APPENDIX H.
MARKET ADVISORY COMMITTEE RECOMMENDATIONS

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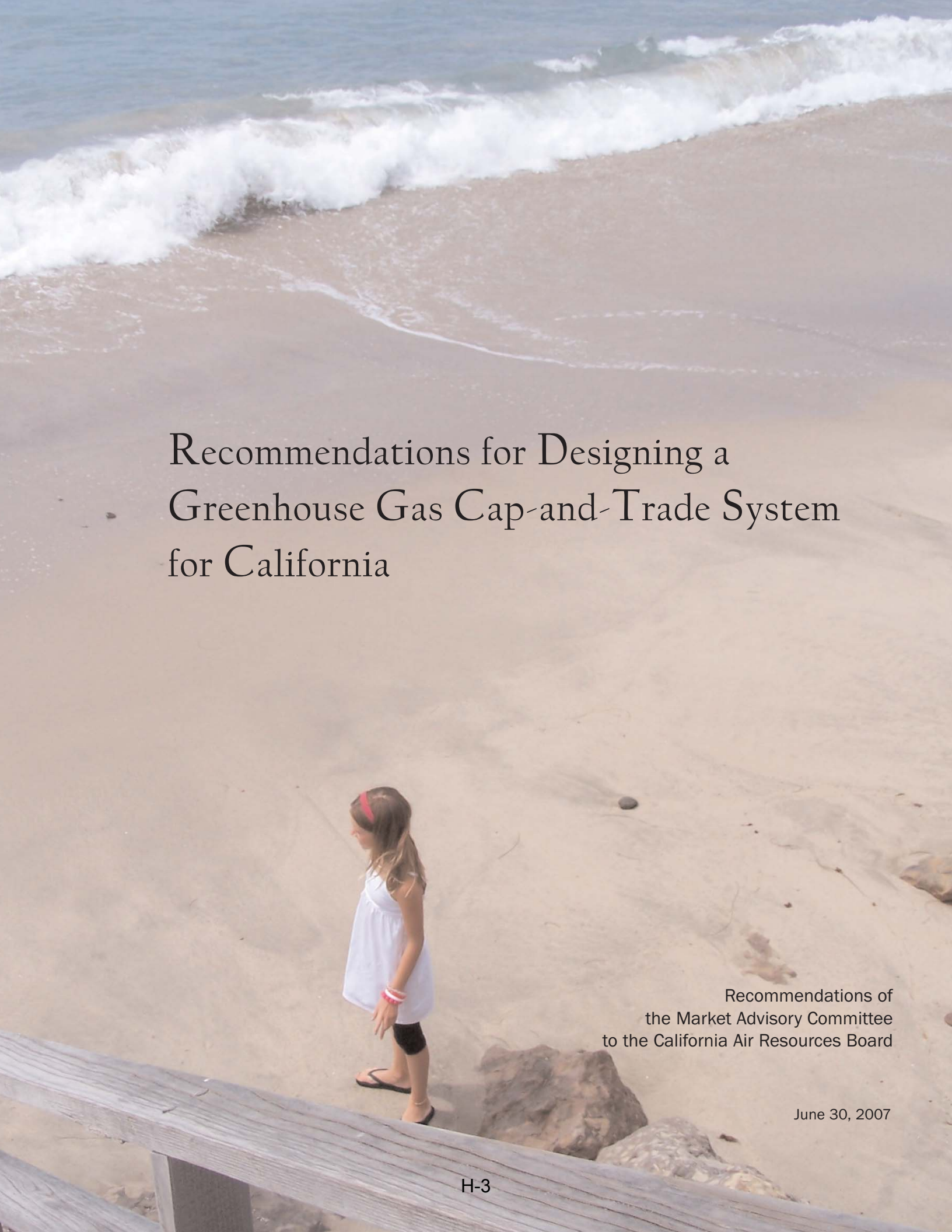

Recommendations for Designing a Greenhouse Gas Cap-and-Trade System for California

Recommendations of
the Market Advisory Committee
to the California Air Resources Board

June 30, 2007

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Executive Summary

The California Global Warming Solutions Act of 2006 (Act) requires the State of California to dramatically reduce greenhouse gas emissions by 2020. Specifically, this forward-looking statute charges the California Air Resources Board with responsibility for overseeing the development and implementation of a plan that will reduce California's aggregate greenhouse gas emissions to 1990 levels by 2020. This challenging emissions-reduction target will need to be achieved during a period of significant population growth and continued expansion of the state's economy. Successfully implementing the Act's requirements will again signal California's leadership in environmental protection and demonstrate that meaningful steps to address climate change are compatible with promoting balanced and sustainable economic growth and development.

In support of the Act, Governor Arnold Schwarzenegger directed the Secretary for Environmental Protection to create a ***Market Advisory Committee*** (Committee) to advise the Air Resources Board regarding the development of a greenhouse gas-reduction plan for California. The Committee is composed of national and international experts who have backgrounds in economics, environmental policy, regulatory affairs, and energy technologies.

The Act recognizes that a market-based system can be used in conjunction with regulatory and other strategies to meet an economy-wide emissions reduction target. Therefore, the Secretary for Environmental Protection charged the Market Advisory Committee with providing recommendations to the Air Resources Board regarding the design of an appropriate ***cap-and-trade program*** for reducing the state's greenhouse gas emissions.

The objective of the Committee was to design a cap-and-trade program to achieve cost-effective emissions reductions within and across all sectors of the State's economy. To achieve this objective, the Committee used a ***systems approach***, one that considers connections among all sectors of the economy and that examines how a cap-and-trade program interacts with existing and proposed emission reduction measures including regulations, performance-based standards, price subsidies, tax credits, and other technology-promoting initiatives. The Committee concluded that a well-designed cap-and-trade program is fully compatible with and complementary to these other regulatory programs and could contribute significantly to achieving the goals of the Act.

Early on, the Committee agreed to a ***set of principles*** that would guide its work in developing an efficient, equitable, and effective program design. These principles included:

- avoiding localized effects or disproportionate impacts on low-income communities or communities already adversely affected by air pollution;
- rejecting approaches that might weaken existing environmental regulations;

- encouraging practical, cost-effective emission reductions;
- minimizing transaction costs associated with compliance; and
- providing a leadership example for other states and countries.

The Committee's hope is that these recommendations will prove useful to the Air Resources Board as it works to implement the Act in a manner that achieves both the environmental and economic goals envisioned by the Governor and the Legislature.

Key Recommendations

Should the Air Resources Board determine that a cap-and-trade program will be used to contribute to the overall goal of reducing California's 2020 greenhouse gas emissions to 1990 levels, the Committee encourages the Air Resources Board to incorporate the following program design features:

The program should eventually include all major greenhouse gas-emitting sectors of the economy in the cap-and-trade program. Special attention must be given to the electricity, industry, buildings, and transportation sectors as key contributors to statewide emissions. Especially at the outset, however, the Air Resources Board should evaluate the practical constraints imposed by data availability, management capacity, administrative complexity, and transaction costs.

California faces special challenges in ***reducing emissions from the electricity sector*** because of the quantity of imported electricity generated from coal. The Committee recognizes and appreciates the leadership already shown by the California Public Utilities Commission and the California Energy Commission in seeking appropriate means of regulating these out-of-state emissions. ***To address emissions associated with imported electricity within a state-based cap-and-trade program, the Committee recommends a "first-seller approach."*** Under this approach, the entity that first sells electricity in the state is responsible to meet the compliance obligation established under the greenhouse gas cap-and-trade program. For electricity generated within California, the owner or operator of the in-state power plant is the first seller and would be required to surrender emissions allowances. For power imported from outside the state, the first seller is most often an investor-owned or municipal utility or a wholesale power marketer who sells the electricity to an in-state, load-serving entity, another power marketer, or a large end-user.

The method by which emission allowances are distributed under a cap-and-trade program does not affect total greenhouse gas emissions under the program, but will affect the distribution of economic costs associated with meeting California's greenhouse gas emission targets. ***The Committee recommends a combined approach in which some share of allowances is allocated free of charge initially, while the remaining allowances are auctioned. The percentage of allowances auctioned should then increase over time.*** Allowance value can be used to fund innovative emission reduction technologies and to focus pollution-reduction efforts in low-income and minority communities. Allowance value can also be utilized to provide transition assistance for

workers and industries subject to strong market pressures from competitors operating in jurisdictions that lack similar caps on greenhouse gas emissions.

The Committee recommends that the state initially retain flexibility to allocate some of the allowances free of charge as a means of managing competitiveness and economic transition issues. In addition, the Committee recommends that any free allocation of allowances be based on environmental performance benchmarks, and that the auction process be designed to encourage voluntary early reductions by firms, municipalities, and individual consumers.

Emission reductions by sources not included in the cap-and-trade program (called "offsets") can be used to reduce costs, increase flexibility, and assist in meeting the 2020 emissions-reduction requirement. ***The Committee recommends that California's cap-and-trade program recognize offsets generated both within and outside the state's borders***. Because of the administrative complexity associated with tracking and verifying offsets, however, the Committee recommends the use of very stringent criteria for determining whether activities qualify as offsets. Specifically, the Committee recommends that the state set standards for an initial group of offset categories that will ensure a high degree of confidence in the environmental integrity of approved offsets. In addition, the Committee recommends that the program introduce such offsets in a phased fashion, adding additional categories over time, as data and monitoring techniques for offset projects improve. Following this approach, California would only accept offsets from other states or countries if those other jurisdictions have an agreement with California to adequately ensure a similar level of environmental integrity and accountability in their emissions control programs.

Lower costs and significantly greater emissions reductions may be achieved over time by linking the California cap-and-trade program with similar policy initiatives in other jurisdictions. To promote a global greenhouse gas market, ***California should encourage linkages with other mandatory greenhouse gas cap–and- trade systems***. The Committee believes the benefits of linking to other programs can and should be achieved without sacrificing environmental integrity or giving less weight to equity and environmental justice considerations. In determining whether California should link its program to that of another jurisdiction, the Air Resources Board should consider the scope, stringency, integrity, and rigor of the other program, as well as its compliance requirements and enforcement strategies for assuring real, measurable, and lasting environmental benefits.

The California Legislature and the Governor have been and continue to be recognized globally for their leadership in adopting the Global Warming Solutions Act of 2006. The members of the Committee wish to express their sincere appreciation to the Secretary for Environmental Protection for the opportunity to contribute to the implementation of this landmark statute, which will likely come to be viewed as among the most significant in California's long history of environmental leadership.

Market Advisory Committee Members

Dale Bryk
Senior Attorney, Natural Resources Defense Council

Dallas Burtraw
Senior Fellow, Resources for the Future

Daniel J. Dudek
Chief Economist, Environmental Defense

Paul Ezekiel
Managing Director, Credit Suisse

Lawrence H. Goulder, Vice Chair
Shuzo Nishihara Professor of Environmental and Resource Economics, Stanford University

Judi Greenwald
Director of Innovative Solutions, Pew Center on Global Climate Change

Winston Hickox, Chair
Former Secretary of the California Environmental Protection Agency

Steven E. Koonin
Chief Scientist, BP

Franz T. Litz
Former Climate Change Policy Coordinator, New York State Department of Environmental Conservation

Brian McLean (Ex-Officio)
Director, Office of Atmospheric Programs, Office of Air and Radiation, U.S. Environmental Protection Agency

Joe Nation
Former California State Assemblymember and Adjunct Professor of Economics, University of San Francisco

Martin Nesbit
Director of the National Climate Change Policy Division, United Kingdom Department of Environment, Food and Rural Affairs

Jonathan Pershing
Director of the Climate, Energy and Pollution Program, World Resources Institute

Nancy Sutley
Deputy Mayor for Energy and Environment, City of Los Angeles

Peter Zapfel
European Union Emission Trading System Coordinator, European Commission

1 Introduction: California's Efforts to Address Climate Change

California's approach to climate change reflects a long tradition of leadership in addressing environmental problems. For more than four decades, California's policies to encourage renewable energy generation and improve energy efficiency have made major contributions to avoiding greenhouse gas (GHG) emissions. As a result, the state's per capita emissions are among the lowest in country.[1] Over the last twenty years California has taken significant steps to directly address GHG emissions and has incorporated climate considerations in state policies across all sectors. California has also embarked on a research plan to better understand the local impacts of climate change.

1.1 California Climate and Climate-Related Policies

Across the economy, California is already implementing a variety of policies that reduce GHG emissions. Its efforts to promote energy efficiency include the Title 24 standards for buildings, appliance efficiency standards, and a requirement to consider efficiency first in the electricity loading order, as well as substantial demand-side management programs. In April 2005, the California Public Utilities Commission adopted a rule requiring investor-owned utilities to use a GHG "adder" for long-term planning and resource procurement. The state's Renewable Portfolio Standard requires 20 percent of California's electricity to be supplied by renewable sources by 2010.

To encourage early reporting and reductions of GHG emissions in advance of mandatory climate targets, California created the California Climate Action Registry in 2000 to help companies and organizations register their emissions. The Registry has since developed industry-specific protocols for emissions reporting and provides technical assistance to members for both reporting and reducing emissions.

In 2002, California pioneered vehicle GHG emission standards under Assembly Bill 1493. California's vehicle standards require a 30 percent reduction in GHG emissions from new vehicles by 2016; thirteen other states have since committed to adopting this standard.[2]

[1] *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 – 2004.* California Energy Commission. December 2006. CEC-600-2006-013-SF

[2] California requires a waiver from the U.S. Environmental Protection Agency to implement this standard. At present, no waiver has been issued and the standards are currently being litigated.

The state has also undertaken efforts to reduce idling in diesel vehicles and promote more fuel-efficient vehicle tires.

On June 1, 2005, Governor Schwarzenegger signed Executive Order S-3-05, which established GHG reduction targets for the state. The targets aim to reduce emissions to 2000 levels by 2010, to 1990 levels by 2020, and to 80 percent below 1990 levels by 2050. Recognizing that GHG emissions—and thus emission reduction opportunities—occur throughout the economy, the Secretary for Environmental Protection established a Climate Action Team that includes the Secretary for Business, Transportation and Housing, the Secretary for Food and Agriculture, the Secretary for Resources, the Secretary of State and Consumer Services Agency, the Chairperson of the Air Resources Board, the Chairperson of the State Energy Resources and Conservation Development Commission, the Chairperson of the Integrated Waste Management Board, and the President of the Public Utilities Commission. The Climate Action Team issued a report to the Governor and the Legislature in March 2006 that outlined a suite of strategies for achieving the Governor's targets and continues to meet to coordinate California's climate strategies.

Senate Bill 1368 directs the California Public Utilities Commission and the California Energy Commission to set a greenhouse gas performance standard to ensure that new long-term financial commitments in baseload power plants by electric load-serving entities have greenhouse gas emissions that are as low, or lower, than emissions from a combined-cycle natural gas power plant. This standard applies whether the power is generated within state borders or imported from plants in other states. The California Public Utilities Commission and the California Energy Commission have adopted the standard at 1,100 lbs of carbon dioxide (CO_2) per megawatt-hour (MWh) of electricity generated. The standard will drive the development of less carbon-intensive technologies for generating electricity, including research and investment in coal power plants that capture and store CO_2, as generators in California and in states that export electricity to California seek to meet the standard.

In addition, Governor Schwarzenegger pledged in January that he would apply the world's first low-carbon fuel standard to transportation fuels sold in California, with the goal of reducing the carbon content of passenger-vehicle fuels in the state at least 10 percent by 2020. Because the standard applies to lifecycle emissions,[3] it will provide incentives for reducing GHG emissions in petroleum processing as well as for increasing the use of biofuels and electricity as transportation energy sources. This approach to reducing transportation emissions represents an innovative step which complements previous initiatives that focused primarily on vehicle tailpipe emissions.

[3] Lifecycle emissions are referred to as "well to wheel" emissions. For petroleum products, these include GHG emissions associated with the extraction, transport, and refining of transportation fuels. For biofuels, these include GHG emissions associated with growing, harvesting, and processing organic material into fuels.

1.2 The Global Warming Solutions Act

1.2.1 Overview of the Act

On September 27, 2006, Governor Schwarzenegger signed Assembly Bill 32, Núñez and Pavley, Health and Safety Code, Division 25.5. Titled "The Global Warming Solutions Act of 2006," this legislation set an enforceable target of reducing the state's GHG emissions to 1990 levels by 2020. The Act covers all the GHGs defined in the Kyoto Protocol "basket" of emissions: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). It gives the California Air Resources Board (CARB) responsibility for adopting the necessary measures to achieve the emissions target and allows for the use of market mechanisms. Specifically, CARB is required to "achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions." Prior to adopting regulations to achieve that objective, CARB must evaluate impacts on California's economy, the environment and public health, equity between regulated entities, and electricity reliability. In addition, CARB must ensure that regulations adopted to implement the Act conform to other environmental laws and do not disproportionately impact low-income communities. These requirements are reflected in the design criteria described in Chapter 4 of this report. Finally, the Act provides for a continued role for the state's interagency Climate Action Team and requires the formation of advisory committees on Environmental Justice and Economic and Technology Advancement to inform the regulatory process.

The Global Warming Solutions Act imposes specific requirements on the use of market mechanisms to achieve its emissions objectives. For example, CARB must consider "localized impacts in communities that are already adversely affected by air pollution." In addition, any market mechanisms employed must be designed to both prevent increases in emissions of toxic air contaminants or criteria air pollutants and to maximize economic and environmental benefits to the state.

1.2.2 Implementation Timeline

The Global Warming Solutions Act sets a timeline for the adoption of regulations to achieve required emissions targets. By June 30, 2007, CARB must create a list of early emission reduction measures that can be adopted by 2010. CARB must create emissions reporting protocols for significant sources of GHG emissions by 2008, basing these protocols on those developed by the Climate Action Registry. By January 1, 2009, CARB must adopt a scoping plan to achieve maximum technologically feasible and cost-effective GHG reductions. Regulations to achieve the 2020 emissions target must be adopted by 2011 and enforced by 2012. Therefore, a market-based program to limit emissions, if adopted by CARB, would become operational on January 1, 2012. As discussed below, the program could recognize and reward emissions-reductions achieved prior to its implementation date.

1.3 Formation and Charge of the Market Advisory Committee

The Secretary for Environmental Protection created the Market Advisory Committee, a committee of national and international experts, to develop recommendations concerning the design of a market-based program for reducing California's GHG emissions. The committee was formed according to Executive Order S-20-06 and will formally submit its recommendations to CARB by June 30, 2007.

The Market Advisory Committee has focused on the design of a mandatory cap-and-trade program for California. The Committee members have experience in the development and implementation of a number of cap-and-trade-type programs, including the European Union's Emissions Trading Scheme, the U.S. Acid Rain Program, the NOx Budget Program, and the Northeast Regional Greenhouse Gas Initiative.[4]

This report offers the Committee's judgments as to the best design options for a mandatory GHG cap-and-trade system for California. In arriving at its conclusions, the Committee gave careful consideration to public comments provided by regular mail, e-mail, and during public meetings on February 27, April 17, May 15, and June 1, 2007. A complete record of written comments is available at the website: http://www.climatechange.ca.gov/.

As this report indicates, the Committee achieved consensus on a wide range of central design issues. However, it did not reach full agreement on all issues. In areas where the Committee did not come to consensus, the report describes available design options and identifies relevant considerations for choosing among them.

The Committee has an advisory role: it is not incumbent upon the Air Resources Board to adopt the recommendations of this report. However CARB chooses to implement the Global Warming Solutions Act, this report should provide information helpful to the Board's decisions.

[4] Descriptions of these programs can be found in Appendix C.

2 Background on Cap and Trade

2.1 Rationale for a Cap-and-Trade System

Cap-and-trade regulatory systems are used in the United States and around the world to achieve a desired level of emissions reductions. Two main attractions of this approach are its ability to put a clear and specific limit on aggregate emissions and its potential to achieve the emissions-reduction target at lower cost than would otherwise be possible. The cap establishes certainty as to the total amount of emissions that will occur under the program. The ability to trade emissions allowances yield cost-savings by promoting emissions reductions at those sources that are able to achieve the reductions most cheaply. Trading emissions allowances lowers costs to the facilities covered under the program. In doing so it reduces economic impacts on workers, consumers, and taxpayers.

A cap-and-trade program has other attractions as well:

- Administrative costs can be lower because regulators are relieved of responsibility for establishing specific targets on a facility-by-facility basis.
- The approach encourages innovation and reinforces technology-promoting policies.
- Broad coverage reduces the potential for shifting rather than reducing production and emissions ("leakage").
- Well-designed programs provide certainty about monitoring obligations and consequences for noncompliance.
- Such programs are likely to prompt further reductions in local air pollutants.

Note that a carbon tax offers several of these same advantages. However, a carbon tax would not ensure a particular level of emissions reductions. Ensuring a specified emissions target is particularly desirable in view of the emissions goal established by the Global Warming Solutions Act.

2.2 Basic Elements of Cap and Trade

Cap-and-trade systems have four fundamental elements: the cap, the allowances, trading, and monitoring/enforcement.

The cap: This is the mandatory limit on the total emissions that can be released in a given period from covered sources. The overall stringency of a cap-and-trade program depends on the level of the cap. For example, a cap set well below current emissions levels will be more challenging to meet than one that allows for continued growth in emissions above current levels (but below projected business-as-usual growth). The cap level is absolute in the sense that it is not affected by shifts in production or GDP or by the effectiveness of any given control technology. In this way, a cap can make a well-defined contribution toward achieving California's overall emissions reduction target.

Emissions allowances: These are permits that entitle the holder to emit a specified quantity of the pollutant being regulated in a given time period. For programs that target GHG emissions, allowances are typically equal to one metric ton of CO_2-equivalent emissions. The total number of allowances issued is determined by the cap level. Thus, for example, if the cap were set at 100 metric tons, then a total of 100 allowances would be made available to the market in some fashion, either through free allocations or via an auction.

Trading: Sources covered by the cap-and-trade program can buy and sell allowances from other entities. Generally, a facility will buy additional allowances (entitling it to additional emissions) if the market price of allowances is less than what it would cost the facility, at the margin, to bring emissions down to the level implied by its initial allowance holdings. Likewise, a facility will sell allowances if the allowance price is higher than what it would cost to achieve the additional reductions made necessary by the sale of allowances. Every allowance purchase by one entity corresponds to an equal reduction in the allowances held by the selling entity. Thus, allowance trades do not affect total allowable emissions because they do not alter the total number of allowances in circulation.[5] Trading ensures that emissions are reduced at least cost and, conversely, that allowances go to the highest value applications.

