHG emission reduction goals of AB 32.

The green bank policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that provides low-cost financing and leverage additional funding for clean energy and energy efficiency projects. This policy alternative satisfies the legality criterion in a strong way. Lambe and Farber (2012) determined the creation of a green bank came with a low legal risk of violating Proposition 13 or the Sinclair Nexus standard because a green bank is designed to only finance GHG reducing projects. However, if proven in court that a green bank created from cap-and-trade auction revenues funds projects outside of efforts of reducing GHG emission, the risk of a successful legal lawsuit would increase. So long as a green bank funds GHG reducing projects, the policy alternative strongly satisfies the legality criterion.

With exception of the energy efficiency policy alternative, every policy alternative strongly satisfies the legality criterion because the policy alternative funds GHG reduction policy actions and does not raise legal risks by counting towards Proposition 98. If the energy efficiency proposal does not count toward Proposition 98 or the General Fund, it would likely have received a grade of adequate or strong.

Robustness/Improvability

The energy efficiency proposal takes the initial $2.5 billion in cap-and-trade revenues to fund energy efficiency upgrades in K-12 schools and community colleges across the state. Energy efficiency upgrades would reduce energy consumed from carbon-intensive sources, lowering statewide GHG emissions. This policy alternative satisfies the robustness/improvability criterion in a poor way. The allocation of money to school districts on a per-student basis will delay energy efficiency improvements in small school districts for some time because initial funding will be too small to install any significant energy efficiency equipment (LAO, 2013). However, larger school districts should receive enough cap-and-trade revenues to finance energy efficiency

projects while smaller school districts wait for additional funds. Over time, significant energy savings in K-12 education and community college facilities will achieve GHG emission reductions despite any implementation problems. However, the policy alternative requires total revenues of $2.5 billion (LAO, 2013). However, if cap-and-trade auctions do not generate at the rate of projected levels of revenue, full implementation of the policy alternative will delay, potentially beyond AB 32's 2020 GHG reduction deadline.

The SB 375 policy alternative dedicates cap-and-trade revenues to supplement SCS implementation. SCSs demonstrate how a MPOs region would meet its GHG emission reduction targets set by ARB through integrated land use, housing, and transportation planning. Both SB 375 and AB 32 aim to reduce GHG emissions. This policy alternative satisfies the robustness/improvability criterion in a strong way. SB 375's contingency plans can achieve ARB's original GHG reduction targets. MPO designed back-up strategies would replace SCSs that failed to achieve ARB's GHG reduction targets in 2020 and/or 2035. If an SCS does not achieve the region's GHG reduction target, the MPO's Alternative Planning Strategy must take affect to achieve the GHG reduction targets set by ARB (Institute of Local Government, n.d.).

The forestry policy alternative allocates cap-and-trade revenues to State Parks to reforest state lands laid barren by wildfire and the Forestry Program for urban forestation efforts, maintaining the state's current carbon sink. This policy alternative satisfies the robustness/improvability criterion in a poor way. State Parks' recent history includes scandals of misplacing special funds. Audits showed State Parks possessed a hidden surplus of more than $54 million in special funds as dozens of state parks faced the threat of closure to save money (Rogers, 2012). The policy outcomes of reforestation will not occur if State Parks mishandles or fails to spend-cap-and-trade revenues. If the Forestry Program's annual grant awards to various non-profits and cities would more than double if it received an additional $5 million from cap-

and-trade revenues (CalFire, 2012a). Such an increased workload on the seven current Urban Forestry Field Specialists could delay or misappropriate funds toward valid grant applications. However, the negative effects of the increased workload may be overcome with funding for additional Urban Forestry Field Specialists or an internal decision to allocate larger grant amounts and thus processing fewer grant requests.

The research and development policy alternative directs cap-and-trade revenues towards the CEC's AB 118 program to finance alternative fuel and vehicle efficiency research and development projects. Both alternative fuel and vehicle efficiency projects aim to reduce GHG emissions from the transportation sector, the largest source of GHGs in California. This policy alternative satisfies the robustness/improvability criterion in an adequate way. Despite the enormous future benefits of research and development projects, they are never guaranteed to succeed. A failed alternative fuel or vehicle efficiency research and development project would not reduce future GHG levels. However, the successful projects already funded by AB 118 continue to save thousands of tons of GHGs per year, partially offsetting failed energy research and development projects (CEC, 2011b).