Monitoring and enforcement: At the end of each compliance period, entities regulated under a cap-and-trade system are required to submit allowances equivalent to the level of their GHG emissions. Accurate measurement and reporting of all emissions is therefore necessary to assure accountability, establish the integrity of allowances, and sustain confidence in the market. To assure compliance, the cap and trade program needs to include penalties for entities that do not hold a sufficient quantity of allowances to cover their emissions. The regulatory agency responsible for the program must track emissions to ensure that (a) emissions match allowances at particular sources and (b) overall emissions match overall allowances.

Beyond these fundamental elements, a cap-and-trade program can incorporate other features to reduce program costs. Such features might include the use of emissions offsets from uncovered sources and sectors, provisions for "banking" allowances for future use or "borrowing" allowances promised for the future, and credits for emissions reductions achieved in advance of program implementation. These and other potential components are discussed in Chapter 6.

[5] If a private party decided to retire the allowances it purchased or held, the total number of allowances in circulation would be reduced, implying further reductions in total emissions.

2.3 Benefits from Cap and Trade

As mentioned, one of the main attractions of a cap-and-trade system is its potential to achieve stated emissions targets and to do so at lower cost than would be possible if facilities faced individual emissions limits. In a cap-and-trade system, facilities that face relatively high costs to reduce emissions will tend to purchase additional emissions allowances rather than incur those costs. Correspondingly, facilities that can reduce emissions at relatively low cost will find it advantageous to purchase fewer allowances or sell any excess allowances; even though this obliges them to reduce emissions further, the avoided cost or sale revenues more than compensate for the costs associated with implementing extra reductions. Thus, allowance trading causes emissions reductions to be undertaken by those facilities that can accomplish reductions at the lowest cost. Moreover, since allowances are valuable, cap-and-trade programs give firms continuing incentives to identify low-cost reduction opportunities: additional reductions are attractive because they allow firms either to sell more allowances or to reduce the number of allowances they must purchase.

If regulators knew exactly how much it would cost each facility to reduce emissions by various amounts and were free to discriminate among sources based on cost considerations, they could set emissions limits for each facility at just the level that enabled the overall target to be achieved at minimum cost. In reality, however, regulators do not have this information. A cap-and-trade program overcomes this information problem by letting the market generate the cost-minimizing configuration of emissions levels across facilities.

This potential for cost savings is not simply a theoretical proposition. Studies indicate substantial cost savings from existing cap-and-trade programs. The two major studies of cost savings for the SO_2 program (Carlson *et al*., 2000 and Ellerman, 2003b) are in general agreement that savings under the trading program amounted to 43–55 percent of expected compliance costs under an alternative regulatory program that imposed a uniform emission standard. Carlson *et al*. cite savings of over 65 percent compared to a policy that might have forced post-combustion controls (scrubbers) to achieve the same level of emissions.

Moreover, a cap-and-trade system gives the regulating authority considerable flexibility in determining how net compliance costs are distributed across covered facilities. Allowances are valuable assets. The regulating authority can significantly reduce—or entirely offset—the costs of the cap-and-trade program by using the value of the allowances to benefit those who pay for them (in most cases residential, commercial and industrial consumers of energy). It can also use the value of allowances to advance program goals such as providing additional protection for low-income consumers. Key considerations regarding the distribution of allowances are offered in Chapter 6.

2.4 Environmental Justice and Other Concerns about Cap-and-Trade Systems: Guiding Design Principles

Notwithstanding these potential benefits, some policy makers and stakeholders have voiced concerns about potential impacts of the cap–and-trade system. Several concerns relate to environmental justice. As part of its work, the Market Advisory Committee consulted with the Global Warming Environmental Justice Advisory Committee of the CARB. The Market Advisory Committee wishes to draw particular attention to several of the environmental justice concerns raised during these consultations and in discussions with other stakeholders:

- *Concerns about the effects of the cap-and-trade program on emissions of criteria pollutants in historically over-burdened communities*: The flexibility inherent in a cap-and-trade program could allow some facilities to avoid reducing—or even increase—emissions of both GHGs and criteria pollutants. Such a situation could contribute to the creation of environmental "hot spots" in historically over-burdened communities. This concern reflects the fear that the cap-and-trade program will not guarantee pollution reduction everywhere in California, and it is particularly strong in communities where health-based ambient air quality standards are not now being met.
- *Concerns about the environmental integrity of the cap-and-trade program*: Several stakeholders have expressed concerns that political considerations could lead to setting a cap that is not sufficiently stringent to reduce actual emissions by entities operating in California, given the potential flexibility to meet compliance requirement by acquiring emissions allowances from other trading systems linked to the program or by purchasing offsets generated outside the state.
- *Concerns about emissions leakage*: Some stakeholders expressed concerns that the cap-and-trade program could cause firms to shift emissions-intensive production to out-of-state sites in response to new emissions controls.
- *Concerns about offsets and linkages*: Many stakeholders expressed concerns that offset and linkage provisions would result in a less stringent program, since it would be difficult for California to ensure the integrity of emission reductions outside of its jurisdiction. They have also raised concerns that such provisions would substantially reduce the ability of a cap-and-trade program to reduce pollution within the state.

The Committee acknowledges the concerns about the potential impact of the cap-and-trade program on emissions of both criteria air pollutants and toxic contaminants in disadvantaged communities. These understandable concerns arise because GHG emissions trading does not impose facility-specific emissions reduction requirements. Even with this flexibility, the Committee believes that a well-designed cap-and-trade program in most cases will yield significant *reductions* in emissions of local pollutants, since the local pollutants tend to be bundled with GHG (especially CO_2) emissions, so that the changes in production methods that lead to reduced GHG emissions also lead to lower emissions of local pollutants. These reductions would be consistent with previous experience. A U.S. Environmental Protection Agency staff analysis found that under the SO_2 emissions trading program, the largest reductions occurred in areas with the highest emissions levels. This finding was true

both regionally and at individual plants.[6] Still, it is crucial to monitor very closely the emissions of local pollutants to track any possible increases. The Committee urges CARB to reinforce the efforts of local air quality management districts (traditionally responsible for compliance with national clean air rules) by closely evaluating the impact that emissions trading is having on criteria emissions or air toxics. The California Health and Safety Code section 39602 designates CARB as the California agency responsible for coordinating and reviewing the activities of local air districts in the state. Section 41503.2 articulates procedures that can be taken by CARB to revise a district's plan if it is found to be deficient. The Committee urges CARB to exercise this authority by reviewing local air district enforcement efforts and revising local air district actions as necessary to prevent any "backsliding" on the standards for local air quality.

The hard cap inherent in a cap-and-trade program helps assure that it meets it statewide environmental goals. To further assure the environmental integrity of the program, the Committee recommends rigorous standards for offsets (Chapter 6) and calls for strict enforcement and tough penalties for non-compliance (Chapter 7). It also endorses the use of more traditional regulatory measures for sources not easily incorporated into the cap-and-trade program.

The Committee believes that, beyond avoiding harm, a well-designed cap-and-trade program can yield significant environmental justice benefits. As discussed in Chapter 6, the recommended cap-and-trade program uses allowance value to encourage in-state emissions reductions and in-state investments in low-emissions technologies. This can be accomplished either by devoting revenues from auctioned allowances to this purpose, or (in the case where allowances are freely allocated) providing allowances to entities that plan to make such investments. By promoting these investments, the program helps assure that California's communities will capture a significant share of the benefits associated with emissions-reducing activities. The Committee endorses devoting a significant portion of the allowance value to investments in California communities that bear disproportionate environmental and public health burdens. With careful attention by CARB to the structure of investment incentives that are incorporated into the Scoping Plan for the Global Warming Solutions Act, the benefits of these in-state reductions could accrue to a significant degree to the lower-income communities that have been historically disadvantaged by their proximity to emissions-intensive activities.

The Committee's recommended design of the cap-and-trade program helps limit the potential for emissions leakage. As discussed in Chapter 5, the recommended program aims to capture emissions resulting from both in-state and out-of-state generation of electricity purchased by Californians. This reduces the potential to escape emission-reduction requirements by substituting imported power for the electricity generated in the state. Furthermore, it should be noted that leakage is more likely under conventional, less flexible regulation, because leakage depends on the costs in California relative to other states—and the state's costs would be higher if the state relied entirely on conventional regulation.

[6] "The Acid Rain Program and Environmental Justice: Staff Analysis" (September 2005) U.S. Environmental Protection Agency, Office of Air and Radiation, Clean Air Markets Program.

Although some Committee members favor specific limitations that would maximize direct benefits for California, all Committee members agree that the flexibility that a cap-and-trade program offers will allow California to reduce global warming pollution at least cost. The Committee is convinced that in the long run, by demonstrating the ability of a cap-and-trade program to reduce costs, California will prompt other jurisdictions to follow its lead. Concerted actions by California and other jurisdictions will help reduce global emissions on the scale and timeframe needed to avert catastrophic climate impacts—impacts that would fall disproportionately on the world's poorest populations.

The Committee believes that offsets—emission reductions by sources not included n the cap-and-trade program—can help reduce costs of meeting the state's emissions reduction target. At the same time, it recognizes the challenges involved in ensuring that offsets lead to real emissions reductions. For this reason, the Committee recommends very strict qualification criteria for offsets. In addition, to help assure that a significant fraction of offsets projects and their associated economic benefits materialize within the state, the Committee encourages CARB to consider giving preferences to in-State offset projects associated with lower income and disadvantaged communities. These and related issues are discussed in Chapter 6.

The Market Advisory Committee was determined to recommend a cap-and-trade system that would be responsive to the environmental justice and other concerns that surfaced in public comments by stakeholders. To that end, the Committee developed the Guiding Design Principles listed immediately below.

Box 2-1: Guiding Design Principles Affirmed by the Market Advisory Committee

A cap-and-trade program to limit California GHG emissions should be designed to achieve the maximum feasible cost-effective reductions that are real, permanent, measurable, verifiable, and enforceable, consistent with the mandate of the Global Warming Solutions Act and the following principles:

1. Avoid localized and disproportionate impacts on low-income and disadvantaged communities or communities already adversely impacted by air pollution.

2. Avoid interference with the achievement of state and federal ambient air quality standards and toxic contaminant reductions.

3. Minimize administrative burdens and maximize total benefits to California, including reducing other air pollutant emissions, promoting the diversification of energy sources, and advancing other economic, environmental, and public health objectives.

4. Be simply designed, easily understood, easy to administer, and easy to comply with.

5. Minimize transaction costs.

6. Minimize the potential for leakage.

7. Include as many sources or categories of sources as practical while encouraging participation beyond the capped sources.

8. Provide appropriate incentives for early voluntary reductions.

9. Stimulate investment and reward innovation.

10. Inspire other states, the federal government, and other countries to take action by providing a robust model for effective action and by including mechanisms to facilitate linkage with regional, national, and international GHG reduction programs. California's program should also be consistent with established international standards and build upon existing international programs.

These principles reflect the Committee's insistence that a California cap-and-trade program must be fair and cost-effective while bringing about real emissions reductions. Some interested parties question whether this can be accomplished through a cap-and-trade system. Here we briefly address some of those questions.

1. *Will a Cap-and-Trade Program Deliver Real Emissions Reductions?*

Under a cap-and-trade program, regulators establish a cap on the total emissions allowable (in any given year) from facilities covered by the program. As mentioned, this cap determines the number of allowances issued (either for free or through an auction). With monitoring and enforcement, this cap assures that emissions from covered facilities will not exceed the level implied by the cap. Provided that the cap is set at a level below current emissions, a cap-and-trade program will deliver real reductions. Trading of emissions allowances means that entities within the system have flexibility to emit at different levels, but since the total number of allowances in circulation is fixed trading does not raise overall emissions. As discussed below, the proposed cap would decline gradually through time, meaning fewer aggregate emissions each subsequent year.

Offsets are emission reduction credits attributed to reductions achieved by entities outside of the cap-and-trade program. Some parties are concerned that allowing for offsets could compromise the ability of the trading program to bring about real reductions. As discussed in Chapter 6, introducing offsets need not weaken the ability of the cap-and-trade program to yield emissions reductions. The critical requirement is that very tough standards must be applied to ensure that offset credits are issued only for emissions reductions that are real, additional, verifiable, permanent, and enforceable.

2. Could the Cap-and-Trade Program Interfere with or Soften Existing Regulations?

Interested parties have expressed concern that a cap-and-trade program might imply a softening of California's existing controls on emissions of other pollutants. The Committee does not believe this is the case. Suppose a given production facility is subject to fixed emissions limits. The introduction of a cap-and-trade program will either cause the facility to reduce emissions further, or it will have no impact on the facility's planned emissions. In no case will the introduction of the trading program cause an increase in emissions. Box 2-2 examines this issue in detail.

Box 2-2:
Impact of a Cap-and-Trade System on a Facility That Already Faces Emissions Limits

Suppose that a facility's maximum allowable emissions under an existing standard is *E*, and that this constraint is binding in that the facility could emit no more than *E* in the absence of the cap-and-trade program. The impact of the cap-and-trade program depends on whether the market price of emissions allowances is higher or lower than the facility's marginal cost of further emissions reductions:

- If the price of allowances is *higher* than the facility's marginal cost of emissions reductions when emissions are at *E*, then the facility will undertake additional reductions to achieve a lower level of emissions, *E'*. This is because the cost to the facility of undertaking these additional reductions is less than the opportunity cost associated with having to hold a larger number of allowances at emissions level *E*. The facility will minimize its compliance costs by continuing to reduce emissions until the marginal cost of further reductions equals the market price of emissions allowances. This applies no matter whether the facility's initial allowance allocation is above or below *E'*, or if it is zero. If the initial allowance allocation is above *E'*, the facility will sell whatever allowances are in excess of the amount it needs for compliance at emissions level *E'*. If the initial allowance allocation is below *E'*, the facility will purchase whatever additional allowances are necessary to be in compliance at *E'*.

- If the price of allowances is *lower* than the cost to the facility of reducing emissions when emissions are at *E*, then the facility will maintain its emissions at *E* and purchase or sell allowances as needed to cover that level of emissions. The existence of the standard means that the facility cannot increase emissions above *E*, despite the fact that at this level the market price of allowances is less than the marginal cost of reductions needed to maintain emissions at *E*.

3. Can the Cap-and-Trade Program Cause an Increase in Local Pollutant Emissions?

Changes in production methods that cause reductions in GHG emissions tend to reduce emissions of other pollutants as well, since many combustion processes produce multiple types of emissions. In particular, efforts to limit GHG emissions by reducing the combustion of carbon-based fuels will tend to produce simultaneous reductions in pollutants such as NOx, SO_2 and mercury. Thus, introducing the cap-and-trade program is likely to yield overall *reductions* in other pollutant emissions. It is conceivable that in some instances, the flexibility afforded by trading could cause a firm to shift production from one facility to another in order to reduce GHG emissions at a lower overall cost and that, because of differences in the industrial processes involved, this could lead to an increase in emissions of a local pollutant at one facility. The Committee thinks circumstances of this sort will be rare. However, consistent with the Guiding Design Principles above, we believe it is important that CARB maintain close vigilance over potential impacts on local pollutants to make sure that local air quality regulations and goals are met. In Section 2.4 below we make specific recommendations about how these concerns can be addressed.

4. Does a Cap-and-Trade Program Reduce the Need for Technology-Promoting Policies?

A main purpose of the cap-and-trade program is to bring about low-cost emissions reductions within sectors covered by the program. The cap not only limits emissions, it creates a market for emissions allowances where every ton of emissions has a price. This price provides sustained incentives for developing new technologies that can reduce GHG emissions: if an entity adopts a new technology that reduces emissions, then it will need to hold fewer allowances. This benefits the entity since it either won't need to purchase as many allowances or it will be able to sell a greater number. At the same time, the cap-and-trade program does not eliminate the need for other policies that are directly focused on promoting new technologies. The reason is that the cap-and-trade program addresses a particular market failure, while technology-promoting policies address others. The cap-and-trade program addresses the failure of market prices to capture the climate-change externality associated with GHG emissions. It remedies this market failure by creating a price signal for avoided emissions. Technology-promoting policies may still be needed, however, to address other market failures that impede the development of new technologies, such as the "innovation market failure" that results from the inability of inventors to reap all of the rewards from new knowledge generated by their investments. Technology-promoting policies such as tax incentives for research and development, California's motor vehicle regulations, and the Low-Carbon Fuels Standard directly confront these other types of market failures. A cap-and-trade system does not obviate the need for such technology policies. To the contrary, it complements technology policies.

5. Does the Cap-and-Trade Program Eliminate Incentives to Reduce Emissions Prior to Its Implementation?

Another concern is that introducing a cap-and-trade program could eliminate incentives to reduce emissions before the program goes into effect. This could result if entities expect that allowances will be awarded solely on the basis of current emissions and without regard to reductions achieved prior to program implementation.

Nothing inherent in a cap-and-trade program need penalize early reductions. Emissions allowances can be allocated to facilities for free or through an auction. As discussed below, if allowances are auctioned, then prior efforts to reduce emissions are rewarded because entities that have accomplished such reductions will need to purchase fewer allowances than they otherwise would. If allowances are distributed for free, then fairness considerations require that prior efforts to reduce emissions be taken into account when deciding how many allowances should be allocated to a given facility. Once the cap-and-trade program is introduced, all facilities covered under the program will have incentives to reduce emissions even further.

2.5 Prior Applications of the Cap-and-Trade Approach and Lessons Learned

In designing a cap-and-trade program for California, there is an opportunity to learn from the successes and limitations of earlier trading-program designs. This section describes key lessons learned from five other programs: the U.S Acid Rain Program, the California South Coast Air Quality Management District's Regional Clean Air Incentives Market (RECLAIM), the NO_x SIP Call Trading Program, the European Union Emissions Trading Scheme (EU ETS), and the Northeast Regional Greenhouse Gas Initiative (RGGI). Each of these programs is described and assessed in some detail in Appendix C.

Experience with each of these trading programs offers strong evidence that cap-and-trade systems have the potential to achieve defined emissions reductions from capped sources at low cost. Prior experience therefore supports the view that a California cap-and-trade program could contribute significantly to meeting California's overall 2020 GHG reduction target. In addition, experience with other trading programs points to certain design features that are conducive to a well-functioning emissions market:

- **Create market scarcity.** The market will only work if there is real scarcity: that is, the aggregate cap on emissions must be below expected business-as-usual levels. Both the RECLAIM and the EU ETS programs initially allocated more allowances than were needed to cover emissions. In the case of the EU ETS, this was because emissions data were not available before initial allocations were set.

- **Allow for unrestricted allowance banking.** Allowance banking enables firms to manage risk and provides an incentive for capped sources to over-comply in early periods as a way of "saving for a rainy day." Where allowed, banking has been used extensively, resulting in much greater early emissions reductions than would otherwise have taken place. Having allowances in the bank creates a hedge against any number of unexpected developments that could lead to higher-than-expected market prices. Had banking been allowed in the RECLAIM program, it is likely that post-combustion NOx controls might have been put in place earlier. Without the ability to bank allowances, firms had no incentive to install controls or reduce emissions earlier than necessary. Also, banked allowances from earlier periods could have facilitated compliance during the 2001 electricity crisis. Moreover, as learned in the EU ETS, the inability to bank allowances from one compliance period to the next may contribute to greater price volatility.

- **Apply very strong selection criteria for any offsets considered by the program.** Program integrity requires a careful approach to the design and implementation of offsets to ensure that credit is issued only for emission reductions that are real, permanent, measurable, verifiable, enforceable, and additional. The standards approach used in the RGGI program provides a good model, balancing high-quality standards for a limited number of project "types" with the need to keep transaction costs manageable so as to facilitate the timely development of offsets.

- **Ensure quality data.** All facets of a cap-and-trade program—including the ultimate credibility of the program—rely on high-quality data. If some or all emissions allowances are being distributed for free, good historical emissions data are needed at the outset to help avoid over-allocating allowances to particular facilities. Once the program is operational, accurate data are needed to determine whether the facilities' emissions are within the amount authorized by the allowances they hold. Therefore, it is critical to monitor, report, and verify all emissions from all sources covered by the program.

- **Provide for data transparency.** Data on emissions and allowance transfers should be made available to the public as a way to build public support for a California cap-and-trade program. The fact that all the data for the Acid Rain Program are available on-line has been credited with helping to build public trust in what was initially a novel regulatory approach.

- **Create automatic penalties.** Automatic penalties for non-compliance, provided they are set at levels well above the likely market price of allowances, create a strong incentive for compliance. Well designed emissions trading programs typically have compliance rates above 99 percent. Under the Acid Rain Program, for example, sources that do not have sufficient allowances to cover their emissions are required to both (1) pay a fine (currently over $3,000 per ton or more than five times the weighted average of the 2007 spot auction trading price for allowances) and (2) offset excess emissions with an equivalent number of allowances. Under the EU ETS, the penalty jumps from 40 euros per ton in the current learning phase to 100 euros per ton for Phase 2 of the program, beginning in 2008. The latter penalty is well above the current EU allowance market price of roughly 15 euros per ton for Phase 2.

- **Consider emissions hotspots in program design.** While a cap-and-trade program will reduce overall emissions to the cap level at the lowest cost, it does not ensure that emissions reductions will occur at each facility. Although CO_2 itself is widely dispersed and does not present a local health concern, the uneven distribution of mitigation efforts could affect facility-specific emissions of "co-pollutants." It will therefore be important to anticipate and address concerns about emissions hotspots early in the design process.

- **Consider early mandatory reporting.** Early mandatory reporting can be helpful, particularly where the time between program adoption and implementation is relatively short. This helps resolve data issues and thereby facilitates early action.

- **Consider program refinements after the initial phase.** A learning phase was helpful in the EU ETS because the time between program adoption and implementation was relatively short, and it allowed the EU to work out kinks in the system. In California, given a longer implementation and experience with emission trading, the initial period need not be explicitly a learning phase but could provide lessons that lead to program refinements. The EU ETS review of its first phase was conducted in late 2006 to identify improvements and extensions to the program for implementation by 2013, the start of the third trading period. The EU review focused mainly on the scope of the trading system (considering which additional sectors and greenhouse gases to cover), the level of the

cap, and allowance allocation. Several changes were made to EU rules (including monitoring and reporting provisions) to reflect experiences gained during the learning period. The changes go into effect in 2008.

- **Carefully manage any changes in trading-system design.** When it becomes desirable in the future to change the stringency of the cap, it is possible to manage such adjustments in a way that preserves the value of early investments and banked tradable allowances. The easiest way is to change the number of allowances that are issued into the market in future years while not touching the bank of emissions allowances that exists from prior years. Statutory constraints led the U.S. Environmental Protection Agency (EPA) to use a more complicated approach in tightening the national cap on sulfur-dioxide emissions under the Acid Rain Program; specifically, EPA changed the denomination for SO_2 allowances issued after specific dates (2010 and 2015). Emission allowances issued before these dates retain their value in terms of tons/allowance. Therefore, banked emission allowances retain the value for the year (vintage) that they were issued. The NO_x SIP Call Trading Program also adjusted program stringency in its third phase to be consistent with the levels required by EPA in its SIP Call when it merged with that program. And RGGI has adopted a steadily declining cap, which automatically reduces the number of allowances issued each year by 2.5%.

- **Coordinate with other programs to assure consistency, and consider possible linkages.** Experiences with other trading systems—notably the Northeast NO_x Budget Program , the EU ETS, and RGGI —suggest that a regional planning process can produce successful programs that span multiple states or jurisdictions while achieving important environmental goals. Further, the transition from the northeastern states' NO_x Budget Program to the much broader NO_x SIP Call provides a model for expanding the coverage of a cap-and-trade program to include neighboring states.

3 General Design Considerations

3.1 Objectives

As discussed in Chapter 2, a fundamental attraction of the cap-and-trade approach is its potential to achieve given targets for emissions reductions and to do so at lower cost than would be possible in the absence of emissions trading. The ability of a trading program to achieve maximum environmental and economic benefits depends on the particular way it is designed. Here and in subsequent chapters we discuss alternative designs for a cap-and-trade program and indicate which design features would best serve California.

The program recommendations that emerge from this discussion are consistent with the design principles described in Section 2 above. Those design principles stem from several fundamental objectives:

- **environmental integrity—**achieving specified GHG reduction targets
- **cost-effectiveness—**achieving emission reduction targets at low cost (where "cost" is broadly understood to include not only the compliance costs of regulated entities and costs to consumers, but also administrative and enforcement costs)
- **fairness—**assuring that the program avoids causing environmental harm to particular communities, and assuring that compliance costs are spread equitably across sectors and regions
- **simplicity—**offering a program that is easily communicated and administered

The cap-and-trade design recommended below yields a program that is best suited to meet these objectives.

3.2 Context for the Program Design

3.2.1 Relationship to Other Energy or Climate Policies

Before setting out the key design elements of a cap-and-trade program it is important to explain how the proposed emissions trading approach relates to other policy measures. The following considerations seem especially relevant:

- The emissions trading program puts a cap on the total emissions generated by facilities covered under the system. Because a certain number of emissions allowances are put in circulation in each compliance period, this approach provides a measure of certainty about the total quantity of emissions that will be released from entities covered under the program.

- The market price of emissions allowances yields an enduring price signal for GHG emissions across the economy. This price signal provides incentives for the market to find new ways to reduce emissions.

- By itself, a cap-and-trade program alone will not deliver the most efficient mitigation outcome for the state. There is a strong economic and public policy basis for other policies that can accompany an emissions trading system.[7]

The connection between the cap-and-trade program and policies directly aimed at promoting the development of new technologies deserves attention. As discussed in the previous chapter, the cap-and-trade program addresses one type of market failure (stemming from the climate-change externality associated with greenhouse gas emissions) but does not address other types of market failures that may impede the development and deployment of new technologies. Accordingly, the existence of a trading program does not eliminate the need for direct, technology-oriented policies: rather, these policies are complementary.

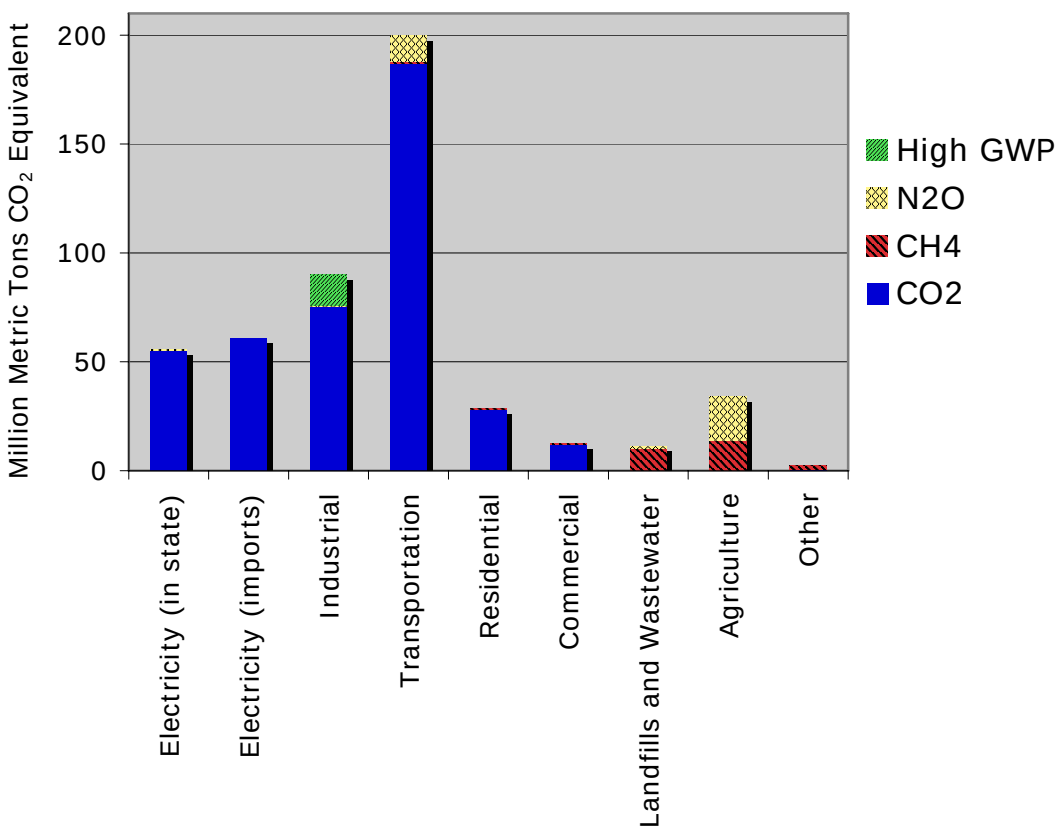
3.2.2 California Greenhouse Gas Sources and Emissions Levels

The bar chart below indicates quantities and sources of GHG emissions in California in 2004. Carbon dioxide accounts for 85 percent of the state's overall greenhouse gas emissions, where emissions of non-carbon GHGs are measured in terms of CO_2 equivalents. Transportation accounts for over 40 percent of the state's GHG emissions, with industrial emissions accounting for about 18 percent of the total. Electricity use accounts for about 24 percent of California's emissions. Approximately half of the emissions associated with

[7] Other important market failures may include:

- Step-Change Technology Deployment – where temporary incentives will be needed to encourage companies to deploy new technologies at large scale to the public good, because there is otherwise excessive technology, market and policy risk. Examples of remedies are renewable portfolio obligations, biofuel requirements, and the Low-Carbon Fuel Standard.
- Fragmented supply chains – where economically rational investments (for example, energy efficiency in buildings) are not executed because of the complex supply chain. Examples of remedies are building codes.
- Consumer behavior – where individuals have a demonstrated high discount rate for investment in energy efficiency that is inconsistent with the public good. Examples of remedies are vehicle and appliance efficiency standards and rebate programs.

electricity use are produced by out-of-state generators that supply power to the state. The leading contributor of nitrous oxide (N_2O) and methane (CH_4) is the agriculture sector. Appendix D provides greater detail on California's recent emissions.



Notes:

High GWP = high global warming potential gases: sulfur hexafluoride (SF6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs)
N2O = nitrous oxide
CH4 = methane
CO2 = carbon dioxide

4 Program Scope and Contribution to Achieving California's GHG Reduction Targets

4.1 Stringency of the Cap

4.1.1 The cap in 2020 and beyond

The Global Warming Solutions Act calls for reducing California's GHG emissions to 1990 levels by the year 2020. To meet the 2020 target, the sum of emissions allowed under the cap-and-trade program, plus expected emissions from sources not included under the program's cap, must be equal to 1990 emissions levels.[8] Although the target applies to the year 2020, the cap-and-trade program needs to continue beyond that year. This is necessary to assure participants that their investments in efficiency and emissions reductions will continue to have value even after the 2020 target is reached.

The breadth of coverage and the quantity of emissions allowed under the cap-and-trade program are closely related to each other. The broader the coverage of the cap-and-trade program, the smaller the number of entities not covered under the program. For any given level of stringency of other regulatory policies, broader coverage of the trading system implies few uncovered sources and therefore lower total emissions uncovered sources. Conversely, if the cap-and-trade program is narrow in scope, more sources and emissions will fall outside the program. Since the Global Warming Solutions Act addresses all state

[8] While the number of emission allowances issued in 2020 will be set equal to 1990 emissions, it should be noted that actual emissions in any given year may be higher or lower than the number of allowances issued in that year because of banking and other flexibility provisions included in the program design. The opportunity for banking can lead to over-compliance in the early years of the program and can help bring technologies into the market. We discuss these features in Chapter 6.

emissions—including emissions within and outside a cap-and-trade program—the stringency of efforts in one domain affects the stringency required in the other.[9]

4.1.2 The cap before 2020

The Committee recommends a gradual approach to achieving the 2020 target: that is, starting with a higher cap that declines over time to return emissions to 1990 levels (taking into account expected reductions from sources outside the cap) by the year 2020. Experience from SO_2 and NOx trading programs in the United States, and from the EU ETS, demonstrates the value of phasing in reductions. A gradual decline is preferable to large, infrequent step reductions in the cap level since it produces less volatility in allowance prices and enables firms to phase in new emissions reductions continuously.

Mandatory reporting should be instituted as soon as possible for all entities likely to be covered by the program, even if their inclusion in the program is delayed. Experience with prior cap-and-trade systems also demonstrates the value of establishing and clearly communicating the transactional, reporting, and verification infrastructure of the program. It also highlights the value of good data. Many of the sources that will be covered are already reporting to the California Climate Action Registry. CARB may build upon this infrastructure to obtain the additional data needed for broader coverage.

4.1.3 How do reductions from various direct regulations relate to the cap?

To meet the statewide emissions target established under the Global Warming Solutions Act, the emissions allowed under the cap-and-trade program, plus emissions from facilities not covered by the program, must not exceed the statewide target. Thus for every ton of emissions reductions accomplished by direct regulation for facilities outside of the cap-and-trade program, the cap established by the cap-and-trade program could be increased by a ton without jeopardizing the goal of reaching the statewide target. However, the impact of direct regulation is different when it achieves emissions reductions for facilities within the cap-and-trade program. In this case, the achieved emissions reductions do not allow for a larger cap. Instead, they simply imply that a larger share of the reductions required under the existing cap will be accomplished with the help of direct regulation. For example, the combination of tailpipe GHG standards for new vehicles and a low-carbon fuel mandate might produce greater reductions within the transportation sector than would otherwise occur under a cap-and-trade program alone. If the cap-and-trade program embraced transportation emissions, these reductions would contribute to keeping emissions within the level given by the cap, but would not imply that the cap could be relaxed.

[9] In the EU ETS roughly half of CO2 emissions are covered under the cap. The emission targets under the cap are expected to be achieved in Phase 1 and strict penalties in Phase 2 should assure continued compliance. However, emission goals outside the cap have been more difficult to achieve so far. EU member states do have responsibility under the Kyoto protocol and EU law to bring overall emissions into compliance.

4.2 Program Scope

4.2.1 General strategies

The scope of the cap-and-trade program is determined by the emissions sources and types of gases included within the program.

Determining the ideal scope of the cap-and-trade program requires a balancing of competing objectives. A broader program will yield additional opportunities for low-cost mitigation, thereby reducing the expected cost of achieving overall emissions targets. It also promotes greater market liquidity by increasing the number of entities involved in trading and helps to ensure that there are enough actors in the market to support active trading and prevent any one entity or group of entities from exercising market power.[10] Other important considerations, however, may argue for narrowing the scope of the program. Such considerations include:

- **environmental integrity:** Any emissions covered by the cap-and-trade program must be monitored, reported, and verified to a high degree of accuracy. The inclusion of sources with emissions that are difficult to measure or verify would create the potential for undetected non-compliance and thereby undermine the environmental integrity of the system. If necessary data are not available, then the breadth of the program should be limited so that sources for which reliable emissions information is lacking are not included in the program.

- **administrative, monitoring, and transaction costs:** The reporting and verification of emissions data imposes costs on the private sector and the government, as do the transactions associated with the issuance, trading, and surrender of emissions allowances. These costs can increase with the scope of the system, particularly if greater breadth would lead to the inclusion of sources for which emissions reporting, monitoring, or verification is difficult.

These factors may offset the potential benefits from a broad system. Accordingly, the Committee recommends that the cap-and-trade program start out with the broadest coverage consistent with the exclusion of entities that pose serious administrative costs or monitoring difficulties. Coverage can expand over time as these difficulties are overcome.

4.2.2 Methods for covering greenhouse gases

[10] The "thin market" which existed under the RECLAIM program in 2000 most likely contributed to the sharp allowance price increases experienced during California energy crisis.

Allowances in a GHG trading program are typically defined in terms of the mass of CO_2-equivalent emissions. This can be derived in two ways:

- *Allowances defined in terms of actual emissions:* Under this approach, each allowance entitles the holder to a given number of tons of CO_2-equivalent emissions at the facility operated by the holder (emissions of non-carbon GHGs can be converted to a CO_2-equivalent value based on their global warming potential).

- *Allowances defined in terms of a proxy for actual emissions:* Under this approach, the purchase (or sale[11]) of a chemical or fuel, where the quantity of the chemical or fuel bears a clear relationship to eventual GHG emissions, is used as the proxy for actual emissions. For example, to cap emissions of CO_2, allowances can be defined in terms of the carbon content of fossil fuels, since the carbon content of a fuel largely determines the CO_2 emissions that will ultimately result from the combustion of that fuel or its refined products.[12] Administrative arrangements to enable such a proxy method will need to be designed to ensure that they are administratively simple while also sufficiently robust.

Proxy methods for counting emissions need not be restricted to CO_2. Emissions resulting from consumptive uses of HFCs, PFCs and SF_6, for example, could be measured by using sales (production plus imports, minus exports) of these chemicals as a proxy, rather than attempting to monitor the many small points (e.g., cooling systems) where the gases may leak to the atmosphere. However, reliable proxies do not exist for all sources of GHG emissions.

The method used to define allowances is relevant to decisions concerning the *points of regulation*—that is, which entities will be required to hold allowances authorizing their emissions or uses of fuels/chemicals under the program. In subsequent sections, we describe various programs designs that differ in how they define allowances and where they impose the compliance obligation. This provides a basis for the recommendations that immediately follow.

4.2.3 Strategies for Capping Emissions Other than CO_2 from Fossil Fuel Combustion

Besides emissions of CO_2 from fossil fuel combustion, GHG emissions can come from a wide array of different sources. Possible sources are outlined in the Revised 1996 IPCC Guidelines, the standard methodological reference that underpins most national and

[11] The use of a given chemical or fuel can be controlled by requiring either the purchaser or the seller of the chemical or fuel to hold allowances.

[12] Using the carbon content of fossil fuels as a proxy will not account for process emissions of CO_2 (e.g., those produced in cement production). Process emissions represent about 2 percent of California's CO_2 emissions. A proxy based on fuel carbon content would need to be adjusted to properly account for carbon-containing raw materials that are not combusted (e.g., production of petrochemicals, asphalt, and lubricants), for CO_2 sinks (e.g., carbon capture and storage), and for carbon emitted as methane due to incomplete combustion.

state greenhouse gas inventories.[13] For the purpose of assessing suitability for inclusion in a cap-and-trade program, these diverse emission sources can be grouped into the following categories:

- **Combustion emissions of CH_4 and N_2O**: These emissions depend on combustion technologies and site-specific combustion conditions rather than the carbon content of the fuel. At most stationary combustion facilities such as power plants, CH_4 and N_2O emissions are relatively small in comparison with CO_2, but N_2O from mobile sources represents 2.5 percent of GHG emissions in California and more than 6 percent of emissions from transportation. Given the highly variable nature of these emissions and the high cost of accurate monitoring, the Committee does not believe that these emissions are suitable for inclusion in a cap-and-trade program.[14]

- **Industrial processes and product uses**: This category includes emissions of GHG waste byproducts that result from chemical reactions in manufacturing, as well as emissions from the use and disposal of products such as refrigerants and closed-cell foams. Some of these sources, which in total account for 4 percent of California's overall GHG emissions, could be included in the cap-and-trade program. It is straightforward, for example, to monitor process CO_2 emissions from cement and lime manufacturing facilities by tracking the carbon contained in limestone and dolomite feedstocks. Certain process and feedstock uses of fossil fuels in refineries could also be monitored. Emissions of N_2O from nitric acid production can be monitored accurately using measurement devices in the process vent. Consumptive uses of fluorinated gases (HFCs, PFCs, and SF_6) are diffuse and difficult to monitor, but chemical producers and importers, or users, should be included in the cap-and-trade program on the basis of "potential to emit."[15] Process emissions from cement, lime, and nitric acid production in California should be included on the basis of monitoring feasibility. Upstream production and imports of fluorinated gases (HFCs, PFCs, and SF_6) could also be included in the trading program using estimates of potential emissions. Combined, the sources above that could be included in a cap-and-trade program make up the majority of industrial process and product use emissions in California.

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[13] Revised 1996 Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories. http://www.ipcc-nggip.iges.or.jp/public/gl/invs4.htm

[14] Mobile combustion emissions of CH_4 and N_2O per vehicle mile traveled vary significantly due to fuel type and composition, technology type, operating speeds and conditions, type of emission control equipment, equipment age, and operating and maintenance practices. N_2O, in particular, can be formed by the catalytic processes used to control NO_X, CO and hydrocarbon emissions. Nationally, N_2O emissions increased by 26% between 1990 and 1998, but subsequently decreased as improvements in emission control technologies installed on new vehicles have reduced both NO_X and N_2O. The national estimate for N_2O from mobile sources has a lower uncertainty bound of -16% and an upper bound of +29%. The uncertainty of estimates for individual vehicles is significantly higher. See U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2005 (www.epa.gov/climatechange/emissions).

[15] An estimate of potential to emit fluorinated gases does not account for the time lag between production and emissions, which could be years or decades depending on the end use of the chemical (e.g., close-celled foams). The estimates in the California state inventory are "actual" emissions rather than "potential emissions."

- **Fugitive emissions of methane**: Fugitive emissions result from the unintended release of methane gas from oil and gas production, pipelines, refineries, and gas processing facilities. Fugitive emissions of methane represent just over 1 percent of California GHG emissions. They are generally difficult to monitor accurately. For example, in petroleum and natural gas systems, emissions come from a large number of small valves and vents spread out over large facilities or miles of pipeline, making it difficult to ensure the completeness and accuracy of emission estimates. Fugitive emission sources should not be covered under the cap-and-trade program because of monitoring difficulties. CARB should consider requiring sources to take measures to capture fugitive emissions, as well as explore the potential for developing monitoring and reporting protocols that would allow efforts to reduce fugitive emissions from certain sources to qualify for offset credits.

- **Biological processes**: Biological processes are highly variable and pose significant monitoring challenges. These include emissions from agricultural practices, livestock, forestry and landfills. Biological process emissions are estimated to account for 10 percent of total statewide emissions. Methane emissions vary daily across the entire surface area of a landfill and currently no technologies exist to make an accurate estimate of total emissions through the soil. Nitrous oxide emissions from fertilizer use can be estimated only within an order of magnitude on the basis of the nitrogen content of the fertilizer.[16] Methane emissions from rice production are similarly problematic. Changes in forest practices and forest cover can sequester additional carbon or release carbon to the atmosphere. It is possible to measure captured landfill and digester gas accurately, however, and these sources could be good candidates for an offset program.[17] or could be addressed through other regulatory measures.

4.2.4 Alternative Programs for Capping CO_2 Emissions from Combustion

Figure 4-1 offers a simplified illustration of how fossil-fuel based carbon moves through the California economy. The figure ignores process emissions of CO_2 which, as mentioned, amount to about 4 percent of California's total GHG emissions.

The figure indicates that carbon enters the California economy through the production and import of two fossil fuels: crude petroleum[18] and natural gas.[19] Refiners are the

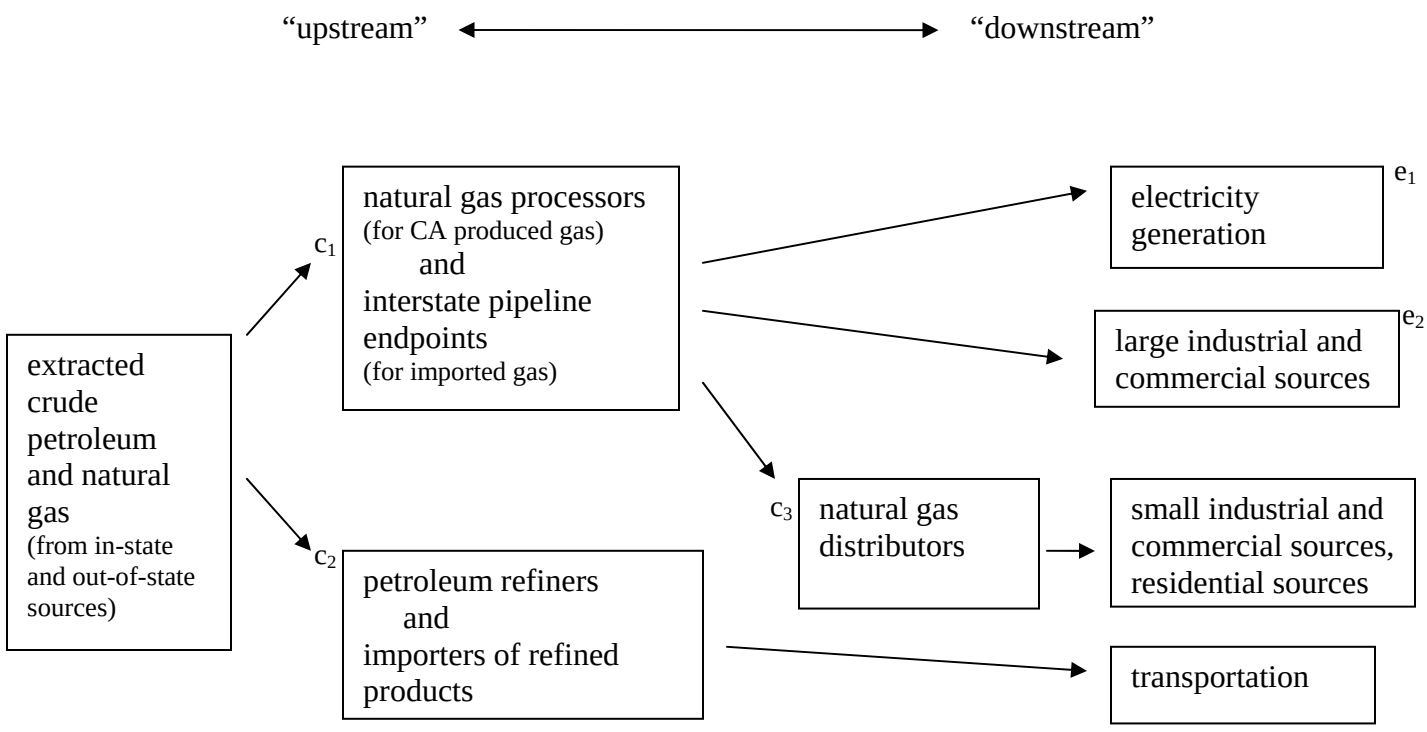
[16] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 4.