The green bank policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that provides low-cost financing and leverage additional funding for clean energy and energy efficiency projects. This policy alternative satisfies the robustness/improvability criterion in a poor way. The uncertainty of how a green bank may operate in California and the problems faced by CEFIA's predecessor, the Connecticut Clean Energy Fund (CCEF) show significant implementation risks. Regarding green bank complementation errors, there are potential problems that could hinder its efforts to reduce GHGs. The Verdant Group's (2010) report found problems with CCEF's operations. CCEF lacked concise program guidelines and did not posses standard process documentation (i.e.

applications, contracts, due diligence reports, project status reports) (The Verdant Group, 2010). The lack of a single point-of-contact or easy website navigation for information regarding program timelines, rules, application materials, support resources and other process disclosures created an impediment and a high level of misunderstanding for CCEF program applicants and an inconsistent level of responsiveness (The Verdant Group, 2010). Despite this happening to an agency that preceded the CEFIA, it serves as a warning to the potential problems a new California green bank may face.

SB 375's contingency plans in the event of an MPO's SCS failure to achieve ARB's GHG emission reduction targets makes the SB 375 policy alternative the best when evaluated by the robustness/improvability criterion. The GHG reduction goals of SB 375 will remain achievable despite any administrative or implementation problems. The heavy reliance on high-end estimates of cap-and-trade revenues, the recent trend of mismanaged money in State Parks, the problems posed by a new green bank caused the first, third, and fifth policy alternatives to receive poor grades on this criterion.

Political Acceptability

The energy efficiency proposal takes the initial $2.5 billion in cap-and-trade revenues to fund energy efficiency upgrades in K-12 schools and community colleges across the state. Energy efficiency upgrades would reduce energy consumed from carbon-intensive sources, lowering statewide GHG emissions. This policy alternative satisfies the political acceptability criterion in a poor way. Despite the backing of Governor Brown, legislative opposition within the Democratic caucus decreases the political acceptability of the proposal. Democrats currently control two-thirds of the state legislature and have expressed concern for the Governor's plan for various administrative, efficiency, and legal reasons (Roberts, 2013). Democratic Senators Jim Beall, Jr. and Kevin De León expressed concern for a lack of minimum funding for school

districts in lower income neighborhoods, while democratic Senator Marty Bock said the Governor should revise his original proposal to increase legislative support (Chorneau, 2013).

The SB 375 policy alternative dedicates cap-and-trade revenues to supplement SCS implementation. SCSs demonstrate how a MPO's region would meet its GHG emission reduction targets set by ARB through integrated land use, housing, and transportation planning. Both SB 375 and AB 32 aim to reduce GHG emissions. This policy alternative satisfies the political acceptability criterion in an adequate way. An allocation of cap-and-trade auction revenues to support the SCSs of California's MPOs would receive support from a variety of stakeholders. MPOs would fully support the proposed alternative because it would supplement anticipated revenues from other sources. As it made its way thought the legislative process, SB 375 received support from cities, counties, and organizations advocating on behalf of the environmentalism, transportation interests, and major car companies (Stivers, 2008). Today, a coalition of cities, counties, and organizations advocating on behalf of the environmentalism, transportation interests, supports the closest legislative version of this policy alternative, AB 574 (Dawson, 2013). Those likely to oppose cap-and-trade allocations toward SB 375 implementation would include a variety of organizations and economic sectors opposed to the original SB 375 legislation. Realtors, contractors, retailers, automobile clubs, hotel and lodging interests, manufacturers, various local transportation authorities, and the Howard Jarvis Taxpayers Association opposed SB 375 (Stivers, 2008).

The forestry policy alternative allocates cap-and-trade revenues to State Parks to reforest state lands laid barren by wildfire and the Forestry Program for urban forestation efforts, maintaining the state's current carbon sink. This policy alternative satisfies the political acceptability criterion in an adequate way. Natural resource agencies and environmental interests groups would support a dedication of cap-and-trade auction revenues to reforestation and urban

forestry. The U.S. Forest Service would likely welcome increased funding for reforestation as federal budget cuts threaten its own efforts. A regional forester of the US Forest Service expressed concerns that promised federal funding for the Forest Service's reforestation services would not materialize (Moore, 2012). Wildlife and nature groups would also support increased reforestation and other forestry practices. Letters of support from groups such as California urban Forests Council, California ReLeaf, California Infill Builders Association, and The Wilderness Society expressed their support for increased reforestation and/or urban forestry through cap-and-trade auction revenues (Hughes et al, 2012 & Chan, 2012). No signs of organized opposition to increased reforestation and urban forestry nor legislation to increase forestry funding were found.