[17] Composting of biogenic waste, unlike landfilling, is a completely aerobic process that does not produce net greenhouse gas emissions. Some state and local governments have created policies and incentives for increased composting of biogenic waste. CARB should determine if the economics of crediting landfill gas collection could undermine or weaken existing policies for composting.

[18] The figure ignores the differences in CO_2 associated with variances in energy and CO_2 emissions associated with oil refining. Thus, for example, the Committee made no distinction between distillates produced from the refining of heavy rather than light crude. Such differences could be much greater if gasoline derivatives are produced from coal-to-liquid technology, with their associated higher CO_2 emissions; in this case, CARB may wish to do a more careful calculation of the refinery associated emissions.

principal purchasers of petroleum while natural gas distribution companies are the principal purchasers of natural gas. Natural gas is purchased either from processors, who purify gas from wellheads, or from interstate transmission companies. The figure ignores some relatively minor flows: for example, the use of refined petroleum fuels in the industrial, commercial, or residential sectors. The figure also ignores California's contributions to GHG emissions through imports of products with embodied carbon content; electricity is the most important example of such a product. We consider the treatment of emissions associated with imported electricity in the next chapter.

Figure 4-1
Uses of Fossil Carbon and Fossil Carbon-Based Products In the California Economy



[19] For simplicity, the figure ignores California's use of coal and its use of imported electricity derived from coal and natural gas. The state does not extract any coal. Combustion of imported coal accounts for less than 1 percent of CO_2 emissions from fossil fuel combustion in California. Such imports are used primarily by industrial co-generation facilities (CEC 2006). Imports of electricity derived from coal and natural gas generate about as much CO_2 as all the electricity generation within the state. We discuss the treatment of these "embodied emissions" in Chapter 5.

The figure facilitates comparisons of different options for defining the scope and point of regulation of a cap-and-trade program. We compare four program designs, starting with the least comprehensive program and then considering successively more comprehensive ones.

4.2.5 Options for Program Scope

The Market Advisory Committee has outlined four different options for defining the scope of a California GHG cap-and-trade program. The programs differ in their coverage of CO_2 emissions from fossil fuel combustion in California, proposed points of regulation, and the infrastructure required for program administration. The design options described below all would require a provision to address emissions associated with imported electricity; this issue is discussed in detail in Chapter 5.

Following the guidelines suggested in 4.2.3 above, all programs cover the same sources of non-CO_2 GHG emissions as well as non-combustion sources of CO_2 emissions from industrial activities such as cement manufacturing. Because of monitoring difficulties, all programs exclude biological process emissions from sources such as livestock and agricultural soils (7.5 percent of California emissions), N_2O emissions from mobile sources (2.5 percent), and methane emissions from landfills (1.7 percent).[20] Some activities that reduce emissions from agriculture and forestry might be appropriate for consideration as offsets. Aviation emissions (4.5 percent) were not included because of the issues arising from addressing such emissions for a single state.[21] Together, the emission sources excluded from all program options considered in this report account for approximately 17 percent of California GHG emissions.

In defining the scope of a state cap-and-trade program, it is important to note that some excluded (and most included) sectors are likely to be subject to other climate-related policies and programs, such as the Low-Carbon Fuel Standard, offset programs, efficiency standards, emissions standards, etc.

Program 1—Coverage of Medium and Large Point Sources of Emissions, and of Some Suppliers of High-GWP Gases; Coverage at Point of Combustion:

[20] Numbers in parentheses represent approximate shares of total 2004 California GHG emissions. Other minor sources excluded from all program designs considered in this report are wastewater treatment and fugitive emissions from petroleum and natural gas systems. These accounted for less than 1 percent of California's 2004 emissions.

[21] Only a share of the fuel consumed by aviation in California is purchased within the state. Under a fuel-based system, in the absence of similar greenhouse gas measures in other states, inclusion of domestic aviation in a cap and trade program might create an incentive to purchase more fuel in other states rather than reduce emissions. However, emissions from all flights entering, leaving and within California could be covered downstream using flight tracking data and fuel burn rates for jet fuel, which is a strictly regulated and homogenous fuel. Such a downstream system would require airlines to hold allowances to cover emissions occurring both inside and outside of California.

- **Scope**: This program is similar in scope to the EU ETS in that it covers medium and large GHG-emitting facilities[22] such as electric power plants and energy-intensive industries such as refining and cement production. Program 1 would include industrial process emissions of CO_2 (from cement and other sources). Unlike the current phase of the EU ETS, Program 1 also includes N_2O emissions from nitric acid production as well as the production or import of fluorinated gases such as HFCs, PFCs, and SF_6.
- **Points of Regulation**: *For CO_2 emissions from in-state combustion* -- emissions points e_1 and e_2 in Figure 4-1. *For other emissions* -- industrial process sources, supply of gases with high global warming potential (GWP), and electricity imports.
- **Extent of Coverage**: Program 1 includes approximately 39 percent of California GHG emissions, and roughly 450 facilities.[23] Coverage in terms of sources is similar to that of the EU ETS but lower in terms of emissions (the EU ETS covers about half of EU CO_2 emissions) because California has a smaller energy-intensive industrial sector and a greater proportion of its emissions come from the transportation sector.
- **Administrative Considerations**: The administrative requirements of Program 1 are very similar to those of established cap-and-trade systems such as the US Acid Rain Program, the NOx Budget Program, the EU ETS, and proposed programs such as the Northeast RGGI. This program can build off proven design features and would require very little new infrastructure to track CO_2 emissions. Currently, all medium- and large-sized electricity generating units in California already report CO_2 emissions to EPA under Title IV of the Clean Air Act; in addition, large point sources are likely to be included in CARB's mandatory reporting program. Additional infrastructure would need to be put into place to provide data on electricity imports and high-GWP gases.

Program 2—Program 1 Plus Upstream Coverage of CO_2 Emissions From Transportation.

- **Scope**: This program includes all the sources covered under Program 1 plus CO_2 emissions from the combustion of gasoline and diesel in the transportation sector.
- **Points of Regulation**: Points in Program 1 plus gasoline and diesel supply point c_2 in Figure 4-1.
- **Extent of Coverage**: The inclusion of CO_2 emissions from gasoline and diesel use expands the scope of the program such that it covers approximately 72 percent of California GHG emissions. Taking into account all GHGs, the transportation sector accounts for about 40 percent of the state's emissions; however, 2.5 percent of that total consists of N_2O and CH_4 emissions from transportation,[24] while approximately 4.5 percent comes from domestic jet fuel use. Leaving out emissions from jet fuel

[22] A commonly cited threshold is 10,000 metric tons of CO_2-equivalent. This threshold is best used as an approximation and actual coverage should be determined through sector-by-sector nameplate capacity thresholds, such as boiler size or maximum output.

[23] This is comparable to the percentage of NOx emissions covered by the NOx Budget Program in the eastern United States.

[24] Nitrous oxide emissions are 6 percent of transportation emissions and come largely from automobiles. These emissions are highly variable and will likely decline in the future as more advanced catalytic converters are introduced to meet standards for other automobile emissions such as NO_X.

use, Program 2 raises coverage approximately 33 percentage points relative to Program 1. Note that this program and the statewide totals reported throughout exclude CO_2 emitted from fuels used in international transport ("bunker fuels" primarily from international aviation and shipping) consistent with internationally accepted reporting guidelines.[25]

- **Administrative Considerations**: Program 2 requires California to create a system to monitor the amount of carbon sold by refiners and importers in the form of gasoline and transport diesel fuel. There are approximately 30 such sources in the state (including refiners, importers, and blenders). There may be opportunities to take advantage of fuel monitoring procedures created to implement California's Low-Carbon Fuel Standard.[26] Note that a provision would need to be made to exclude gasoline or diesel that is exported from California.

Program 3—Program 2 Plus Upstream Coverage of Fossil Fuel Combustion by Other Sectors

- **Scope**: This program includes the sources covered under Programs 1 and 2, but would add upstream coverage of CO_2 emissions from fossil fuel combustion at small industrial and commercial facilities, and by all residential users.
- **Points of Regulation**: Points in Program 2 plus distributors of natural gas to small industrial, commercial, and residential users (delivery point c_3 in Figure 4-1).
- **Extent of Coverage**: Program 3 would cover approximately 83 percent of California's GHG emissions. Direct use of fossil fuels by the residential sector accounts for 6 percent of state emissions while small commercial and industrial sources account for 5 percent. Including natural gas distribution to small sources therefore raises program coverage by 11 percentage points relative to Program 2. As noted earlier the principal sources that remain uncovered in Program 3 are emissions from agriculture, emissions from jet fuel use, N_2O emissions from transportation, and emissions from landfills.
- **Administrative Considerations**: In addition to the requirements of Program 2, Program 3 requires a new monitoring and reporting system to include local natural gas distribution companies. There are about 10 of these in California, including both investor-owned utilities (IOUs) and municipal systems. Much of the needed data is collected by a diverse group of municipal, state, and federal regulatory agencies; the information they gather is of varying quality and collected for different reporting periods. To prevent double-counting, this new system would need to distinguish between natural gas sold to large point sources (since their use of natural gas is already covered at the point of emissions) from natural gas sold to smaller entities.

[25] United Nations Framework Convention on Climate Change (UNFCCC), Decision 2/CP.3.

[26] Implementation of the Low-Carbon Fuel Standard will require reporting of both the carbon content of gasoline and diesel and total gallons of each fuel produced or imported. For use in the cap-and-trade program, total carbon content (carbon intensity of different fuels multiplied by number of gallons sold) is the relevant figure and could be computed from the same data.

Program 4—Upstream Coverage of CO_2 from Fossil Fuel Combustion, and Downstream Coverage of Large Sources of Non-CO_2 Gases and Some Suppliers of High-GWP Gases

- **Scope**: This program takes an upstream approach to cover all CO_2 emissions from the combustion of natural gas, petroleum, and coal in California, including emissions from the medium and large point sources covered at the facility level under Programs 1, 2, and 3. As above, this program would also include provisions to cover sources of industrial process emissions, high-GWP gases, and electricity imports.
- **Points of Regulation**: *For CO_2 emissions from in-state combustion* -- natural gas delivery point c_1 and gasoline and diesel supply point c_2. *For other emissions* -- industrial process sources, supply of high-GWP gases, and electricity imports.
- **Extent of Coverage**: Like Program 3, Program 4 would cover approximately 83 percent of California's GHG emissions. The sources that would remain uncovered are also the same as those listed in Program 3.

Administrative Considerations: As with Program 3, Program 4 requires the development of a monitoring and reporting system to track all fossil fuels produced in or imported into California, as well as fuel exports. Program 4 includes all natural gas processing plants, the state's seven interstate natural gas pipelines, and pipelines from Mexico. Data on fossil fuel flows are collected by a diverse group of municipal, state, and federal regulatory agencies; again, the information is of varying quality and collected for different reporting periods. As with Program 3, there is no precedent for using this approach in a cap-and-trade program run by a single agency. However, it is by no means without precedent in the United States. For example, an upstream approach was used in the 1980s with great success to phase-out lead emissions from motor vehicles by regulating the lead content of gasoline and allowing trading and banking of lead content credits. It was also employed in phasing out the use of ozone depleting substances in the late 1980s and 1990s, by regulating their production and import, rather than the emissions that result from their actual use. In both cases measuring the actual emissions was not a serious option.

- Some important differences from Program 3 are: (1) emissions data from large point sources are not required for managing allowances (although such data would be collected anyway under CARB's mandatory reporting program); (2) it is not necessary to distinguish between fuel quantities sold to different categories of consumers because all combustion is treated in the same way, i.e., upstream; (3) a system would be needed to track imports of coal because emissions from coal use would no longer be monitored at large point sources as would be the case under Programs 1, 2, and 3; (4) in the case of natural gas pipelines, the entity responsible for holding emissions allowances associated with gas imported from out of state will be the first entity that takes delivery of the gas in California and has legal ownership of the fuel; and (5) while the upstream system would cover all combustion-related CO_2 emissions, some industrial sources (mainly cement and nitric acid production) would need to be included to deal with process emissions.

Table 4-1 summarizes the emissions coverage that would be achieved by the different program options considered, along with the number of facilities that would need to be covered.

Table 4-1 Contributions of Different Programs to California Emissions Reductions

Program	Estimated Number of Points of Regulation[1]	Year 2004 Emissions under These Points of Regulation[2]		Percentage Contribution to AB32 Emissions Reduction Target if Cap Requires Reduction of[3] ...			
		tons	% of state total	10%	20%	30%	40%
1	450	192.6	39	13	27	40	54
2	480	355.9	72	25	50	74	99
3	490	408.8	83	29	57	86	114
4	150[4]	408.8	83	29	57	86	114

[1] The number of points of regulation listed is an estimate and excludes an indefinite number of small facilities responsible for emissions of high GWP gases. It also excludes the agents (LSEs and various electricity wholesalers) responsible for embodied emissions in imported electricity.

[2] Baseline 2004 emissions include CO2 embodied in imported electricity and exclude land use and forestry changes and international bunker fuels. Units are million metric tons of CO2 equivalent. The state total in 2004 was 494.3.

[3] Assuming 2020 business as usual emissions of 608.1 and 1990 emissions 29% below that level (implying a need to reduce emissions by 176.3 million tons). Also assumes proportional increases of emissions from all sources.

[4] An interstate or intrastate pipeline will often transport gas on behalf of several entities – businesses that take delivery of gas via the pipeline for purposes of direct consumption or subsequent sale in California. For Program 4, the estimated number of points of regulation includes approximately 100 business entities that take delivery and assume ownership of natural gas in connection with pipeline transport.

Additional Notes:
- These values are based on two sets of data received from the ARB: the revised 2004 inventory and a list of emissions of CO2 from sources over 10,000 tons in 2004.
- In every program, the cap-and-trade program is assumed to cover all process and high GWP emissions (4.2% of 2004 GHG emissions) and to cover CO2 emissions embodied in imported electricity (12.3% of 2004 GHG emissions).

Some Implications for Program Stringency

The numbers in Table 4-1 are relevant to the overall stringency of the cap-and-trade program. The far-right set of columns indicates how much each program would contribute toward achieving the overall emissions reduction required by 2020 under the Global Warming Solutions Act under different assumptions about program stringency. For example,

if California implements a cap-and-trade program that produces a 20 percent reduction in emissions from sources covered under Program 1, from their 2020 projected levels, this will deliver 27 percent of the overall reduction in GHG emissions from all sources required to meet the Act's target for 2020.

The figures in Table 4-1 not only indicate the contribution to the target from entities from within the cap-and-trade program but also give an idea—for different levels of program coverage and stringency—of how large the reductions would need to be from entities outside the cap-and-trade program to meet the overall 2020 target. For example, if entities within the cap-and-trade program reduce their covered emissions by 20 percent under Programs 3 or 4, this would accomplish 57 percent of the state's overall emission reduction goal and would imply that the remaining 43 percent of needed reductions would have to be accomplished by entities outside the trading program. This would require the sectors not covered by programs 3 and 4 to reduce their emissions by 73 percent[27]—a very difficult proposition in view of the fact that the uncovered entities are those with emissions that are particularly hard to monitor (N_2O emissions from agriculture, for example). Although certain types of direct regulation (such as standards for equipment or for agricultural and forestry practices) might help to overcome monitoring problems and thus could be used to reduce emissions in the uncovered sectors, achieving a large contribution to the 2020 target from these uncovered sectors is likely to be difficult. This suggests that achieving the overall 2020 target might require reductions within the cap-and-trade program that are significantly above 20 percent.

Tighter direct regulation of entities covered within the cap-and-trade program does not change this inference about the stringency of the cap. As discussed in 4.1.3 above, emissions reductions stemming from tighter direct regulation of entities in covered sectors contribute to the emissions reductions called for by the cap-and-trade program – they are not supplemental to the program's required reductions. Hence they do not lower the magnitude of reductions needed outside the program to meet the statewide 2020 target.[28]

Implementation Issues

The four programs outlined above involve different combinations of points of regulation and methods of regulation (actual emissions vs. a proxy). It is worth emphasizing however, that the point of regulation does not determine where the costs of compliance occur. Rather, economic analysis indicates that the distribution of cost burdens depends on the ability of affected firms to shift costs downstream or upstream. If the points of regulation

[27] The percent reduction required outside the cap-and-trade program can be calculated from the table as follows: Baseline emissions outside the cap-and-trade program are 17 percent (1 minus 83 percent) of 600.8 MMT, or 102.1 MMT. The required reduction to be achieved outside the cap-and-trade program is 43 percent of a total reduction requirement of 174.2 MMT (2020 business-as-usual emissions of 600.8 MMT minus 1990 emissions of 426.6 MMT), or 74.9 MMT. Finally 74.9 divided by 102.1 is 0.73, meaning a 73 percent reduction is required from sources outside the cap-and-trade program.

[28] Thus, for example, if under Programs 3 or 4 entities within the trading program were required to reduce emissions by 20 percent, tighter direct regulation of those entities would not ease the emissions-reduction requirement (73 percent relative to baseline) for sectors outside of the program.

are downstream, downstream entities can shift some of the costs upstream—that is, up the supply chain. Similarly, when the points of regulation are upstream, upstream entities can pass some of the costs of regulation to entities downstream. Indeed, economic theory indicates that under plausible conditions, if two programs achieve the same coverage, the distribution of cost impact is the same no matter whether an upstream or downstream approach is used (Varian, 2000).

The number of entities, facilities or fuel transfer points to be regulated in all four programs is manageable, ranging from fifty to several hundred. By comparison, the U.S. Acid Rain Program handles over 4,000 emissions sources while the EU ETS covers more than 10,000 facilities. Moreover, many of these sources are already reporting voluntarily through the California Climate Action Registry.

Program 1 could be implemented now. By regulating large and medium sources at the point of emissions, it is consistent with other cap and trade programs, such as the U.S. Acid Rain Program, the NOx Budget Program, the EU ETS, and RGGI. Data on hourly CO_2 emissions from all power plants are currently available and techniques for measuring and reporting the other covered sources are available. These sources will also be covered by California's mandatory reporting requirements.

Program 2 augments Program 1 by including the road transportation sector. This sector is not currently part of any cap-and-trade program and some work would be required to identify specific points of regulation, develop measurement and reporting protocols, and sort out the regulatory roles and responsibilities of industry and government officials. The transportation sector is also being regulated for its GHG emissions through vehicle and fuel requirements. Nevertheless, as discussed below, including the transport sector can augment those policies and yield the various benefits from broader scope, including lower costs and greater market liquidity.

Programs 3 and 4 are the most comprehensive programs evaluated here. Program 3 is broader than Program 2 because it covers all fuel consumption by the industrial, commercial, and residential sectors. As with Program 2, additional work would be needed to ensure that fuel use by these sectors is accurately and completely measured and reported. Points of regulation, protocols for measuring and reporting fuel carbon content, and responsible officials at natural gas distribution companies need to be identified. In addition, the particular government agency (or agencies) that will administer various aspects of the program needs to be established. Finally, Program 3 would require separately accounting for natural gas sold to large point sources (since emissions from these sources would be directly regulated) so as to avoid double counting.

Program 4 achieves the same coverage as Program 3, but does so differently. Because the points of regulation in this program design are upstream of most fuel use, emissions data would not be required for tracking allowances and it would not be necessary to distinguish fuel sold to different source categories. In the case of natural gas pipelines, the first entity having legal ownership of the gas and taking delivery of the gas within the State's borders is the party that would bear responsibility for surrendering sufficient emissions

allowances to be in compliance with the California's program requirements. Since coal imports would need to be included (to avoid creating an incentive for importing additional coal), the point of regulation for coal imports would need to be identified, along with protocols for measuring and reporting coal carbon content, and the industry and government officials responsible for this category of covered entities.

Other issues relevant to choosing among different program design options are:

Linkage with Other Systems: Linking a California cap-and-trade system with another system will be easiest if both systems adopt a similar structure. (Otherwise, there can be serious problems of double-counting.) The Northeast states' RGGI program and the EU ETS impose the compliance obligation at the point of emissions. RGGI only covers the electricity sector; the EU ETS covers all large point sources from the major industrial sectors. Thus, linking to these systems would be simpler if the California system also applied at the point-of-combustion for emissions associated with electricity production, as in programs 1, 2, or 3. On the other hand, if other states (or the nation) were to adopt an upstream approach based on fuel carbon content to deal with CO_2 emissions, this would favor Program 4.

Carbon Capture: Programs 1, 2, and 3 automatically create incentives for carbon capture and sequestration. Since large point sources would be regulated on the basis of actual emissions, these program designs would reward avoided releases of CO_2 to the atmosphere. However, Program 4 can be designed to generate the same incentives by allowing credits for carbon capture and sequestration.

Should the Transport Sector Be Included in the Cap-and-Trade Program?

Programs 2, 3, and 4 cover emissions from the transport sector within the cap-and-trade program. Program 1 does not. The Committee prefers to include the transport sector. By broadening the scope of the program, including the transport sector creates more emissions-reduction opportunities and thereby lowers the costs of meeting a given emissions cap.

An important consideration, however, is whether other important regulations—in particular, the Low-Carbon Fuels Standard and California's motor vehicle GHG standards—make inclusion in the cap-and-trade program superfluous for the transportation sector. A related consideration is that although transportation accounts for 40 percent of the state's GHG emissions (and 45 percent of its CO_2 emissions), the reductions that would be achieved in this sector as a result of the price signal generated by the cap-and-trade program are expected to be small compared to the emission reductions stimulated in other sectors. This introduces the question whether the economic and emissions benefits of including this sector would be large enough to justify the administrative costs. Each of these issues is discussed in more detail below; it will be important to take them into account in assessing the merits or demerits of including transportation-sector emissions within the cap-and-trade program.

- Do Other Transport-Sector Regulations Make the Cap Superfluous?

A cap-and-trade program would not be redundant with other transport sector policies because the Low-Carbon Fuel Standard and motor vehicle GHG emission standards regulate emissions in different ways. The Low-Carbon Fuel Standard is a performance standard designed to ensure that the carbon intensity of California transportation fuels declines over time. It sets limits on carbon intensity, but not on the quantity of transportation fuel consumed. As a result, it does not limit the overall amount of carbon that might be emitted in the state from the use of these fuels.[29]

California's motor vehicle GHG standards target characteristics of the vehicle fleet by setting a standard for average, per-mile tailpipe emissions of GHGs from new vehicles. Like the Low-Carbon Fuel Standard, this policy establishes an intensity target that constrains emissions per unit of output or service, rather than the absolute amount of emissions. Moreover, because GHG standards are likely to raise purchase prices for new vehicles, they will tend to encourage consumers to hold on to earlier model vehicles longer, which can delay environmental gains. In contrast, a cap-and-trade program that includes the transportation sector works toward emissions reductions from both new and used vehicles by raising gasoline prices and thereby promoting lower gasoline consumption. Hence a cap-and-trade program introduces different incentives and constraints from those of California's motor vehicle GHG standards and is not redundant.

- Is Inclusion of the Transport Sector Warranted, Despite the Small Near-Term Emissions Impact?

As noted, emission reductions from the transportation sector as a result of the cap-and-trade program are likely to be small both in absolute terms and per dollar of allowance value in the program. This is because the impact of the cap-and-trade program on fuel prices would be small. For every $10 increment in the per-ton-CO_2-equivalent price of allowances, the effect on gas prices would be 8.8 cents per gallon. Empirical studies indicate that a price change of this size is not likely to produce a very large reduction in consumer demands for gasoline. Thus, the trading program alone would not be expected to produce major emissions reductions from the transport sector.

Some observers have suggested that this is a good reason to delay including the transportation sector in the cap-and-trade program, even in light of the principle favoring broad-based coverage, because the effect on emission reductions would be relatively small—at least until program stringency and resulting allowance prices reach higher levels in the future. However, the Committee believes that, in the long run, including the transportation sector is critical to providing a consistent price signal across all sectors to promote economy-wide reductions in GHG emissions. Failing to provide this consistent signal would lead to distortions in automobile supply and purchase decisions. In addition, if cap-and-trade were applied to the transportation sector it would help reduce distortions relating to decisions as to

[29] Furthermore, although some of the costs of this policy will be passed on to consumers, much of the costs are likely to be borne by refiners. This is because refiners that produce relatively low-carbon fuels will receive a financial reward from refiners that produce relatively higher-carbon fuels.

how much to drive. Specifically, by incorporating the carbon price in the price of gasoline, it would encourage owners of conventional fuel cars to make more socially efficient decisions as to how much to drive.

If the state chooses to embrace the fundamental principle of comprehensive coverage, it should strive to incorporate that principle from the outset, when the cost of doing so is relatively low. This would reduce uncertainties about whether this sector will ever be included, and establish an efficient architecture for the cap-and-trade program to grow in stringency over time.

Evaluation of Program Options

The Committee was in full agreement that the cap-and-trade program should work toward comprehensive coverage. It ultimately focused on two ways to achieve this objective:

- Option A: Progress from Program 1 to Program 2 to Program 3
- Option B: Start with Program 4

Under the first option, Program 1 would be launched in the very near future. It would then expand to Program 2 as data and administrative requirements related to that program's broader coverage are overcome. Subsequently, the trading program would expand to become Program 3, again when associated data and administrative requirements are met. The second option would involve starting with Program 4 as soon as the data and administrative requirements associated with that program are met.

Proponents of the first option (progressing from Program1 to Program 3) identify the following key advantages:

- the ability to begin the program in the very near future with implementation of the first step (Program 1)
- the flexibility associated with a more gradual expansion of the cap-and-trade program's scope
- greater prior experience with the downstream regulatory approach—experience that reduces risk and can help lower administrative costs
- the fact that downstream entities—the entities that may have the most options for reducing emissions—are the ones required to submit allowances for compliance[30]
- a larger number of regulated entities, which may promote greater liquidity in the allowance market
- no need for special provisions to reward facilities that engage in carbon capture and sequestration.[31]

[30] Many Committee members are convinced that incentives for reducing emissions are strongest when downstream entities must submit allowances. Under Program 4, these entities are not the points of regulation and thus do not submit allowances. Their incentive to reduce emissions stems from the higher fuel prices that result as upstream entities limit fuel supplies subject to the emission constraints established by the cap.

Proponents of the second option (starting with Program 4) identify the following key advantages:

- the assurance of effective and comprehensive coverage afforded by controlling carbon as it first enters the economy
- the possibility of lower administrative costs because (a) a smaller number of sources are regulated and (b) carbon-based fuels, rather than CO_2 emissions from combustion, must be monitored[32]
- the potential to reduce fraud or litigation over inventory rules and regulations regarding downstream inventories
- the ability to achieve comprehensiveness in one step, which can reduce haggling by regulated entities to obtain special exclusions from participation

The Committee did not reach complete consensus as to which of the two options is preferable overall. Most Committee members preferred the first option, on grounds that its advantages outweighed the advantages of the alternative. A few Committee members preferred the second option overall.

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Summary of Recommendations in this Chapter:

- ***In 2020, the emissions cap in a California GHG trading program should be set equal to total allowable emissions under the Global Warming Solutions Act minus projected emissions from sources and sectors not covered by the cap-and-trade program.***
- ***CARB should start with a higher cap and reduce the cap level gradually such that the cap level by 2020 is consistent with meeting the overall emissions target of the Act.***
- ***In general, CARB should seek to expand the cap-and-trade program over time so that it covers as many sectors, sources, and gases as practicable.***
- ***As soon as possible, CARB should adopt mandatory reporting requirements for all sources likely to be covered by an GHG emissions cap.***
- ***For non-combustion CO_2 emissions and for the non-CO_2 greenhouse gases, an emissions-based approach should be adopted where possible, with an upstream approach used for certain high-GWP gases.***
- ***For CO_2 emissions from combustion, the sense of the Committee is to prefer a cap-and-trade program design in which (1) the program initially covers first sellers of electricity and large industrial emitters, and (2) the transportation and buildings***

[31] Other emerging technologies include K-Fuels (which improves the energy content of fuels by taking out excess water) and Greenfuels (storing carbon in algae).

[32] Some Committee members are convinced that monitoring the use of carbon-based fuels is less costly than monitoring CO_2 emissions.

sectors are added in subsequent phases as soon as CARB determines that emissions in those sectors can be monitored, and that the administrative costs of extending coverage to those sectors are not prohibitive. However, a few members of the Committee prefer an upstream approach that imposes the compliance obligation on fuel suppliers upstream and thereby provides broad coverage from the outset.

- ***As a general matter, fugitive emissions and emissions from biological processes are too difficult to monitor and therefore should not be covered under the cap-and-trade program. The Committee encourages CARB to examine ways to improve monitoring of fugitive and biological process emissions, as a first step toward incorporating certain emissions of those types in a cap-and-trade system.***

5 Issues Specific to the Electricity Sector

5.1 Background

5.1.1 Significance of the Electricity Sector to California Emissions Reductions

In-state electricity generation accounts for just over 11 percent of CO_2 emissions in California. Electricity's contribution more than doubles, however, when out-of-state electricity generation to serve California consumers is included (CEC 2006). To be effective and to avoid potentially significant emissions "leakage," a cap-and-trade program for California needs to take account of emissions associated with out-of-state electricity generation. For if emissions from in-state generators were capped, while emissions from out-of-state generators that provide power to California were not, the cap-and-trade program could raise costs to in-state generators relative to out-of-state generators and thereby cause a shift toward reduced domestic production and higher levels of electricity imports. In that scenario, emissions reductions in California could be largely offset by increased power-sector emissions elsewhere. Clearly this would contradict the spirit and letter of the Global Warming Solutions Act, as well as the Guiding Design Principles listed in Chapter 2. In this chapter the Committee focuses on ways that the cap-and-trade program can be designed to address both domestic and imported electricity.

Although the leakage issue deserves close consideration, it is worth noting that if California links its cap-and-trade program with programs of other states in the western electricity grid, much if not all of the leakage problem would be eliminated. Six states, including California, have already joined the Western Regional Climate Action Initiative, and discussions for potential linkages are already underway.

5.1.2 Regulatory Context

California has a 30-year legacy of promoting end-use efficiency and clean electricity supplies. As a consequence, the state's per-capita electricity consumption is low relative to the rest of the nation and its per-capita GHG emissions from the electric sector are low as well. [33]

The California Public Utilities Commission (PUC), along with other agencies in the state, has led efforts to promote end-use efficiency and emission reductions in the activities it regulates. In recent years, prior to passage of the Global Warming Solution Act, the PUC established a regulatory architecture that focuses on electricity load-serving entities (LSEs)—the companies that purchase electricity in the wholesale power market and deliver it to customers.[34] LSEs include not just the investor-owned utilities that the PUC regulates, but also municipal utilities, co-ops, and other entities that serve customer electricity load. Investor-owned utilities are the LSEs that fall within the PUC's jurisdiction; they account for nearly 70 percent of delivered electricity supply in California. Box 5-1 provides a summary of recent environmental policies that the PUC has implemented that seek to affect investor-owned LSEs.

Box 5-1: Recent PUC Policies

- May 2003: Adopted a "loading order" for energy procurement that gives priority to more efficient and cleaner sources (as part of the state's Energy Action Plan).
- December 2004: Adopted a CO_2 cost adder of $8–$25/ton.
- October 2005: Issued a policy statement on GHG performance standards.
- February 2006: Declared intent to develop a load-based cap on electric-sector GHG emissions.
- May 2007 California PUC adopted GHG performance standards for procurement

5.1.3 Two Main Alternatives for Covering Emissions from the Electricity Sector

There are many ways that a cap-and-trade system can be designed to control potential emissions leakage in the electricity sector. The Committee has given considerable attention to several options, and we discuss the following two in detail:

[33] The carbon intensity of electricity generation in California in 2004 was 700 lbs of CO_2 per MWh (egrid). Using the California Emissions Inventory and electricity consumption data from the California Energy Commission to account for imported power brings the average emissions intensity of electricity consumed in the state to 930 lbs/MWh. Across the nation, the average emission intensity of electricity generation is 1,176 lbs/MWh.

[34] In this report LSEs include municipal utilities as well as other retailers. In some other contexts, the term "LSE" has a more restrictive definition that excludes municipal utilities.

- A *load-based* approach: This places the obligation for compliance with the LSE.

- A *first-seller* approach: This places the legal obligation for compliance on the first seller of power into California electricity markets.

Each of these approaches takes account of emissions associated with the generation of electricity imported into the state. Hence both have the potential to control emissions leakage. However, the point of regulation differs in the two cases. Under a load-based cap, the LSE is the point of regulation: it is responsible for accounting for emissions from both imported electricity and electricity generated and consumed in-state. Under the first-seller approach, the responsible entity or point of regulation is either the owner or operator of the California power plant, or the importing contractual party, depending whether the electricity involves in-state or out-of-state generation. The importing contractual party could be any wholesale power marketer (it need not be an LSE). Under each of the two approaches, emissions can be calculated either based on fuel content or on the actual monitoring of generator emissions. We will return to the emissions monitoring issue below.

The Committee considered and rejected a pure generator-based approach in which emissions from California generators are capped but emissions associated with out-of-state generation are not. Such an approach would not deal with leakage and would be inconsistent with the Global Warming Solution Act, which aims to reduce emissions associated with the state's consumption (not just generation) of electricity.[35]

The California PUC has already begun to analyze and develop a load-based approach to reducing electric-sector GHG emissions. These efforts predate the Global Warming Solutions Act and apply to the state's three major investor-owned utilities. The PUC, the California Energy Commission (CEC) and CARB are working as partners in a joint proceeding to develop a recommended approach that CARB might use to reduce emissions from the power sector under the Global Warming Solutions Act.[36] In addition, the Oregon and Washington PUCs are considering load-based caps.

Both the load-based and first-seller approaches would need to approximate emissions from some out-of-state sources. Imported power is often assigned an emission intensity based on the California Climate Action Registry's Power/Utility Reporting Protocol. This approach allows for a precise identification of the power plant and associated emissions for

[35] The Committee also considered but rejected an alternative system involving a load-based GHG cap for electricity consumed in the state and a source-based GHG cap for electricity generated in the state and exported. This differs from the first-seller approach because the point of regulation for imported power would be an LSE, rather than the contractual party that brings electricity into the state (which is not necessarily an LSE).

[36] The motivation for pursuing a load-based approach was to implement a unifying incentive framework that would support the implementation of PUC policies to promote end-use efficiency and renewable energy investments by the LSEs, consistent with the May 2003 "loading order" that was adopted as part of the state's Energy Action Plan. Furthermore, the LSE is the entity over which the PUC has jurisdiction, so a load-based approach is the only regulatory option available to the PUC. With the passage of the Global Warming Solutions Act, the PUC has suggested a load-based approach as a strategy to address emissions leakage that could otherwise result from limiting regulation to California power generators.

about 56 percent of imported power (Alvarado and Griffin, 2007). The remainder would probably have to be assigned an emissions intensity. This could be the average emission intensity for the originating control region, as identified on the North American Electric Reliability Council (NERC) E-tag,[37] (unless the first seller offered evidence otherwise), or a high default intensity, corresponding to the emissions intensity of the most polluting sources in the region.

The two approaches would differ somewhat in their treatment of emissions embodied in imported electricity. The first seller approach presumably would impose a compliance obligation on contractors bringing power into the state, as identified on E-tags or through some other reporting mechanism. The load-based approach would require an additional level of approximation in making an assignment between the contracting party identified as the first seller and the LSE that has the compliance obligation.

The load-based and first-seller approaches differ more substantially with respect to the regulation of emissions from in-state generation. Emissions from in-state power plants are already measured and reported according to existing CARB regulations. Under the first-seller approach, these emissions could be monitored accurately. In contrast, the load-based approach would require an approximation when assigning emissions from in-state sources to LSEs because sources do not always serve a specific LSE. A first-seller approach would take advantage of emission monitoring at every source to achieve a precise connection between regulated entities and the emissions for which they are responsible under the program.

Finally, we note how the approaches described in this chapter connect with the four overarching program designs described in the previous chapter. Under Programs 1, 2, and 3, the approaches described here apply directly. Under Program 4, however, these approaches apply only as they pertain to out-of-state sources of power-sector emissions. In-state sources would be covered upstream based on the carbon content of natural gas supplies used in the state.

5.2 Assessing the Alternatives

The Committee has evaluated the two approaches in terms of their environmental integrity, implications for consumer prices, cost-effectiveness, and ability to serve as a potential model for broader (multi-state or national) cap-and-trade systems.

5.2.1 Environmental Integrity

Controlling Leakage

[37] NERC E-tags are used to track the transmission of electricity so that sources of grid congestion may be more easily identified and mitigated. Along with other information, the E-tag identifies the source and destination control region and thus could be used to assign an average emissions intensity to electricity transmitted into California as part of a specific transaction.

The ability to achieve desired emissions reductions depends on the extent to which a program can control emissions leakage. Both power-sector approaches discussed here would control leakage by attributing emissions to imported electricity, thus avoiding incentives to meet the emissions cap simply by shifting from in-state generation to out-of-state power.

Neither approach seems clearly superior to the other in terms of its ability to control leakage. Both would have to rely on information provided under contracting mechanisms that bring power into California to account for out-of-state emissions and both rely on some degree of approximation to establish the emissions intensity of power received at the border.

The ability to control leakage depends on two other features.

Contract Shuffling: A potential difficulty associated with imported power is "contract shuffling." The introduction of a California cap-and-trade program could induce wholesalers of out-of-state power to shift the assignment of existing sources so that sources with relatively lower emissions are assigned to California load while relatively dirtier sources meet demand elsewhere. This shuffling of contracts could reduce the emissions attributed to California imports, even though no actual reduction in emissions had taken place.

Both the load-based and first-seller approaches appear to provide similar incentives for contract shuffling. In fact, some observers are concerned that contract shuffling could dramatically undermine a California cap-and-trade program: they note that there is sufficient generation capacity within the eleven states in the western power interconnect to entirely comply with expected emission reductions in California without any real change in generation.

However, the opportunities for contract shuffling may be more limited than would initially appear. The PUC's procurement rule and SB 1368 prohibit long-term contracts with facilities that do not meet a GHG emissions standard. Thus they affect the expected long-run profitability of various investment options in the western region. Alvarado and Griffin estimate that in 2005 about 44 percent of out-of-state power is unassigned power. Only two percent of this 44 percent (or about 0.9 percent of the imported power) is coal-fired; the rest is gas-fired in the Southwest or hydro in the Northwest. Since only the coal-fired plants face significant incentives for shuffling of contracts, these figures suggest that if an estimate of emission intensity were to be applied to unassigned power, there would be little room for shuffling contracts to achieve artificial reductions.

The Committee encourages the three California agencies that are partners in the regulation of the electricity industry to develop a extensive plan for how to account for emissions associated with imported power. This accounting would be necessary under either a load-based or first-seller approach. Finally, as we note below, California's participation in a broader regional effort involving six or more states will help reduce the opportunity for contract shuffling.

Legal Challenges: Both approaches are subject to potential legal challenges based on whether California's treatment of imported electricity is consistent with the Interstate Commerce Clause, which prohibits discrimination in trade. The principal issue is whether the regulations treat in-state and out-of-state electricity in a similar way. Because both the load-based and first-seller approaches are likely to rely on information from the contractual first-sellers that bring power into state, they appear similar in this regard. The load-based approach is consistent in its treatment of imports vs. domestically generated power insofar as both are regulated at the LSE, whereas the first seller approach is consistent in regulating the entity that first sells power into California's electricity system, no matter where the power originated. Therefore, the Committee believes either approach—in the context of a downstream system that regulates electricity generation rather than upstream fuel suppliers—can be designed to be consistent with the Interstate Commerce Clause. Under the "upstream approach" represented by Program 4, electricity imports would be treated differently from in-state generation, raising issues of Commerce Clause comparability that the Committee did not evaluate. Another potential legal challenge has to do with the Federal Power Act. Some have suggested that this Act may render substantive "first seller" obligations unenforceable by the state with respect to wholesale transactions. The load-based approach imposes obligations directly on the load serving entities, and indirectly on wholesale transactions. These issues also require further investigation.

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Capabilities for Monitoring In-State Emissions

Thus far we have focused on environmental integrity as it relates to the treatment of emissions associated with electricity imports. Both the load-based and first-seller approaches seem to have comparable strengths in this area. However, there is a significant difference between the two approaches with respect to the precision with which in-state emissions are measured, monitored, and reported. Under a cap-and-trade program that regulates first sellers, in-state generators would be subject to accurate, stack-based emissions measurement and monitoring requirements. This information is currently collected and reported under the Acid Rain Program. A source's compliance obligation would relate precisely to its emissions. In addition, a source's emissions and compliance are readily apparent to stakeholders and the public, providing openness and transparency in the program.

In contrast, a load-based approach rests on the assignment of emissions values to electricity from multiple suppliers, and sometimes must rely on the use of default values based on averages over subregions of the electricity system. This is necessary because it is not technically feasible to track specific electrons to specific generators; moreover sometimes the financial contract path is also imprecise. This less precise method of tracking emissions raises issues about whether reductions under a load-based approach can be adequately measured in comparison to an emissions- and generator-based cap. It also raises concerns about the transparency of such an approach.[38]

[38] One other potential concern is accounting for emissions associated with power that is exported from the state. Sometimes this power is sold into the California power market and resold by marketers out of state, and sometimes it is sold directly to out of state parties. Under the first seller approach, a decision to regulate these emissions would require a refinement to indicate the first seller of power into the California electricity system

A recent market reform initiative by the entity that operates California's grid has the potential to further complicate these tracking issues. Specifically, an important administrative issue on the horizon is how the cap-and-trade program will interact with the California Independent System Operator (ISO) Market Redesign and Technology Upgrade (MRTU). This reform already has approval from the Federal Energy Regulatory Commission (FERC) and is expected to be implemented in 2008. The reform would, among other things, establish a day-ahead market that is likely to attract 10–20 percent of the power on grid. The reform moves away from unit-specific contracts and commitments and allows more sophisticated portfolio strategies in the power market. The day-ahead market would move the industry away from assigning specific buyers and sellers. In the market the LSE would submit a schedule of bids for purchase and the ISO would clear the market among offers to sell. Results would get pooled, in effect. Absent separate pools for power characterized by different emission rates, this could erode the ability of an LSE to indicate its preference for relatively clean generation.

These considerations—concerning both different levels of confidence in emissions measurement as well as the added difficulty of tracking emissions from generator to seller under the new ISO market reform initiative—tend to favor the first-seller system.

5.2.2 Implications for Consumer Prices

An important feature of LSEs in California, including investor-owned utilities and municipal utilities, is that they operate under general cost recovery rules that base electricity prices on their average cost of servicing customers. As discussed immediately below, the impact of the cap-and-trade program on electricity prices to consumers does not depend on whether a first-seller or load-based approach is applied to the electricity sector. However, the consumer price impacts under both approaches depend on whether allowances are auctioned or given away for free and, if they are given away for free, to whom they are offered.

If allowances are auctioned, the LSEs are likely to experience similar cost-increases under both approaches, and to incorporate those costs in retail electricity prices in a similar way. Under the first-seller approach, the in-state generators and initial sellers of out-of-state power are the points of regulation: they are the entities that must hold allowances. Generators and initial sellers would pass allowance costs to the LSEs, which in turn would incorporate these costs in consumer prices. Under the load-based approach, the LSEs are the points of regulation and need to hold allowances. Again, the LSEs would incorporate allowance costs in consumer prices. The ultimate impact on consumer prices is therefore similar in both cases.