The research and development policy alternative directs cap-and-trade revenues towards the CEC's AB 118 program to finance alternative fuel and vehicle efficiency research and development projects. Both alternative fuel and vehicle efficiency projects aim to reduce GHG emissions from the transportation sector, the largest source of GHGs in California. This policy alternative satisfies the political acceptability criterion in an adequate way. A large coalition of private sector firms and CEC would support increased research and development while its opposition would likely come from only maritime interests. A dozen green technology firms and capital firms requested ARB to allocate cap-and-trade revenues toward research and development programs (Birmingham et al, 2012). Meanwhile a set of marine and boating groups, including the Northern California Marine Association and the California Yacht Brokers Association opposed the very creation of the program (Cornwell, 2007).

Previous votes on AB 118 show stunted and partisan support for additional funds for the program. The creation of the program passed the Senate with a bare majority of 21 out of 40 Senators before receiving a more substantial vote share of 46 out of 80 votes in the Assembly (Official California Legislative Information, 2007a & Official California Legislative Information,

2007b). Both votes divide largely on partisan lines. Votes on follow-up legislation (AB 109) received levels of support similar to AB 118 (Official California Legislative Information, 2008a & Official California Legislative Information, 2008b). The very close votes in support of prior legislation directly linked to the AB 118 program indicates this policy alternative would face a difficult time making it through the legislative process.

The green bank policy alternative spends cap-and-trade auction revenue on seed funding to create a green bank. A green bank would be a quasi-public corporation that provides low-cost financing and leverage additional funding for clean energy and energy efficiency projects. This policy alternative satisfies the political acceptability criterion in an adequate way. Green technology firms attempting to create the new technology in the green economy would welcome new opportunities for easily accessible financial capital. The dozen green technology firms and capital firms who stated their support of ARB 118 would benefit from a new source of accessible capital for their business operations and production of new green technology products (Birmingham et al, 2012). Current state legislation, SB 798 would create a green bank to finance infrastructure-related projects (Official California Legislative Information, 2013).

Strong conservative resistance to public funding of green energy companies will weaken support for a green bank. Following the national attention given toward the collapse of the Bay Area solar energy company Solyndra, conservative resistance to green energy loans amplified. The collapse of Solyndra is often cited as a reason for government to remove itself from providing loans in private enterprise. State Assemblymember Tim Donnelly (2011) best summed up the conservative argument against a green bank by stating government cannot create an industry or jobs, but only more government programs.

Four of the five policy alternatives received an adequate grade of satisfying the political acceptability criterion. Those are projected to receive relatively healthy support among

Democratic legislators and opposition from Republicans. Meanwhile different coalitions outside organizations and interests (businesses, local government, environmental) will actively support or oppose the five policy alternatives. A lack of Democratic support for the K-12 and community college energy efficiency proposal is the reason it received the lone grade of poorly satisfying the political acceptability criterion.

SUMMARY OF CRITERIA-ALTERNATIVE EVALUATION

Having completed my evaluation of the five policy alternatives against the seven criteria, I next summarize my findings. Each alternative was assigned a grade of does not, poorly, adequately, or strongly satisfies each criterion. Table 4.4 fills out the incomplete Table 4.1 by filling in each blank cell with the grade of each policy alternative as it relates to each criterion. At first glance it appears supplementing AB 118 research and development funding is the best policy alternative to pursue. It strongly satisfies two of the more important criterion, efficiency and legality, and failed to receive a grade of not satisfying or poorly satisfying a criterion. On the opposite end, the K-14 energy efficiency plan appears to be the worst policy alternative. The K-14 energy efficiency policy alternative received the most grades of not satisfying (two) and poorly satisfying (three) different criterion.

However, is supplementing AB 118 research and development funding the best option to pursue? Another way to answer that question is to develop a quantitative CAM out of the original qualitative CAM. I do this by replacing the grades of does not, poorly, adequately, and strongly with the numbers 0, 1, 2, and 3 respectively, in parenthesis, and by assigning the criteria weights I assigned for each criterion. For example if a policy alternative is evaluated as strongly satisfying a criterion, receiving a score of 3 against a criterion with a weight of .2, the cell would show a 3 designating the strong grade and (.6) for the cell's total score because .6 is the factor of 3 x .2. My criteria weights on page 7 will be used on Table 4.5.