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or first seller of power generated in California. The load-based approach would regulate on the basis of sales from power producers to LSEs in the state. In that instance, CARB would account for emissions associated with sales in excess of sales to in-state LSEs. Hence accounting for emissions associated with exported electricity appears resolvable under either approach.

If allowances are allocated for free, in some cases the impact on consumer prices could be smaller than in the case of auctioning (regardless of whether the first-seller or load-based approach is adopted). Using an allowance has an opportunity cost regardless whether the allowance was purchased or given away. However, in California utility regulators are likely to prevent LSEs, whose rates they regulate, from passing allowance opportunity costs along to consumers in cases where the LSE receives allowances for free. This is likely to be particularly true of the municipal utilities, which are effectively owned by consumers. Thus, if allowances are freely allocated to LSEs and the LSEs are prevented from passing along the opportunity costs associated with the use of free allowances, the impact on consumer prices will be less than under a system that auctions allowances or one that freely allocates allowances to generators.

This potential muting of the price signal to consumers if free allowances are allocated to LSEs occurs under both the first-seller and load-based approaches. In the latter case, price increases are restrained simply because the opportunity cost of allowances is not regarded as a variable cost. Under the first-seller approach, LSEs will sell any free allowances they receive back to the first sellers. Even though first sellers would in turn charge higher prices to the LSEs (reflecting the opportunity cost of the allowances), the LSEs would need to deduct from these higher costs the revenues they receive from selling allowances. Thus, the muted impact on consumer prices occurs under both approaches, provided that allowances are freely allocated to LSEs. This phenomenon does not favor one approach over the other.

Although the potential to mitigate consumer price increases may have considerable political appeal, lower retail electricity rates also have a downside. Economic efficiency requires that electricity be priced at its marginal social cost. The inability of LSEs to pass through the opportunity costs of allowances implies even lower electricity prices and thereby widens the gap between electricity prices and social cost. While the Market Advisory Committee acknowledges that choices concerning the price structure for electricity are largely political in nature, we recommend that any decision to cushion the price impact of carbon constraints on consumers should focus on promoting energy efficiency and other measures that reduce energy costs but do not mute price signals, and should focus particular attention on low-income customers. Broader, direct mitigation should be temporary in nature, and designed to ease the transition to an economy where all actors face electricity prices representing the full cost to society associated with the generation and transmission of electricity.

The possible free allocation of allowance value to LSEs has raised concerns by independent power producers that this allocation would give an advantage to investor-owned utilities, with whom IPPs compete to provide generation services. If this is in fact a possibility, it would be so under either a load based approach or first seller approach. The PUC is in the role of monitoring the procurement process for IOUs, and it is their responsibility to ensure that IOUs do not receive unfair advantage in providing generation services.

The free allocation of emission allowances generates rents—that is, profits beyond the normal expected return to capital —to recipients of the free allowances. The rents come from the value of emissions allowances, which in turn is driven by the scarcity of allowances under the cap-and-trade program. When allowances are given out for free to generators, generators capture these rents. When allowances are given out for free to LSEs, consumers enjoy the rents (in the form of lower electricity prices) to the extent that LSEs cannot claim the opportunity cost of allowances as a variable cost. There is substantial analytical and empirical evidence that free allocation can generate very large rents and increase profitability for those entities that receive free allowances.[39]

In contrast, when allowances are auctioned, what would have been rents to owners of generators or utilities become auction revenues obtained by the regulating authority. To a large extent, the choice between auctioning and freely allocating allowances does not affect the relative appeal of the first-seller vs. load-based approaches (because both can achieve an equivalent distribution of rents and effect on consumer prices). But under both approaches the choice of whether to auction allowances or distribute them freely is important because it determines whether rents are enjoyed and who enjoys them. We return to this issue in Chapter 6 below, where we discuss a range of issues surrounding whether allowances should be auctioned or freely allocated.

5.2.3 Cost-Effectiveness

General

For facilities covered under a cap-and-trade program, each unit of emissions involves a cost: additional emissions either necessitate the purchase of additional allowances or reduce the number of allowances the facility can sell while remaining in compliance. As a result, LSEs and generators under the program have incentives to identify least-cost opportunities to reduce pollution. LSEs have an incentive to procure more efficiency and lower-carbon generation, while generators have an incentive to find ways of reducing emissions. In addition, the price signal encourages reduced demands for electricity by industrial, commercial, and residential consumers.

At the same time, as discussed above, the price signal could be muted somewhat in cases where allowances are freely allocated to LSEs. This result favors consumers but can have a disadvantage in terms of the overall cost-effectiveness of the cap-and-trade program because it reduces the incentive for electricity users to reduce consumption.

Ease of Administration

With respect to administrative simplicity, it is much more straightforward and less cumbersome to report and track generator emissions than to report and track emissions associated with load-based sales. Both the first-seller and load-based approaches require that emissions be monitored at the source. However, under a load-based approach the need to

[39] See, for example, Goulder (2000), and Bovenberg, Goulder, and Gurney (2005).

track power sales for in-state sources by time of day adds an extra administrative burden.[40] The load-based approach also seems to involve a greater number of entities, since the regulator must collect data not only from all generators (as under the first-seller approach) but also from LSEs.

Ability to Promote Low-Cost Emissions-Reduction Strategies

The Committee compared the load-based and first-seller approaches in terms of the incentives they create for pursuing three main options for reducing electricity-related emissions. The three options considered are: (1) choices made at the LSE to purchase from less carbon-intensive generators, (2) choices made by generators to install lower carbon technologies, and (3) improvements in end-use efficiency that reduce electricity consumption by consumers. We particularly stress the third option, end-use efficiency, since many feel it will play a critical role in reducing emissions.

- Choices made at the LSE to purchase from less carbon-intensive generators

Under a first-seller approach generators will be required to hold allowances and will pass the cost of those allowances on when selling their electricity. The LSE will face a higher price if purchasing from a generator with high carbon emissions and a lower price if purchasing from a generator with low emissions.

Under the load-based approach, the LSE is responsible for holding allowances. In deciding where to buy electricity, the LSE would consider both the price of the electricity and the added cost of the allowances required to cover accompanying carbon emissions.

Both approaches generate the price signals to LSEs. Some on the Committee felt that they would therefore stimulate the same behavioral adjustments by LSEs. Others on the Committee felt that load-based approach may have an advantage on the grounds that the obligation to hold and submit allowances (an obligation that applies to LSEs under the load-based approach) will produce stronger incentives for LSEs to seek out less carbon-intensive generators.

- Choices made by generators to install lower-carbon technologies

Under the first-seller approach, generators will want to make efficiency improvements and install lower-carbon technology so they don't have to hold as many emissions allowances. Under the load-based approach generators will take into consideration the price the LSE is willing to pay for electricity and will therefore also have an incentive to install less carbon-intensive technology. Some Committee members feel that responsibility for holding and submitting of allowances is an important factor in determining how different entities respond to GHG constraints. These Committee members think this gives the first-

[40] For example, one public comment reported that in the CA ISO control area alone there are 15,000 transactions per hour with 99 load schedules and 800–1000 custody exchanges between market participants per hour.

seller approach an important advantage by offering generators stronger emissions-reduction incentives. Other Committee members argue that the price signal is what drives decisions, and therefore that the two approaches provide generators with incentives of equal strength.

- Improvements in end-use efficiency that reduce electricity consumption by consumers

Modeling has shown that increased investment in end-use energy efficiency can substantially reduce the cost of complying with an emissions cap in the electric sector. Therefore it is important to design a system that will promote such investment. If changes in the price of electricity do not induce the efficient level of investment by consumers, it would be appropriate for the cap-and-trade program to incorporate an alternative incentive for investment in end-use efficiency.

An important incentive for end-use efficiency improvements already exists as a result of the LSE's desire to reduce costs. If the LSE can convince consumers to improve the efficiency of their electric appliances and cooling systems, it can reduce load and purchase less electricity.[41] Under a cap-and-trade program for GHG emissions, the cost to the LSE of electricity goes up (as discussed previously, it would go up either directly in the first-seller approach or through the added cost of allowances in the load-based approach). This increase in cost gives the LSE an even stronger incentive to promote end-use efficiency among its customers.

Some on the Committee are concerned that additional actions undertaken by LSEs in response to a carbon price signal, combined with any additional actions consumers take on their own, will still produce less than the ideal improvement in end-use efficiency.[42] In this case, a direct subsidy or mandate could be built into the cap-and-trade program. For example, revenues from an auction of allowances could be earmarked to provide subsidies for end-use efficiency. Alternatively, the program could require that the value of allowances freely allocated to LSEs must be invested in end-use efficiency programs.

5.2.4 Ability to Serve as a Model for Other Cap-and-Trade Programs

The Committee also considered which of the two approaches—load-based or first-seller—is more likely to provide a model for other programs, including the recently announced Western Regional Climate Action Initiative, which involves California, Oregon, Washington, New Mexico, Arizona, Utah, British Columbia and Manitoba as well as a future federal program and evolving structures in other countries.

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[41] The gains are realized because regulators in California have decoupled revenues from sales for the investor-owned LSEs. Furthermore, in many cases a reduction in demand reduces the marginal rates LSEs have to pay in the wholesale market.

[42] Depending on details of how LSEs are regulated, incentives to promote end-use efficiency may in fact be weak even under a cap-and-trade program. History has shown, however, that California regulators can provide LSEs with effective incentives to minimize the cost of electricity—the state's LSEs therefore have a successful track record of promoting end-use efficiency.

The Western Regional Climate Action Initiative

The Western Regional Climate Action Initiative includes states with electricity sector characteristics that are significantly different from California's. For example, California's record of long-term, systematic investments in energy efficiency and the strong role of the LSE in supporting these investments are unique in the region. If the California system is to serve as a model for the western states, the Committee recommends a first-seller approach for two reasons. First, a load-based system would not cover emissions associated with electricity exports sent outside the six-state region, potentially preventing exporting states (all but California) from capping their entire electric sectors (see Table 5-2 below). Second, in states where LSEs have little experience delivering energy efficiency and where the regulatory structure imposes a direct financial disincentive for such investments, a load-based cap may not create an incentive for LSEs to invest in efficiency. Finally, to avoid double counting, it will be important for all states in a merged regional program to use the same approach.[43]

Table 5-2: Generation, Consumption, and Net Imports for Six States That Are Party to the Western Regional Climate Action Initiative[44]

	generation (MWh)	percent of region's generation	consumption (MWh)	percent of region's consumption	Net Imports*
Arizona	98,897,707	19.2%	64,080,000	13.7%	-34,817,707
California	192,809,576	37.4%	238,710,000	50.9%	45,900,424
New Mexico	32,940,360	6.4%	19,330,000	4.1%	-13,610,360
Oregon	51,526,306	10.0%	45,213,000	9.6%	-6,313,306
Utah	38,211,975	7.4%	23,860,000	5.1%	-14,351,975
Washington	101,547,794	19.7%	78,134,000	16.6%	-23,413,794
Region	515,933,718	100.0%	469,327,000	100.0%	-46,606,718

Source: Generation data comes from 2004 Egrid, Consumption data from the CEC (http://www.energy.ca.gov/electricity/us_percapita_electricity_2003.html).

Notes: (1) Data sources report different years, but the region as a whole appears to be a net exporter. (2) Given the region's heavy reliance on hydropower, net import values may mask differences across the year. (3) Several other U.S. states, along with British Columbia, have indicated that they are contemplating joining this Initiative. British Columbia and Manitoba recently joined the Initiative.

Western Electricity Coordinating Council

[43] Problems arise if one state uses the load-based approach and another within the group uses the first-seller approach. In this case, emissions generated in one state could be counted both by the generating state (if that state uses a first-seller approach) and by the state importing the generated power (if that state uses a load-based approach). This would create stronger incentives for emissions reductions from affected plants, but overall, program effectiveness would be reduced (CCAP 2005).

[44] Utah recently announced that it will join the Western Regional Climate Action Initiative.

The Western Electricity Coordinating Council (WECC), which coordinates power dispatch over the western electricity grid, encompasses portions of 14 western states (including the entirety of 11 states) along with British Columbia and Alberta, Canada. Virtually no power is dispatched from the WECC to the East or to the Texas grid (which is governed by the Electric Reliability Council of Texas). If the major electricity generating states in the WECC were to agree on the electricity portion of a cap-and-trade program, a simple generator-based approach could be employed without concern for leakage, contract shuffling, or gaming, and without the attendant complexity of a load-based system.

Future Federal Emissions Cap

At the federal level, a load-based approach is not needed to address leakage because of limited international trade in electricity.[45] Based on this consideration, the Committee judges that a generator-based approach is the most likely choice for a federal program. For a California cap-and-trade program, this gives the first-seller approach an advantage, since it has greater potential to serve as a model for a federal program.

5.2.5 Summary of Central Considerations and Recommendations for California

Table 5-3 summarizes the advantages and disadvantages of the first-seller and load-based approaches.

We recommend a first-seller approach in light of its relative simplicity and ease of emissions accounting. Responsibility for in-state emissions can be tracked precisely under a first-seller system, but it is only approximately accounted for under the alternative load-based approach.[46] A lesson from previous programs is that their success has been associated with public acceptance—that, in turn, has been fundamentally linked to transparent and precise monitoring and accounting.

Furthermore, if the state seeks to develop a program that has strong potential to serve as a regional/national model and to link easily with an international system, a first-seller approach is preferred This option would allow California to transition naturally to a regional or national generator-based system. Although our recommended approach differs somewhat from the one that the California PUC has been most actively exploring, we share the PUC's general objectives regarding effective regulation of emissions associated with electricity use and believe that our recommended approach meets those objectives.

[45] A third issue is how the policy may affect retail electricity prices. As in California, this issue hinges on whether allowances are auctioned or given away for free, and to whom. The federal debate often conflates this decision with the decision about the choice of regulated entity. As we have argued these two decisions are in fact separate.

[46] There is a level of approximation under both approaches for emissions associated with out of state generation, but the approximation is also greater under a load-based approach.

Table 5-3: Summary Table Comparing First-Seller and Load-Based Approaches

Environmental Integrity	
Ability to Control Emissions Leakage	Similar under both approaches.
Ability to Track Responsibility for In-State Emissions	First-seller approach has an advantage. Identification of in-state source of emissions more difficult under load-based approach.
Implications for Consumer Prices	Similar in most cases. However, price impact is muted if allowances are allocated for free to LSEs and regulatory agencies do not permit LSEs to pass the opportunity cost of allowances through to customers.
Cost-Effectiveness	
Ease of Administration	First-seller approach has an advantage, in part because of the potential for more accurate monitoring. The load-based approach entails additional administrative requirements, such as the need to track in-state sources by time of day.
Ability to Promote Low-Cost Emissions Reduction Strategies	Some on Committee feel this is similar under both approaches. Other Committee members assert that the load-based approach may have an advantage on the basis that the obligation to hold allowances will produce stronger direct incentives for LSEs to pursue low-cost emission reduction strategies.
Ability to Serve as a Model for Other Cap-and-Trade Programs	First-seller approach may have advantage. It would probably allow for an easier transition to a federal cap-and-trade program, in particular, since a federal program would likely be generator-based.

The Committee also recommends that attention be given to the following additional issues in program design:

- The cap-and-trade program needs to be able to demonstrate that it is achieving stated emission reductions in the electricity sector. Specific concerns relate to assuring data quality for out-of-state generators serving California load, attributing emissions from both in- and out-of-state generators to specific LSEs, and managing the degree to which contract shuffling reduces actual emissions reductions under the program. If

not well addressed, these concerns could limit the ability of California's program to link with other trading systems and could also affect overall program credibility.

- Care should be taken to ensure that independent power producers are treated equitably. In addition, the special circumstances of multijurisdictional utilities deserve close attention.

- Finally, care should be taken to ensure that provisions designed to discourage contract shuffling or to track emissions from imports do not interfere with trades in short-run and real-time electricity markets.

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Summary of Recommendations in this Chapter:

- ***The Committee recommends a first-seller approach to regulating emissions associated with all electricity delivered in the state.***
- ***The cap-and-trade program should be separate from and complement, not replace, other regulatory efforts aimed at developing an efficient and less carbon-intensive electricity system.***
- ***State agencies should continue to develop policies that reward and, to the extent possible, require emissions accounting for out-of-state generation.***
- ***A portion of the allowance value created under a cap-and-trade program (either from auctioned allowances or through allocation to LSEs) should be directed to investments in end-use efficiency improvements.***
- ***A portion of the allowance value created under a cap-and-trade program should be used to keep the net cost of electricity to consumers from rising too far in the early stages of the program. This could be done by allocating allowances to regulated LSEs or through direct consumer rebates.***

6 Other Design Issues

6.1 Allowance Distribution

6.1.1 General Principles

Because allowances have an economic value, how California decides to distribute them will affect how the economic impact of a cap-and-trade system is distribution among regulated entities, consumers, and other parties. Under some circumstances (as discussed in connection with the electricity sector), the method of initial allowance distribution can affect prices and the distribution of costs of meeting California's emission reduction targets. However, it is important to recognize that the method of initial allowance distribution has no effect on the environmental outcome, that is, the achievement of the emissions cap.

California should strive to distribute allowances in a manner consistent with fundamental objectives of cost-effectiveness, fairness, and simplicity. As discussed below, these objectives favor a system in which California ultimately auctions all of its emissions allowances. However, several factors weigh in favor of distributing some allowances for free at the outset of the program and transitioning to a full auction over time.

The Committee strongly recommends that California distribute allowances in a manner that advances the following principles:

- reduces the cost of the program to consumers, especially low-income consumers
- avoids windfall profits where such profits could occur
- promotes investment in low-GHG technologies and fuels (including energy efficiency)
- advances the state's broader environmental goals by ensuring that environmental benefits accrue to overburdened communities
- mitigates economic dislocation caused by competition from firms in uncapped jurisdictions
- avoids perverse incentives that discourage or penalize investments in low-GHG technologies and fuels (including energy efficiency)
- provides transition assistance to displaced workers
- helps to ensure market liquidity

The free distribution of allowances can result in a substantial transfer of wealth from consumers to those entities that receive allowances. Under the EU ETS, the electric sector in the UK received free allowances and enjoyed windfall profits of £500 million in the first year of the program alone.[47] The Committee recommends that California avoid windfall profits, where they would occur, by limiting the free allocation of allowances. There should be no free allocation to firms under the cap that are able to pass most of their costs on to consumers. These include electric generators, other first sellers of electricity, oil refineries, and natural gas processors. Some independent power producers may operate under long term fixed price contracts and thereby not be able to pass through costs until those contracts expire. Whether these producers should receive a free allocation in the interim should be evaluated carefully.[48] LSEs that are closely regulated or municipally owned are not included, since these entities are likely to be obligated to pass the value of freely allocated allowances through to their ratepayers.

6.1.2 Use of Allowance Value

Allowance value is represented either by the market value of freely allocated allowances or by the revenues from auctioned allowances.

The Committee recommends that California use a portion of the allowance value generated under a cap-and-trade program to promote investment in low-GHG technologies and fuels (including energy efficiency) by providing incentives to firms and consumers. The state could do this by auctioning allowances and using the proceeds to support investment incentive programs. Alternatively, it could tie the free allocation of allowances to commitments for climate-friendly investments.

More specifically, the Committee recommends that California use a substantial portion of the value of allowances to promote end-use efficiency among residential, commercial, and industrial energy consumers, and to increase assistance to low-income consumers. This can be accomplished by auctioning allowances and using the proceeds to support existing and new efficiency programs, or by distributing allowances for free to LSEs,

[47] Such windfalls can occur if generators receive more than their share of allowances (and therefore sell allowances to other covered entities) or if they are able to pass the opportunity cost of the freely allocated allowances onto ratepayers. In the latter case, ratepayers end up paying for allowances that were given freely to the generator, creating windfall gains.

[48] Independent power producers under long-term fixed-price contracts cannot necessarily pass through changes in their costs to their customers. Some contracts allow for adjustment of price in response to changes in cost, but they are unlikely to designate allowance cost explicitly. Under an upstream program (Program 4) allowance cost would be embedded in fuel price and this would be passed through automatically. Under a downstream program the interpretation of cost will be important for parties to these contracts. It is unclear what are the terms of existing contracts. The PUC could investigate this issue by issuing a data request to investor owned utilities to determine the incidence of changes in cost under these contracts, and policy makers could consider an explicit compensation for harmed parties if deemed appropriate. The Committee notes that even when contracts are silent on an issue such as changes in environmental policy, they may be silent intentionally and thereby describe a conscious assignment of risk. In the long run these contracts will be renegotiated and climate policy risks are likely to be an explicit consideration.

natural gas distribution companies, or other entities that are well positioned to deliver efficiency services to consumers. The state could also offset the economic impact of the program by using auction revenues to finance reductions in income taxes or other taxes that distort economic decisions. As indicated in several economic studies, this would create efficiency gains by reducing the distortionary cost of the tax system.[49]

The Committee believes it is also appropriate to use a portion of the allowance value to finance reductions of GHGs and criteria pollutants in communities that bear disproportionate environmental and public-health burdens.

In addition, the Committee recognizes that California is already beginning to feel the impacts of global warming and supports using a portion of the allowance value to promote investments that will help the state's ecosystems and citizens adapt to these impacts.

The Committee believes that it is appropriate to devote a portion of allowance value to the general public. In doing so it reduces the impact of the cap-and-trade system on consumers. If allowances are auctioned, some of the revenue from the auction can be used to finance reductions in State tax rates, or can be returned to taxpayers directly through rebate checks, perhaps on a per-capita basis.

Finally, the Committee believes it is appropriate to use a portion of allowance value to provide transition assistance aimed at mitigating the impact a pollution cap might have on workers or firms that are subject to strong market pressures from competitors located in un-capped jurisdictions. Such firms are most likely to include industrial facilities with substantial GHG emissions and large industrial and commercial consumers of electricity and natural gas. We recommend that California undertake further study to determine whether any firms are likely to shut down or substantially downsize on account of competitive pressures that are directly connected to the absence of caps on global warming pollution outside of the state. We also recommend that the state evaluate whether incentives for efficiency or other clean-technology investments are sufficient to mitigate the projected economic dislocation, and if they are not, to consider direct financial assistance drawing on the allocation of allowance value. Such assistance should be linked to continued economic activity through an output-based updating system that, for example, would distribute one allowance per unit of a good or service that is manufactured. It should also be structured in a way that will not discourage or penalize investment in low-carbon technologies or fuels, including energy efficiency, and should only be provided for a temporary period of transition.