Table 4.4 ***Completed Qualitative AB 32 CAM***

	ALTERNATIVES				
CRITERIA	**K-14 energy efficiency for school and community college districts**	**Supplement SB 375 funding**	**Increase reforestation and urban forestry**	**Supplement AB 118 research & development funding**	**Provide seed funding for a new green bank**
Efficiency	Poorly	Adequately	Poorly	Strongly	Adequately
Equity	Does Not	Poorly	Adequately	Adequately	Does Not
External Environmental Effect	Adequately	Adequately	Strongly	Adequately	Strongly
Transparency/ Accountability	Strongly	Poorly	Adequately	Adequately	Poorly
Legality	Does Not	Strongly	Strongly	Strongly	Strongly
Robustness/Improvability	Poorly	Strongly	Poorly	Adequately	Poorly
Political Acceptability	Poorly	Adequately	Adequately	Adequately	Adequately

Table 4.5 ***Completed Quantitative AB 32 CAM***

	ALTERNATIVES				
CRITERIA	**K-14 energy efficiency for school and community college districts**	**Supplement SB 375 funding**	**Increase reforestation and urban forestry**	**Supplement AB 118 research & development funding**	**Provide seed funding for a new green bank**
Efficiency [.5]	1 (.5)	2 (1)	2 (1)	3 (1.5)	2 (1)
Equity [.05]	0 (0)	1 (.05)	2 (.1)	2 (.1)	0 (0)
External Environmental Effect [.05]	2 (.1)	2 (.1)	3 (.15)	2 (.1)	3 (.15)
Transparency/ Accountability [.05]	3 (.15)	1 (.05)	2 (.1)	2 (.1)	1 (.05)
Legality [.2]	0 (0)	3 (.6)	3 (.6)	3 (.6)	3 (.6)
Robustness/Improvability [.05]	1 (.05)	3 (.15)	1 (.05)	2 (.1)	1 (.05)
Political Acceptability [.1]	1 (.1)	2 (.2)	2 (.2)	2 (.2)	2 (.2)
TOTAL	**(.90)**	**(2.15)**	**(2.2)**	**(2.7)**	**(2.05)**

[x] = Criteria Weight
(x) = Score based on evaluation

After determining supplementing current AB 118 research and development revenues as the best policy alternative, I seek to discover if my original and subjective assignment of criteria weights lead to the results on Table 4.6. To determine if that is the case I run two sensitivity analyses on quantitative CAMs by adjusting my original criteria weights. My first sensitivity analysis on Table 4.7 provides a more equitable distribution of criteria weights while maintaining the importance of the efficiency and legality criteria. I lowered the efficiency criterion weight from .5 to .25, maintained the legality criterion at .2 given to legality, and increased the criteria of equity, external environmental effect, transparency/accountability, and robustness/improvability by .05 each. I chose this reweighing of criteria because of Table 4.6's very high criteria weight to efficiency compared the other six criteria. Table 4.8 places an emphasis on the implementation process of each policy alternative. Higher weights are assigned to external environmental effect, robustness/improvability, and transparency/accountability. Meanwhile equity, legality, and political acceptability all receive criteria weights of .05. With the exception of efficiency, I relegated two criteria I perceive as more important, legality and political acceptability, with small criteria weights.

The sensitivity analyses on Tables 4.6 and 4.7 did not change the original finding on Table 4.5 with regards to the highest score going toward the AB 118 policy alternative. The SB 375 and reforestation policy alternatives received nearly identical scores on all three quantitative CAM tables. Given that both policy alternatives have nearly identical scores. The green bank policy alternative followed as fourth best policy alternative. Meanwhile, the low marks for the K-14 energy efficiency plan places it as the worst of the five policy alternatives. Given the final scores for both the SB 375 and reforestation/urban forestry policy alternatives, a new question comes to mind of which policy alternative should be pursued with greater intensity, and therefore merit a greater share of cap-and-trade auction revenues.

Table 4.6 ***1st Sensitivity Analysis for Quantitative CAM***

	ALTERNATIVES				
CRITERIA	**K-14 energy efficiency for school and community college districts**	**Supplement SB 375 funding**	**Increase reforestation and urban forestry**	**Supplement AB 118 research & development funding**	**Provide seed funding for a new green bank**
Efficiency (.25)	1 (.25)	2 (.5)	2 (.5)	3 (.75)	2 (.5)
Equity (.1)	0 (0)	1 (.1)	2 (.2)	2 (.2)	0 (0)
External Environmental Effect (.1)	2 (.2)	2 (.2)	3 (.3)	2 (.2)	2 (.3)
Transparency/ Accountability (.1)	3 (.3)	1 (.1)	2 (.2)	2 (.2)	1 (.1)
Legality (.2)	0 (0)	3 (.6)	3 (.6)	3 (.6)	3 (.6)
Robustness/Improvability (.1)	1 (.1)	3 (.3)	1 (.1)	2 (.2)	1 (.1)
Political Acceptability (.15)	1 (.15)	2 (.3)	2 (.3)	2 (.3)	2 (.3)
Total	**(1.0)**	**(2.1)**	**(2.2)**	**(2.45)**	**(1.9)**

[x] = Criteria Weight
(x) = Score based on evaluation

Table 4.7 ***2nd Sensitivity Analysis for Quantitative CAM***

	ALTERNATIVES				
CRITERIA	**K-14 energy efficiency for school and community college districts**	**Supplement SB 375 funding**	**Increase reforestation and urban forestry**	**Supplement AB 118 research & development funding**	**Provide seed funding for a new green bank**
Efficiency (.35)	1 (.35)	2 (.7)	2 (.7)	3 (.95)	2 (.7)
Equity (.05)	0 (0)	1 (.05)	2 (.1)	2 (.1)	0 (0)
External Environmental Effect (.15)	2 (.3)	2 (.3)	3 (.45)	2 (.3)	3 (.45)
Transparency/ Accountability (.15)	3 (.45)	1 (.15)	2 (.3)	2 (.3)	1 (.15)
Legality (.05)	0 (0)	3 (.15)	3 (.15)	3 (.15)	3 (.15)
Robustness/Improvability (.2)	1 (.2)	3 (.6)	1 (.2)	2 (.4)	1 (.2)
Political Acceptability (.05)	1 (.05)	2 (.1)	2 (.1)	2 (.1)	2 (.1)
Total	**(1.35)**	**(2.05)**	**(2)**	**(2.2)**	**(1.75)**

[x] = Criteria Weight
(x) = Score based on evaluation

CHAPTER 4 SUMMARY & NEXT CHAPTER

My CAM analysis determined cap-and-trade revenues would be best spent to supplement the AB 118 research and development program among the five evaluated policy alternatives. The SB 375 and forestry policy alternatives received similar evaluated scores on all three quantitative CAM tables. Meanwhile, the K-14 energy efficiency policy proposal received the lowest scores. The following chapter of the thesis will recap the findings of the paper and its real world implications. As the cap-and-trade program continues its first year of holding auctions for allowances, ARB must soon decide how to spend the millions of dollars in new revenue. The chapter will recap provide recommendations moving forward; summarize the positives and negatives components of the thesis, and what areas of research analysts should pursue in the future.

CHAPTER 5

RECOMMENDATIONS AND CONCLUSIONS

I begin the chapter with a brief summary of ARB's responsibilities under AB 32 and the current status of California's cap-and-trade program. Following my summary of cap-and-trade's current status, I explain my recommendations and note current legislation and policy proposals related to the alternatives presented in this paper. Lastly, upon reflection, I review the advantages of the thesis, limitations, and potential future research related to climate change and cap-and-trade.

CALIFORNIA CONTEXT

AB 32 tasked California's Air Resources Board to administer the statewide reduction of GHGs through regulations and market-based mechanisms. The primary GHG reduction goal is to lower the total amount of GHG emissions within California to 1990 emissions levels by 2020 and 80 percent below 1990 GHG emission levels by 2050. ARB's responsibilities under AB 32 included: adopting the maximum feasible and cost-effective reductions in GHG emissions for sources and categories of sources subject to AB 32, the authority to adopt market-based compliance mechanisms, specifically a cap-and-trade system, adopting a list of discrete early action emission reduction measures that can be achieved prior to the adoption of market-based compliance mechanisms and other measures, and the authority to impose administrative, civil, and/or criminal penalties consistent with its authority under air quality statutes for violations of any rule, regulation, order, or standard adopted by the board pursuant to the bill's provisions (Ross, 2006).