CARB may wish to convene an advisory group involving persons with budgetary experience and wide knowledge of energy, environmental, tax and budgetary policy, and including representatives of both the Department of Finance and the Legislature, to prepare a study outlining several sensible options for recycling revenues to businesses or individuals.

6.1.3 Recommendations for Allowance Distribution

[49] See, for example, Parry (1997) and Goulder *et al.* (1999).

As the above discussion indicates, the state can promote climate-friendly investments either by tying the free allocation of allowances to climate-friendly investments or through the distribution of auction revenues.[50] Free allocation could also mitigate the potential diversion of allowance value to purposes unrelated to climate change mitigation. However, free allocation is not able to advance certain important goals. Since free allocation does not bring in revenues, unlike auctioning it cannot be used to finance reductions in existing income or sales taxes, or to pay for consumer rebates – activities that would provide broad-based compensation. Moreover, some Committee members believe tying free allocation to specific purposes is more cumbersome and less transparent than using auction proceeds to advance program goals.

Some have argued that the free distribution of allowances is preferable because it is similar to traditional regulation, under which companies are effectively allowed to emit for free up to a certain level without incurring any cost. In effect they have had a prior right to pollute. Free distribution is similar to traditional regulation in this regard only to the extent that the covered firm cannot pass allowance costs onto others. For such firms, allowances allocated freely communicate both allowable emissions and required reductions. The amount given for free determines the balance.

On balance, the Committee finds most compelling the arguments for a mixed approach in which auctioning is increased over time. California can achieve any policy objective that free distribution might deliver through the targeted use of auction proceeds, or other policies. The key advantages of auctioning over allocation are: (1) auctioning more effectively avoids windfall profits and perverse incentives; (2) auction revenues can be used more directly and more transparently to advance program goals; (3) auctioning treats new entrants and existing emitters on a level playing field; and (4) auctioning avoids the challenges of designing a fair free distribution. However, some Committee members believe that the government is more likely to be effective at distributing allowances directly for purposes supportive of climate change mitigation and transition assistance than it would be at selling the allowances and distributing the revenue. If converted to cash through an auction, the value of allowances could more easily be used for purposes unrelated to the goals of the program.

The Committee also acknowledges concern regarding the lack of familiarity with auctions, especially in a regulatory context.[51] There is no experience with a 100 percent auction of allowances in previous emission trading programs. There is a precedent for smaller auctions in various NOx, SO_2 and CO_2 markets; in addition, the Northeast states' RGGI program is requiring participating states to effectively auction at least 25 percent of allowances. At the time of this writing, six RGGI states have announced their intent to

[50] A third alternative is to distribute allowances to a trustee or fund manager who would auction allowances and use the proceeds to make investments according to specific criteria or otherwise distribute funds as directed by the State. While technically this is a free distribution to a third party, we consider it to be identical to an auction in effect and do not discuss it separately.

[51] A voluminous literature has grown over three decades about the performance of auctions in theory and practice. One increasingly useful approach in auction design is "test bedding" of a design using experimental methods. See Holt et al. (2007) for a recent review.

auction 100 percent of their allowances, and the European Union is considering various options, up to a full auction, for Phase III (2013-2018) of its emissions trading program. Planning is already underway in New York for starting auctions in 2008 prior to program implementation in 2009. More generally, there is ample precedent for the government to begin charging for something that previously it gave a way for free, for example in the sale of timber, oil-tract leases, and the radio spectrum auction.[52] And although the CO_2 auction would be large on an annual basis, it is not especially large compared to treasury-bill auctions, which have many more elements of complexity. However, complexity lies not only in designing or running the auction but also in the ability of sources to effectively participate. This consideration favors a period of learning-by-doing by adopting a phased approach.

Another concern is the impact an auction might have on cash flow of regulated firms. Firms may face challenges in budgeting and financing, especially at the beginning of the program. It is possible that large auction expenditures by firms may slow down investment because of capital-market constraints.[53] However, it seems unlikely that many highly profitable investments would be foregone because of difficulty raising funds for them.[54] On the other hand, with free allocation the government may need to answer the question: "Why subsidize this industry or firm rather than others?" Meanwhile, as we have already noted, the influx of revenue to the government poses many opportunities to complement the program and achieve related goals, although doing so effectively and avoiding negative outcomes will require transparency and oversight.

Some observers have suggested that CARB may not have the authority to auction and that auctioning might require further legislative action. If this is the case the agency could consider a number of alternatives to implement a design that would resemble an auction, including allocation to a public trustee, LSEs, or local distribution companies who could auction allowances on behalf of the state's citizens, or direct allocation to households.

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Summary of Recommendations in this Section:

- ***The Committee believes that over time auctioning should be a key part of allowance allocation under the cap-and-trade program. In the near term, however, the state should retain flexibility to allocate a share of allowances for free to certain sectors.***

[52] For example the U.S. Federal Communications Commission eventually turned away from what has been called a "beauty contest" process for allocating the radio spectrum for phone licenses to the use of an auction in 1994. This approach worked well and raised about $20 billion in the initial series of auctions (McAfee and McMillan, 1996) The subsequent UK radio spectrum auction raised about $34 billion and has been termed the "largest auction ever" (Binmore and Klemperer 2002).

[53] Upfront payments for allowances might raise the firms' cost of capital, and there are many examples where capital structure matters for firm efficiency (Wruck, 1994).

[54] Ideas we suggest for using allowance value to incentivize and support new investments also would help overcome any potential barriers.

- ***Some Committee members favor a 100 percent auction from the outset. Other Committee members favor a mixed approach with some free allocation initially, transitioning to a full auction over time.***
- ***We recommend that California use a portion of the allowance value created under a cap-and-trade program to promote investment in low-GHG technologies and fuels (including energy efficiency), to finance pollution reductions in communities that bear disproportionate environmental and public-health burdens, and to provide transition assistance to workers and firms subject to strong market pressures from competitors located in un-capped jurisdictions.***

6.2 Recognition for Early Action

The cap-and-trade program should be designed to take advantage of sources' desire to be rewarded and not penalized for early action. Fair treatment for early action will help make sources allies of the state in advancing emissions monitoring efforts and demonstrating superior environmental performance. These advances can then be the basis for including sectors in a more environmentally effective manner over time.

Many of the sources that would be covered by the cap-and-trade program have been working to document their early emission-reduction efforts through participation in the California Climate Action Registry. This would facilitate CARB's ability to track early action.

6.2.1 Benefits from Recognizing Early Action

- Providing incentives for early action encourages firms to report and establish emission baselines for different industries, and to innovate with respect to emissions monitoring. Therefore early-action incentives may allow for the inclusion of a sector in the cap-and-trade program earlier than would otherwise be possible.[55]

- Reporting on early action helps establish best practices that might be applied as regulatory standards in the future.

- Incentives for early action encourage firms to find and harvest "low-hanging fruit" – low-cost currently available emission-reduction opportunities.

6.2.2 Promoting Early Action

[55] Note that this last point has the potential to deter early action if firms attempt to avoid inclusion in a cap-and-trade program.

If allowances are auctioned, early action may provide its own rewards by reducing the number of allowances a firm must purchase once the cap-and-trade program is in place. Similarly, if allowances are allocated for free on the basis of benchmarks established before the early action is undertaken, firms can benefit by virtue of being entitled to a larger allocation of free allowances. Thus consideration of early action favors auctioning. To the extent that free allocation is employed, environmental performance benchmarks should guide the distribution of allowances.

While auctioning allowances yields "automatic" rewards from early action, some firms might nevertheless choose to wait until just before inclusion in the cap-and-trade program to make needed investments. In this case, encouraging firms to make early investments could require additional incentives. The Committee considered two possibilities:[56] (a) granting the firms "offset" allowances (see section 6.3) for reductions made in periods before they are included in the cap-and-trade program, and (b) employing direct financial incentives and tighter regulatory policies outside the cap-and-trade program. The Committee prefers the second option since it avoids issues of additionality that may be associated with offsets.

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Summary of Recommendations in this Section:

- ***The cap-and-trade program should be designed to promote early action.***
- ***The case for auctioning emissions allowances gains additional support because of the incentives it provides for early action.***
- ***To the extent that free allocation is employed, the basis for such allocation should be benchmarking, which provides early action incentives.***
- ***Offset credits should not be granted for early action, except in the special case where those credits can be removed from the stock of allowances available to other entities. Rather, the design of the allowance distribution method, direct regulation, and financial incentives should be used to promote early action.***

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6.3 Offsets

An offset is a credit for emissions reductions achieved by an entity in a sector that is not covered by a given cap-and-trade system.[57] By encouraging emissions reductions in

[56] A third option was also considered, but it can only be used in the case where all early action occurs before allowances are auctioned or distributed. It involves granting credits for early action (similar to offset credits) but then removing those credits from the stock of allowances available when the auction or distribution process begins.

[57] An offset must deliver an emission reduction outside of the cap. Such reductions can come from (1)

areas or sectors outside the cap-and-trade program, offsets broaden the reach of the program and help promote the achievement of overall emissions-reduction goals at lower cost.

This potential of offsets to lower the costs of achieving emissions reduction targets unfortunately is matched by significant challenges and risks in the practical implementation of an offsets provision. Many of these challenges and risks center on the issue of "additionality"—whether credited reductions are indeed additional to what would have happened anyway in the absence of the offset project. The Committee recognizes that many stakeholders have grave concerns about the state's ability to develop standards that will ensure that offsets deliver an additional environmental benefit that is equal to emission reductions at a regulated facility. The Committee also recognizes that overcoming these concerns poses a significant challenge, and that in order to implement a credible offsets program California must take care to establish accurate and rigorous baselines in addition to adopting strong monitoring and verification requirements. Moreover, experience in this area is limited and of mixed success. Nevertheless, the Committee is confident that California will be able to establish environmentally sound criteria for offsets.

6.3.1 Objectives

California's offsets program should:

- ensure the environmental integrity of offset projects,
- obtain emission reductions from and drive innovation in sectors of the economy that are difficult to include in a regulatory program, and
- provide a model for other programs.

6.3.2 Key Design Considerations

All offset projects should meet the criteria of being: real,[58] additional,[59] independently verifiable,[60] permanent,[61] enforceable,[62] predictable, and transparent.

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sectors within California that are not subject to the cap-and-trade program or (2) entities outside California that are not subject to a cap (similar to the Certified Emissions Reductions that are available through the Kyoto Protocol's Clean Development Mechanism, which aims to promote emission-reduction projects in nations without an emission cap). It should noted that a California facility that is not itself regulated but that is included within a capped sector cannot earn offsets from its emissions reductions. Such actions simply reduce demand for allowances from regulated sources within the sector and are not additional to the cap-and-trade program. For example, if the electric sector is capped, the emissions reductions within this sector attributable to investments in renewable energy and energy efficiency do not qualify as offsets, although they help achieve the emissions reductions required by the cap.

[58] Appropriate quantification protocols are required to assure that offsets reflect actual reductions and not incomplete accounting.

[59] The issue of "additionality" concerns whether reductions are indeed beyond those that would occur under business as usual. It is extremely difficult to develop objective standards for additionality and many efforts to date have failed to produce offsets that meet stringent standards for additionality and/or that enjoy public confidence.

California should select specific project types for eligibility under an offset program and define a performance standard and protocols that would apply equally to both in-state and out-of-state projects. We also recommend that California employ a combination of conservative monitoring adjustments and rigorous accounting methods to ensure that reductions are real and additional. A successful set of standards will generate public confidence, ensure environmental integrity, and minimize administrative costs.

A Standards-Based Approach

In the past, baselines and additionality have been determined on a case-by-case basis under an administratively burdensome process that created uncertainty for both offset project developers and environmental advocates. Increasingly, policy makers have adopted a "standards-based" approach, under which generic performance standards protocols for determining baseline and additionality for specified offset categories are developed and subsequently applied to projects. This is the approach taken by RGGI, and the Kyoto Protocol's Clean Development Mechanism is evolving toward this approach through its combined methodologies. This approach is less administratively burdensome and creates more certainty for both project investment and environmental performance.

California must choose between a standards-based approach and one that requires a case-by-case review of individual offset projects. Because of its administrative complexity and costs, the Market Advisory Committee recommends against the case-by-case approach. Instead we recommend that California develop a standards-based approach.

For simplicity, California could start with a short list of acceptable project types and add to it over time. New project types could also be considered by petition. Categories already developed for RGGI could serve as a starting point. Allowing offset standards to evolve in order to capture the learning that should occur as the program is implemented is essential to maintaining program benefits. Most Committee members also believe that Clean Development Mechanism (CDM) credits under the Kyoto Protocol should also qualify as offsets under a California cap-and-trade program. Likewise, several Committee members support allowing joint implementation (JI) credits to qualify[63].

Geographic Limitations

Interested parties and some Committee members urge restrictions on the geographic scope of offsets for a variety of reasons. Some wish to ensure that the environmental co-

[60] Project performance in terms of emission reductions should be easily monitored and verifiable.
[61] Reductions should be permanent or backed by guarantees if they are reversed.
[62] Reductions should be backed by contracts, legal instruments, and official registration requirements that define their creation, provide for transparency, and ensure exclusive ownership.
[63] Explanations of the Clean Development Mechanism and Joint Implementation can be found in the glossary. The Committee notes that some CDM projects have been criticized as giving credit to "business as usual" activities via suspect baselines, and some Committee members feel that CARB should not accept CDM credits as offsets until standards are improved to correct this problem.

benefits that Californians are paying for through the cap-and-trade program remain in California.[64] There is also a desire to keep the collateral investment and employment benefits that may be associated with offset projects within California's economy, or to share those benefits only with other states that are stepping up to the challenge of reducing global warming pollution. In addition, there are practical concerns about verifying additionality and enforcing compliance in jurisdictions outside of California.

The Committee recommends that California enter into a memorandum of understanding (MOU) with any other state from which it will accept offsets, much as the RGGI states have committed to do. This will help address concerns about enforcement and additionality. Some Committee members believe that such an MOU should be contingent on a commitment from the other jurisdiction to adopt a mandatory cap on global warming pollution and that California should not accept international offsets at this time. Most Committee members feel that there should be no geographic restrictions— that a standards-based approach with considerations for risks (discussed below) puts sufficient limits on offsets. Allowing offsets from outside the state, in particular, will ensure that global emission reductions are obtained at the lowest possible cost and may also encourage other states to follow California's lead on climate change.

Accounting for Risk

There is an inherent risk to offset projects insofar as some may not, in fact, generate additional reductions. The Committee recommends addressing this risk by barring the distribution of credits for expected future reductions. A project should receive credits for reductions only after the reductions have been realized. The Committee considered the use of a discount factor for offset credits as another way to account for this risk. As discussed below in section 6.5 on linkages, the use of a discount factor for out-of-state offsets would pose serious impediments to linking a California cap-and-trade system with systems in other regions. These difficulties could be avoided if discounting were applied only to in-state offsets. However, this practice would put in-state offsets at a disadvantage relative to international offsets brought in through linkage. Hence it is not recommended.

Quantity Limits

Interested parties and some Committee members favor quantity limits for offsets in order to ensure that regulated sectors begin to make the transformative investments that will be needed to meet the state's long-term GHG reduction goals. To the extent that quantity limits are imposed on offsets, there will be a greater need to meet the overall emissions cap through emissions reductions by facilities covered under the cap-and-trade program. And, as discussed above, there is concern over the risk that offsets may not deliver additional environmental benefit. The Committee recognizes that the environmental justice community

[64] While the climate benefit is necessarily global, measures undertaken to reduce GHG emissions within the state may produce simultaneous reductions in emissions of local pollutants.

is particularly concerned that offsets could seriously reduce incentives for emissions reductions in urban areas where pollution levels are relatively high

The Committee acknowledges the importance of promoting fundamental improvements in technology, and of providing strong incentives for pollution reductions in urban areas and other areas suffering from low environmental quality. However, most Committee members feel that binding quantity limits on offset credits do not offer the best way to address these issues. The better approach to achieving long-term technology-transformation goals in certain sectors is to employ direct technology-promoting policies (such as the low carbon fuel standard, vehicle emissions standard, and various tax-incentives for increased research and development). In areas that experience poor air quality, tighter restrictions on emissions of the relevant local pollutants (as opposed to greenhouse gases) is the most direct way to address this problem.

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Summary of Recommendations in this Section:

- ***Offsets should be allowed as part of the overall cap-and-trade program.***
- ***Offsets should be real, additional, independently verifiable, permanent, enforceable, and transparent.***
- ***California should use a standards-based approach rather than case-by-case review to assign offset credits. The state should identify specific types of eligible projects, while taking a conservative approach to maximize the environmental benefits of using offsets.***
- ***The sense of the Committee is that California should reject geographic or quantitative limitations on offset credits so as to maximize the opportunity to reduce GHG emissions at the lowest cost. However, some members feel that this and other legitimate policy considerations (for example, social equity, air quality, predictability of prices for participants) warrant quantitative or geographic limitations or both, in which case such limitations could be introduced in initial phases of the program with a view to gradual relaxation or removal once other policy considerations have been adequately addressed. California should only accept offsets from other jurisdictions if they assure a similar level of accountability and project rigor; this may require formal MOUs for implementation.***
- ***Periodic reviews should be conducted to ensure that offsets do not result in local pollution "hot spots" or backsliding on emissions of non-GHG pollutants.***

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6.4 Cost-Containment Mechanisms

As noted elsewhere, a main attraction of a cap-and-trade system is its potential to lower the cost of achieving a given emissions-reduction target. In addition, because a cap-and-trade system establishes an explicit cap on emissions, it provides greater certainty concerning the environmental objective to be achieved.

At the same time, uncertainties about cost and timing in the adoption of new, low-carbon technologies create some potential for high or volatile allowance prices under a cap-and-trade program. High prices can cause economic hardship, while price volatility creates uncertainty for investments in emission reductions and reduces confidence in the market. Fortunately, a trading program can be designed to include elements that reduce the potential for high or volatile allowance prices. In this section we discuss these elements.

6.4.1 Banking, Borrowing, and the Compliance Period

Initial efforts to design emissions trading programs focused on the gains from trading allowances among entities within the same time period. However, experience to date with such programs indicates that intertemporal trading of allowances can be a very useful feature for managing price volatility and limiting allowance costs. Intertemporal trading provides flexibility as to the timing of emissions reductions.[65]

Banking and borrowing are the two main forms of intertemporal allowance trading. Banking allows entities to over-comply in an early phase of program implementation and save allowances for surrender or trade in future compliance periods. This improves environmental performance by achieving reductions earlier; it also reduces cumulative compliance costs by creating an incentive for early over-compliance by entities that have low near-term marginal abatement costs. By providing flexibility, banking reduces price volatility and thereby promotes investments that provide deeper reductions in the near term. The Committee acknowledges these favorable properties of banking and supports a program with unlimited banking. That is, the Committee believes that allowances that are not submitted in a given period should qualify for use in any future period.

Borrowing allows entities to apply allowances from a future compliance period in the current compliance period. Borrowing may involve a penalty such as a requirement to surrender extra allowances or pay a fee. There is less experience with borrowing in a cap-and-trade system. While banking can accelerate environmental progress and spur technological innovation, borrowing can have the opposite effect. Moreover, borrowing creates the risk that borrowed tons (i.e., extra emissions in an earlier compliance period) will not be recouped in the future compliance period.[66] Based on these considerations, the Committee does not support borrowing.

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[65]The Los Angeles RECLAIM program appears to have suffered because of the absence of intertemporal flexibility—in particular, the absence of banking provisions. See "An Overview of the Regional Clean Air Incentives Market", Staff Paper, EPA Clean Air Markets Division, 2006.

[66] See A. Denny Ellerman, Juan-Pablo Montero. "The Temporal Efficiency of SO2 Emissions Trading," September 2002, MIT Center for Energy and Environmental Policy Research Working Paper No. 02-003.

An important design feature of a cap-and-trade program is the length of the compliance period. At the end of each compliance period, entities must submit sufficient allowances to validate the emissions that have occurred over that period. This submission is called a true-up. Any penalties to non-complying entities (that is, entities with allowances insufficient to validate their emissions) would be assessed during the true-up at the end of each compliance period. In the Acid Rain Program, compliance is assessed annually.

The length of the compliance period affects intertemporal flexibility. Committee members believe that a one-year compliance period (which would require annual true-ups) would be too short—at least at least in the early years of the program when an allowance bank has not developed —to allow covered entities to smooth emission fluctuations due to changes in weather, market conditions, or other variables. However, a very long compliance period would not provide regular assurance that emissions targets are being met and that covered entities hold allowances equal to emissions. The Committee concluded that a compliance period of approximately three years in length might appropriately balance the goals of flexibility and environmental integrity. Under this scenario, compliance would be assessed by comparing the sum of emissions for each of the three years with the total allowances holdings at the end of the third year.

The compliance period need not be the same as the length of time required for reporting of emissions. The Committee endorses no less frequent than annual mandatory emissions reporting with quarterly reporting for large sources and upstream fuel suppliers to ensure prompt feedback on data quality and timely flow of information to the emissions market (see Chapter 7).

6.4.2 Safety Valve

A safety valve places a ceiling price on emission allowances in order to provide price certainty and limit the cost of a cap and trade program. When the allowance price reaches this predetermined level the program administrator may sell additional allowances at the ceiling price.[67] Thus a safety valve brings assurances that the price of allowances will not exceed a certain level. At the same time, it removes what many consider to be a major potential attraction of a cap-and-trade program: the certainty that total emissions from entities within the program would be kept within a given cap.

Along with removing prior certainty as to the total emissions of the cap-and-trade system, a safety valve could increase the risk that overall California emissions – that is, emissions from the cap-and-trade program plus those from entities outside of the program – might exceed the limit declared under the Global Warming Solutions Act. Moreover, without the environmental integrity ensured by an unambiguous hard cap, California may not be able to link to other emissions trading programs (see Subsection 6.5.)

[67] Equivalently, regulated entities could pay the amount of the safety valve for every ton of emissions over the number of allowances held.

On the other hand, it is possible to keep the total emissions under the cap-and-trade program within a given pre-established limit, even with a safety valve. One way to accomplish this would be for the state to purchase offsets that fully compensate for the additional emissions allowed by the sale of additional emissions allowances. The revenues to finance such purchases could come from the states' allowance sales undertaken to maintain the safety valve, or (if allowances are auctioned initially) the allowance auction.

The Committee judges that the various difficulties and challenges posed by a safety valve outweigh the potential attractions. It concludes that the safety valve should not be included as part of a California cap-and-trade system.