Current Status of Cap-and-Trade Program

Cap-and-trade has entered its first full year of operation and continues to accrue tens of millions of dollars through quarterly allowance auctions. ARB holds quarterly auctions for all

firms and entities covered by cap-and-trade to purchase allowances. However, ARB will need to develop specific spending plans as the Governor and the State Legislature move forward and develop their own preferences of how to spend cap-and-trade auction revenues. Previous legislation passed into law set up frameworks of how to spend cap-and-trade auction revenues and current legislation sets up specific spending plans from the money raised from cap-and-trade auctions. I detail the legislation later in the chapter.

RECOMMENDATIONS

Recap of Analysis

The previous portions of this thesis included a CAM analysis, expressed in qualitative and quantitative terms, and two sensitivity analyses to determine the best of the five potential alternatives. The initial quantitative CAM (Table 4.5) gave the highest score to the supplemental AB 118 research and development funding alternative. Increasing reforestation and urban forestry, supplementing SB 375 funding, and providing seed funding for a new green bank alternatives received lover but similar scores. The alternative based on Governor Brown's K-14 energy efficiency proposal received the lowest score. Sensitivity analyses (Tables 4.6 and Table 4.7) showed no difference in the ranking of all five alternatives. The results of Chapter 4 help decide how cap-and-trade revenues should be spent.

Recommendations

Based on the results of the policy analysis conducted, I recommend initial cap-and-trade auction revenues should supplement existing funding for AB 118 research and development grants. AB 118 alternative was the only one to not receive a grade of "does not" satisfy or "poorly" satisfies when weighed against the seven criteria. AB 118 has strong efficiency numbers when it comes to the amount of GHG abatement per dollar spent on the program. Additionally, AB 118 aims to reduce GHG emissions from the state's largest source, the transportation sector

(ARB, 2008b). Replacing carbon-intensive and petroleum-based fuel vehicles with alternative, low-carbon, and cost-effective vehicles can make significant reduction in total GHG emission within the transportation sector by 2020 and especially 2050. High priority should be given to potential spending of cap-and-trade revenues to transportation-based GHG abatement projects or programs.

After sufficient funding is given to supplement the AB 118 program or an equivalent program, I recommend to strongly considering an allocation of cap-and-trade revenues for SB 375 implementation and increased forestation. SB 375 implementation funding is highly appropriate because of its relatively high marks against the efficiency, external environmental effect, legality, and robustness/improvability criteria and aims to reduce GHG emissions from the transportation sector. I strongly consider increased reforestation and urban forestry due to the forestry sector's ability consume and emit CO2 through carbon sequestration and forest decay respectively. Since forestry's portion of the most recent AB 32 Scoping Plan is small, only a small portion of AB 32 revenues will be required to meet 2020 and 2050 benchmarks from the forestry sector (ARB, 2008b).

Present Context of Alternatives

Currently, current policy proposals and bills within the California State Assembly and Senate reflect some of the five alternatives discussed in this thesis. Governor Brown's proposal to spend Proposition 39 revenues, the basis for the K-14 energy efficiency alternative, was recently altered in a compromise with the state legislature. The evaluated policy alternative received the lowest score and did not satisfy several criteria. However, the compromise improved upon the equity criterion. The compromise allocates money with additional emphasis on poorer school districts instead of purely on a per-student basis. Each district will be given a poverty-weighted allotment that is based on Average Daily Attendance (Matthews, 2013). Additionally, the

agreement between the legislature and Governor Brown requires benchmarks and outcome verification (Matthews, 2013).

Assemblymember Bonnie Lowenthal's Assembly Bill 574 closely follows the SB 375 funding alternative because it establishes the Sustainable Communities Infrastructure Program to fund SCS implementation and equivalent greenhouse gas (GHG) reducing strategies with cap-and-trade auction revenues (Lingbloom, 2013a). The SB 375 implementation-funding alternative received the third best score within the CAM analysis, and strongly satisfied the robustness/improvability criterion. As of July 2013, the bill is in the Assembly Appropriations Committee after passing the Assembly Transportation and Natural Resources committees.

Two pieces of legislation regarding carbon sequestration and resource management are currently working their way through the legislature. The increased forestation and subsequent carbon sequestration received the second highest CAM analysis score due in part due to strongly satisfying the external environmental effect criterion. Initial legislation to create guidelines for carbon sequestration spending is within Senator Ted Lieu's Senate Bill 511 (Liu, 2013). The bill remains in the Senate Appropriations Committee. Assembly Bill 1023 from Assemblymember Susan Talamantes Eggman would have ARB provide incentives or grants for waste reduction, recycling, composting, and recycled content manufacturing projects that reduce GHG emissions in California (Galehouse, 2013). The bill is currently in the Assembly Appropriations Committee.

One piece of legislation partially resembles the AB 118 research and development funding alternative. The AB 118 alternative received the highest score of all five alternatives. Asemblymember Ed Chau's Assembly Bill 1375 would require an unspecified amount to cap-and-trade funds to be allocated in the form of grants to California 501(c)(3) nonprofit corporations to design and implement programs that "accelerate deployment, demonstration and deployment of transformative" technologies that have the potential to reduce GHG emissions

(Lingbloom, 2013b). This bill narrows the type or organization to 501(c)(3) instead of leaving it open to companies and local governing bodies under the current AB 118 program. The bill is currently in the Assembly Appropriations Committee.

California State Senator Kevin De León's Senate Bill 798 creates a California Green Infrastructure Bank, financed by cap-and-trade revenues (Official California Legislative Information, 2013). This proposal similar to the green bank alternative; however it narrows the scope of a possible green bank to financing only transportation-related GHG abatement projects. The green bank alternative received the fourth highest score out of the five alternatives. As of July 2013, it remains in the Senate Governance and Finance Committee.

WHAT TO EXPECT IN THE FUTURE

Cap-and-trade auction revenues will not meet the early projections of cap-and-trade revenues. Many government officials anticipated almost a billion dollars in annual cap-and-trade revenues to finance programs to achieve AB 32 goals. However, only $257 million have been raised through the first three auctions, well short of earlier projections (Megerian, 2013). This is likely due to smaller-than-projected prices for carbon allowances. Some analysts expected initial allowances prices to be higher then current prices (Hull, 2013). Other analysts say a low price on carbon is not necessarily a bad thing and that it is a sign that the market does not think it will be hugely expensive to reduce GHG emissions. However, many analysts speculate that allowance prices will rise in future auctions as the carbon market continues to take shape (Hull, 2013). If the fourth and final auction of cap-and-trade's first year generates revenues averaging the first three auctions, less than $350 million in first-year revenues will have been raised. Meanwhile the Governor and state legislature have agreed how to allocate the initial half billion in cap-and-trade auction revenues.

The 2013-2014 Fiscal Year Budget for the State of California borrows the first $500 million to be used for the General Fund and repaid at a later date. The Brown Administration says the state needs more time to design and develop a cap-and-trade-financed GHG reduction plan (Detrow, 2013). This would delay any spending on the GHG reductions programs for at least one year and increase the chances of not reaching the 2020 GHG reduction benchmarks. However, environmental groups expressed frustration with the agreed upon deal and its resulting delay in GHG abatement policies from cap-and-trade revenues (Megerian, 2013 & Detrow, 2013). In light of the decision to initially borrow half a billion dollars from the state's cap-and-trade fund, I discuss what this means for the validity of my CAM assumptions (alternatives, criteria, and how criteria weighted) and impacts this thesis's limitations. Before the state begins to pay back its $500 million loan from the cap-and-trade program, legal challenges against the program will make their way through the state judiciary.

Cap-and-trade faces legal threats from those opposed to the program. Two organizations have filed separate lawsuits challenging the validity of the cap-and-trade program. The Pacific Legal Foundation alleged that the market's charge for GHG emissions violates California law because it constitutes a tax (Harrison, 2013). The California Chamber of Commerce's lawsuit is based on similar grounds (Davis, D., 2012). Both lawsuits attempt to strip ARB's authority to auction off allowances to covered entities. These lawsuits underline my reason for giving higher criterion weights to the legality criterion and AB 32 stakeholder insistence on cap-and-trade spending in a legally acceptable manner.

ADVANTAGES

This thesis provides a comprehensive look at the policy problem of climate change, the consequences of climate change, the policy measures to limit the sources of, and the relevant market mechanism policy to fight climate change, cap-and-trade. The introduction chapter details

climate change, its cause, and the consequences California will face. Policy solutions were divided into government-imposed regulatory measures and market-based mechanisms. Within the market-based mechanisms category are the carbon tax and cap-and-trade policies. Explaining the differences between a carbon tax and a cap-and-trade program provides accurate information for both policies, contrary to the repeated attempts by conservative and anti-cap-and-trade interests to label cap-and-trade as hidden tax, referring to it as "cap-and-tax."

This thesis also explains the free allowances component of cap-and-trade. When individuals first learn of cap-and-trade, it is unlikely they realize not all allowances must be purchased at auction. However, this paper explains free allocation, the different allocation schemes used to allocate free allowances, and the positives and negatives of each allocation scheme. Knowledge of the free allocation component of cap-and-trade is necessary to fully understand the program. Unfortunately, most news stories do not address or acknowledge that a higher percentage of total allowances are awarded to covered entities for free in the initial years of the cap-and-trade program.

The extent of the five policy alternatives receiving equal scrutiny from the same criteria simplifies the evaluation for the reader. I chose policy alternatives that show how the government may induce GHG abatement through the spending of cap-and-trade revenues. Government can take direct action by reforesting treeless natural areas or directly funding energy efficiency upgrades in commercial buildings, schools, or other public buildings. Government may also take a step back by merely providing low-cost financing to green energy start up or grants to other green technology firms to increase research and development for GHG reducing technologies.

LIMITATIONS

My assumptions on how cap-and-trade spending may be spent and the recent decision to borrow $500 million from cap-and-trade revenues to pay for General Fund expenditures may

have been incorrect. I did not consider spending or borrowing cap-and-trade auction revenues to pay for General Fund expenditures due to the Sinclair Nexus Test I discussed in Chapter 1. Both Legislative Counsel (as cited by LAO, 2012a) and Lambe and Farber (2012) indicated the spending of cap-and-trade revenues could not be spent for general purposes. However, since cap-and-trade revenues are likely to spent on non-GHG reduction measures in the short term I should have considered including one or more alternatives that did not specifically focus on GHG abatement policies. Additionally, if the decision to borrow cap-and-trade revenues for general purpose funding is not struck down by judicial ruling, the K-14 energy efficiency alternative should have received a higher score against the legality criterion or legality should be reconsidered as a necessary criterion in future CAMs analysis of cap-and-trade spending options.

My usage of inductive reasoning means my conclusions from this paper should not be considered accurate for cap-and-trade programs outside California. Using inductive reasoning as a means to come to my conclusions means they are not necessarily true, even if all the gathered evidence is accurate (Singleton, Jr. & Straits, 2010). Using deductive reasoning in a more general study would create conclusions that could apply to several cap-and-trade programs currently in operation.

Despite the relevance of the issue in California, the current stage of the state's cap-and-trade program requires future research. As the program continues to collect revenues at quarterly meetings and public officials decide how to allocate the new revenue, public policy and public administration researchers should observe and analyze the program, its benefits, and disadvantages. My thesis and the research put into is only one of potentially dozens of analyses of the program over the next decade.

POTENTIAL FUTURE RESEARCH

The newness of the Green Bank alternative and Connecticut's CEIFA opens the door for observing CEIFA's initial years of operation and extrapolating important implications for potential future green banks. Despite a descriptive website, CEIFA contained little information on its activities and operations. Perhaps this was to be expected as the CEIFA recently ended its transformation from CCEF to CEIFA. However, years from now, the operations, administrative issues, and program successes of CEIFA will become available for green economy analysts. These analysts should study CEIFA's operations and attempt to extrapolate general and informative lessons from what they observe.

Analysts should analyze the scope of carbon leakage from California as cap-and-trade places a price on carbon and the state pursues AB 32 goals. The higher costs associated with cap-and-trade forcing carbon-intensive businesses and activities to move outside California was among the most serious concerns raised by opponents of cap-and-trade. An analysis of the effects of California's cap-and-trade program and ARB's allocation scheme for free allowances on carbon leakage would provide a great awareness on the relationship between cap-and-trade and carbon leakage.

The disparity of estimated auction revenues and actual auction revenues during the first three cap-and-trade auctions merits more study. How were early revenue projections wrong? Is there a reason, auction revenues have not achieved as much revenue as anticipated? These questions and the disconnect between estimated revenues and actual revenues merits further study.

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