While a safety valve would establish a ceiling for allowance prices, another potential design feature is an allowance price floor. CARB could enforce a floor by *purchasing* allowances and removing them from circulation whenever the allowance price reached the lower limit. The Board could also enforce a floor by instituting a reservation (or floor) price in any auction for emission allowances.[68] A price floor has the attraction of giving investors certainty that the price of emission allowances would never fall below a specified level. While a price ceiling could jeopardize environmental integrity and reduce the return on investments in clean technologies, [69] a price floor would reinforce environmental integrity and the value of clean investments. The Committee encourages CARB to consider enforcing a price floor.

6.4.3 Other Cost-Containment Mechanisms

Several policies that might fall under the rubric of "cost-containment mechanisms" have been discussed previously in this report. These include methods of allowance distribution (Section 6.1), recognition for early action, (Section 6.2), and offsets (Section 6.3). Another option is a "circuit breaker," which delays or cancels a scheduled decline in the emissions cap. While a circuit breaker may reduce allowance prices, it provides neither price nor quantity certainty for covered entities, and does not ensure that a given environmental goal is reached.

Complementary government policies represent another category of cost-containment mechanism. These policies include investments in energy efficiency, standards for renewable energy procurement, and other efforts to reduce demand for high-carbon commodities. In particular, many of the regulatory strategies necessary to achieve the goals of the Global Warming Solutions Act may also lower allowances prices and reduce price volatility. CARB should investigate the complementary benefits of these policies on the carbon market while ensuring that specific emission reductions required under other regulations are not double-counted in that market.

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[68] A reservation price is generally considered a good feature of auction design. If bidders are unwilling to pay the reservation price for a lot of allowances then those allowances are withheld from the market during that auction, which contracts the supply of allowances and maintains the a floor on the market price of allowances.
[69] Burtraw and Palmer (2006).

Summary of Recommendations in this Section:

- ***California should issue allowances under the cap-and-trade program that do not expire and may be banked for use in any subsequent compliance period.***
- ***A compliance period of approximately three years in length might offer a reasonable balance between the goals of promoting compliance flexibility and assuring environmental integrity.***
- ***Borrowing of allowances from future compliance periods should not be permitted.***
- ***A safety valve should not be included.***

6.5 Potential Linkages with Other Cap-and-Trade Programs

Linking California's emissions trading program with other existing systems expands the potential for economic gains from trade and associated cost-savings. Successfully linking to other emissions trading efforts will also demonstrate the compatibility of systems, and increase the likelihood that a national system with appropriate linkages to state efforts might be adopted.

In general, linking with other systems will be accomplished more easily if the elements in each system are similar. For example, monitoring requirements across systems need not be identical in every way, but they need to be accepted as comparable in rigor by companies and governments. Transparency and public access to emissions data are also essential design features in building acceptance of the program and associated monitoring requirements.

Terms for linking with other programs will need to be negotiated individually with the specific jurisdiction(s) involved. This may require establishing a formal institution within California that evaluates other trading programs on an ongoing basis to determine their appropriateness for linkage. Additionally, it will be necessary to monitor changes in linked programs to assess whether such changes call for a re-evaluation of linking privileges. Finally, linking to outside regimes may implicitly join the California program to additional trading systems if the outside program in question has further links to other programs.

In sum, linking trading programs with different designs requires thorough consideration of:

- Environmental integrity, specifically the potential to expand environmental benefits compared with the absence of linking
- Cost effectiveness, including the potential for lower costs in linked systems compared to systems that operate independently
- Fairness for all participants

6.5.1 Environmental Integrity

The most important question in deciding whether to link with other programs is whether this step will maintain or expand the environmental benefits that would otherwise be obtained without linkage. If both systems assure full and carefully monitored compliance, linking will not reduce the environmental integrity of the combined system. For example, California could develop a comprehensive program, including multiple sources and sectors, and could link with RGGI—a system that covers only the power sector—without compromising environmental integrity. In fact, linking can help bring about greater environmental benefits. Since it is likely to reduce overall costs, it can generate greater support for a tightening of emissions caps in both systems.

6.5.2 Cost-Effectiveness

Linking to other cap-and-trade systems should also increase economic efficiency as the market expands. Possible exceptions involve cases where transaction costs are extremely high. However, even where transaction costs are high, buyers and sellers should respond, making the market more efficient.

6.5.3 Fairness

Linking emissions trading programs may raise equity concerns related to the treatment of comparable entities under the different programs. An entity in one program may face higher abatement costs than a comparable entity in the other program due to the stringency of the applicable emissions cap or for a variety of other reasons. In fact, differences in abatement costs are the source of the economic-efficiency benefits of linking programs. Where these differences exist, participants in both programs should benefit from linkage. Despite the reduced compliance costs enjoyed by sources that would otherwise face higher abatement costs in a separate system, the purchase of allowances from another system mean that pollution reduction – and the collateral environmental and economic benefits that go with it – accrue to residents of the other jurisdiction. Arguably, if the two programs are comparably rigorous, this is an acceptable cost, because the cost differential can go in either direction over time, and because by linking with comparably rigorous programs California is encouraging other jurisdictions to follow its lead. However, if California links with a system that has a relatively weak cap, the sum of the two programs' emission reductions is unchanged, yet California is likely to forego collateral benefits for no good purpose, since it would not be encouraging the comparably rigorous action from other jurisdictions that is necessary to address global warming.

Fairness issues with respect to local and regional air quality can also arise when linking two trading programs. If GHG emissions in California are higher with a linked program than with a non-linked one, emissions of local air pollutants may also be relatively higher.

6.5.4 Linkage Challenges

Design elements in specific emissions trading programs may facilitate or hinder linkage. Most design elements do not pose compatibility problems, including the following:

- stringency of targets and allocation of allowances
- sources and gases covered
- provisions for new sources and/or opt-ins

Other design elements, however, make linkage more difficult. These elements include:

- Voluntary regimes: The Committee is concerned that issues of verification and additionality present serious problems in many voluntary systems, and recommends that they be excluded from consideration.
- Dissimilar monitoring requirements: Monitoring is the gold standard for tradable allowances. Identical requirements across states and sources (as in the U.S. SO_2 and NO_x programs) and between the federal government and states (as with RGGI) keeps transactions costs low and confidence in the market and in program compliance high. Differences in protocols should be carefully considered and justified.
- Non-compliance penalties and enforcement: Differential non-compliance penalties can affect the integrity of the overall regime, e.g., weak non-compliance penalties will tend to produce a weaker system, leading to the potential for a combined regime to exceed intended caps.
- Offsets: Since offsets and allowances are freely transferable, any linkage effectively forces all linked regimes to adopt the most liberal offsets provision. Some Committee members are concerned that programs (such as RGGI and the EU ETS) that include geographical and/or quantitative limits on offsets may be unwilling to link with programs that allow unlimited use of offsets.
- Safety valve(s): If a safety valve mechanism is included in one regime but absent in a second, market distortions could result, particularly if the market price in the second trading program is higher than the safety valve price. This could lead to a failure to meet the environmental target.
- Absolute vs. rate-based (or intensity-based) targets: Allowances in a system that regulates absolute emissions can be traded into a regime that regulates emissions intensity—but not vice versa.
- Borrowing: As with safety valves, the presence of borrowing in one, but not both, linked regimes may lead to a loss of overall environmental benefits. This loss of benefits is exacerbated if regimes have established different stringency levels.

The Committee has evaluated the suitability of linking a California cap-and-trade program with other GHG emissions trading programs that are either being implemented or are under development. Our findings are summarized in Table 6-1 below.

Table 6-1: Other Emissions Trading Programs and Their Suitability for Linkage to a California Program

System	Description	Suitability for Linking
The Regional Greenhouse Gas Initiative (RGGI)	A proposed GHG trading scheme among ten states in the Northeast and Mid-Atlantic United States.	Linkage is likely to be possible. Technically, load- vs. source-based approach to regulating electric sector emissions need not be problematic, nor would RGGI's focus on electric utilities. Issue of variable stringency may raise political questions. The RGGI system has not yet been implemented.
EU Emissions Trading System (EU ETS)	The world's largest fully operational system for emissions trading. Includes the 25 member countries of the European Union.	Linking would be possible. Issue of allowing CDM credits to enter may be problematic. Also, issue of variable stringency and less rigorous monitoring standards and implementation may raise political questions.

Summary of Recommendations in this Section:

- ***Linkages with other mandatory GHG trading systems should be encouraged. Linkages can increase market liquidity and cost-effectiveness and improve the functioning of the cap-and-trade program without sacrificing environmental integrity or equity and without violating institutional constraints.***
- ***To actively promote a global carbon market, California should encourage linkage only with other mandatory systems, including the existing EU ETS and the Northeast RGGI, which is due to launch in 2009. In deciding whether to link with these and other systems, CARB should consider:***
    - ***the scope and stringency of the other system;***
    - ***the integrity of the cap in the other system, including whether that system contains a "safety-valve" mechanism that suspends or otherwise undermines the cap;***
    - ***the rigor of emissions monitoring, reporting, and verification requirements in the other system;***
    - ***the integrity of allowed carbon offsets; and***
    - ***the record of compliance and enforcement in the other system.***

7 Administrative Issues

7.1 Emissions Monitoring

The bedrock foundation of a successful trading program is a rigorous system for collecting accurate emissions data. Common principles of emissions monitoring and reporting should apply in any cap-and-trade program. First, regulated entities have the responsibility to ensure that data are accurate and complete. Second, the regulating government authority has multiple responsibilities to: assist regulated entities in complying with monitoring standards, to verify the accuracy of the data, and to provide emissions data to the public in a timely and transparent way. If both parties implement their responsibilities properly, the public will have confidence and trust that the cap-and-trade system is achieving the intended environmental goal. If the data are not trusted, the trading program may be seen as ineffective and inferior to more costly command-and-control regulations..

This section draws on experience with existing cap-and-trade programs to briefly outline some administrative issues that California should address when designing its emissions monitoring and reporting requirements. A general discussion of these issues is possible even though the state has yet to determine the precise scope of any cap-and-trade program it might implement to comply with the requirements of the Global Warming Solutions Act.

Although there are upfront administrative challenges, cap-and-trade systems are typically easier to manage than traditional regulatory programs once they are up and running. For example, the U.S. Acid Rain Program established and administers monitoring requirements for 4000 sources, collects and quality assures hourly data from each of these sources, handles thousands of allowance transfers per year, determines compliance and prepares annual assessments with a modest work force of 50 people. The costs of establishing a new mandatory monitoring and reporting regime can be minimized through the use of existing processes and protocols, provided these have sufficient rigor. The Global Warming Solutions Act instructs CARB to rely on monitoring and reporting methodologies established by the California Climate Action Registry (CCAR) to the maximum extent feasible. It may also rely on existing national regimes for monitoring CO_2 from fossil fuel combustion (e.g.., fuel-flow and stack-based measurement methods under the Acid Rain Program).

For most fuels with homogenous carbon content, such as natural gas, accurate measurements are possible using fuel-based metering. Stack-gas monitoring can be used; it is especially cost-effective where the equipment is already in place or where solid fuels are combusted (e.g., coal-fired industrial co-generation units).

California must anticipate that emissions monitoring data may sometimes be incomplete—for example, in the event that fuel meters fail or data are lost at a facility. Missing data should be substituted with data that intentionally overestimate emissions in order to create incentives for complete monitoring. For example, the 90th percentile fuel consumption value for a day may be substituted if less than one day's worth of data is missing. As the duration of missing data increases, more stringent substitute data could be used. For example, if more than a day's data are missing, the peak possible value could be used (e.g., the rated heat input of a combustion unit).

Monitoring for GHG offsets represents a relatively new area of technical expertise. If offsets are used in California, CARB needs to define offset monitoring methods and verify reductions with the same rigor applied to emissions from capped sources. CARB will need sufficient staff to ensure that approved methods and processes have been followed. Depending on the size and scope of the program, and the scope of potential offsets, the number of staff needed to implement an effective offset monitoring program could conceivably be larger than the staff needed to run the cap-and-trade program itself.

Monitoring at the national level for major sources of SO_2 and NOx emissions, even using highly automated systems, has required a dedicated team of individuals to work collaboratively with sources to provide training, respond to questions, conduct field audits, and carefully review emissions data. Likewise, California will need to dedicate sufficient and properly trained staff to assist sources in monitoring, calculating, and reporting their emissions

7.2 Emissions Reporting and Auditing

The emissions reporting entity should be the particular facility or unit at a facility that is the source of emissions. While reporting at the corporate level is appropriate for a voluntary program like CCAR, most mandatory environmental regulations at the state and federal level require reporting by owners and operators of facilities and units that emit the targeted pollutants. This is, in part, because of the potential complexities of dealing with regulated entities that change character frequently through the restructuring of corporate sub-entities, mergers with other corporations, and acquisitions and divestitures of facilities.

Experience with the Acid Rain and NOx Budget Programs has shown that costs and time can be minimized by requiring electronic data to be submitted in a standard format to a central point. Furthermore, EPA has been able to use these data to look for trends and to

identify anomalous values that can help to efficiently target site audits. Therefore, the Market Advisory Committee believes that data relevant to the cap-and-trade program should be reported to, and centrally stored by, CARB. Besides offering simplicity and economies of scale, centralized data reporting and storage will allow regulators to compare data from different facilities in the same sector.

For some reporting entities, particularly smaller sources, the cost of using the highest-quality monitoring methods may be significant. California should provide reporting entities with the flexibility to use less expensive and less accurate methods, so long as the methods are designed to overestimate emissions compared with higher-quality methods.

Emissions data should be reported electronically on a quarterly basis using standard formats. For example, monthly fuel consumption data could be used in generating emissions data and three months of data could be reported at once. Quarterly reporting will provide information to the state on emissions trends, facilitate timely quality assurance/quality control, and provide information to the public and to emissions markets regarding trends.

Once quarterly emissions data have been reviewed and verified for accuracy, these data should be posted on the CARB website. This will help to address concerns about the local pollution effects of trading and will enable the public to track emissions changes in their communities. Quarterly release of data could also help to avoid the problem of market volatility that occurred in the EU ETS in 2006. In that instance, the market's expectations concerning 2005 emissions were much higher than the actual data revealed.

California should dedicate sufficient resources to ensure that emissions reporting occurs without delays, that data are audited each year (both centrally and through targeted site audits), and that the public can access emissions data on the Internet. Site audits could be conducted with government staff from the state, or by the regional or local jurisdiction in which regulated facilities are located.

As with the emissions monitoring program, CARB will need to assign computer database specialists, web specialists, and other staff to run the reporting system, provide training concerning reporting methods to affected entities, and respond to questions. These staff would ensure that the emissions and allowance tracking systems are operational and on-time, and that the system operates with sufficient redundancies to prevent loss of data or security breeches.

7.3 Compliance and Enforcement

In any cap and trade program, participants must be accountable for their emissions and must comply with requirements for monitoring, reporting, and holding adequate emissions allowances. The government must provide certainty through well-recognized and automatic penalties for non-compliance.

In running a cap and trade compliance program, CARB would need to set firm deadlines with respect to:

- a cut-off date for reporting emissions (e.g., by March 1 for the preceding year),
- the completion of final allowance transfers and the submission of adequate allowances to cover emissions (e.g., by May 1), and
- a freeze on further allowance transfers so as to allow for determinations concerning compliance for each period (e.g., by July 1).

CARB should be capable of handling these responsibilities on time and ensuring that compliance determinations are accurate. In addition, CARB must ensure that failure to comply with these deadlines is penalized. In the NOx Budget Program, for example, the penalty for non-compliance—that is, the failure to hold sufficient allowances to cover emissions—involves making up for the shortfall of allowances on a one-to-one basis plus an additional penalty of two allowances for every 1 ton of excess emissions. Non-compliant entities must therefore come up with a total of 3 tons worth of allowances for every 1 ton of excess emissions. Penalties in the California cap-and-trade program should be automatic and non-negotiable.

One advantage of tying penalties to an additional allowance obligation, as in the NOx Budget Program, is that the government does not need to determine appropriate financial penalties. Instead the financial level of the penalty is determined by the market. This approach also has the advantage of compensating the environment for delayed compliance. In contrast, the EU ETS and the SO_2 trading programs both specify financial penalties along with a requirement to make up the shortfall in allowances.

Finally, civil and criminal penalties should be established for intentional violations of program requirements. Such penalties provide an additional level of deterrence to ensure that the financial incentives associated with the cap and trade program are not abused.

7.4 Program Implementation

Experience in both the United States and Europe has shown that an integrated information system is needed for effective implementation of cap-and-trade programs. Such systems can handle both emissions and allowance tracking. California will need to create an integrated information system soon in order to meet the deadlines set down by the Global Warming Solutions Act. Fortunately, systems for tracking emissions have been developed already by the California Climate Action Registry, and other emissions trading programs provide experience in allowance tracking.

The emissions tracking system should provide all covered sources with an electronic means of submitting data (e.g, through web-based data entry or batch data submission). As with the electronic submission of income tax forms, the cap-and-trade program data system

would minimize redundant data entry and could provide immediate feedback to sources on data-quality issues as is done in the Acid Rain Program.

Similarly, the allowance tracking system would provide an online accounting system for sources to track their allowance accounts and even make transfers (just like online banking). Use of the system would be open to designated representatives (with secure access), as well as to other individuals who wish to obtain allowances. Information in the allowance tracking system (e.g., current account holdings and transfers) should be accessible to the public, as in the Acid Rain Program, to promote transparency and build confidence in the system.

The allowance tracking system would also be used to place allowances from an initial allocation or auction into the designated accounts of regulated sources. If California chooses to auction some portion of allowances, staff resources would be needed to arrange and operate the auction. Important tasks include providing notice and terms, conducting the auction, and ensuring that auction proceeds and allowances are deposited in the correct accounts.

CARB should use a web-based interface to facilitate transfers by authorized account holders, to retire allowances surrendered for compliance, and to cancel allowances as needed for environmental reasons or to impose administrative penalties.

Each allowance should have a unique serial number to facilitate tracking and avoid fraud. The serial number should include the vintage in which the permit is first valid. Assigning a vintage is necessary to ensure that allowances may be banked but not borrowed (i.e., to prevent the use of allowances with future vintages for compliance in a current year).

CARB's role in managing the data system would be to act as a transfer agent for sources conducting transactions. CARB would not need to collect price information from transactions but would need to provide timely notification of completed allowance transfers to buyers and sellers.

7.5 Program Evaluation and Adjustment

Research conducted on many environmental and regulatory programs demonstrates that public support and confidence are critical to achieving programmatic success. Involving stakeholders and the interested public in the process of program design from the outset helps to build the foundation for continuing confidence in the program and reinforces political support for the organization that implements it (Jasanoff and Wynne, 1998). Maintaining clear and open communication over the life of the program ensures that trust will be reinforced as experience with the program accumulates.

Because lack of familiarity with market-based regulatory programs can lead to misconceptions about their characteristics, objectives, and effects, CARB will need to provide accurate, complete, and objective information about program performance to all

interested constituencies. Integrating this communication function into the agency's strategy for program management, and using the results to improve program efficiency, will help to capture the value of learning-by-doing.

8 Conclusions

8.1 Summary of Recommendations

Chapter 4 -- Program Scope and Contribution to California Reduction Targets:

- ***In 2020, the emissions cap in a California GHG trading program should be set equal to total allowable emissions under the Global Warming Solutions Act minus projected emissions from sources and sectors not covered by the cap-and-trade program.***
- ***CARB should start with a higher cap and reduce the cap level gradually such that the cap level by 2020 is consistent with meeting the overall emissions target of the Act.***
- ***In general, CARB should seek to expand the cap-and-trade program over time so that it covers as many sectors, sources, and gases as practicable***
- ***As soon as possible, CARB should adopt mandatory reporting requirements for all sources likely to be covered by an GHG emissions cap.***
- ***For non-combustion CO_2 emissions and for the non-CO_2 greenhouse gases, an emissions-based approach should be adopted where possible, with an upstream approach used for certain high-GWP gases.***
- ***For CO_2 emissions from combustion, the sense of the Committee is to prefer a cap-and-trade program design in which (1) the program initially covers first sellers of electricity and large industrial emitters, and (2) the transportation and buildings sectors are added in subsequent phases as soon as CARB determines that emissions in those sectors can be monitored, and that the administrative costs of extending coverage to those sectors are not prohibitive. However, a few members of the Committee prefer an upstream approach that imposes the compliance obligation on fuel suppliers upstream and thereby provides broad coverage from the outset.***
- ***As a general matter, fugitive emissions and emissions from biological processes are too difficult to monitor and therefore should not be covered under the cap-and-trade program. The Committee encourages CARB to examine ways to improve monitoring of fugitive and biological process emissions, as a first step toward incorporating certain emissions of those types in a cap-and-trade system.***

Chapter 5 -- Issues Specific to the Electricity Sector:

- ***The Committee recommends a first-seller approach to regulating emissions associated with all electricity delivered in the state.***
- ***The cap-and-trade program should be separate from and complement, not replace, other regulatory efforts aimed at developing an efficient and less carbon-intensive electricity system.***
- ***State agencies should continue to develop policies that reward and, to the extent possible, require emissions accounting for out-of-state generation.***
- ***A portion of the allowance value created under a cap-and-trade program (either from auctioned allowances or through allocation to LSEs) should be directed to investments in end-use efficiency improvements and technology R&D.***
- ***A portion of the allowance value created under a cap-and-trade program should be used to keep the net cost of electricity to consumers from rising too far in the early stages of the program. This could be done by allocating allowances to regulated LSEs or through direct consumer rebates.***

Chapter 6 – Other Design Issues:

Section 6.1 – Allowance Distribution:

- ***The Committee believes that over time auctioning should be a key part of allowance allocation under the cap-and-trade program. In the near term, however, the state should retain flexibility to allocate a share of allowances for free to certain sectors.***
- ***Some Committee members favor a 100 percent auction from the outset. Other Committee members favor a mixed approach with some free allocation initially, transitioning to a full auction over time.***
- ***We recommend that California use a portion of the allowance value created under a cap-and-trade program to promote investment in low-GHG technologies and fuels (including energy efficiency), to finance pollution reductions in communities that bear disproportionate environmental and public-health burdens, and to provide transition assistance to workers and firms subject to strong market pressures from competitors located in un-capped jurisdictions.***

Section 6.2 – Recognition for Early Action:

- ***The cap-and-trade program should be designed to promote early action.***
- ***The case for auctioning emissions allowances gains additional support because of the incentives it provides for early action.***
- ***To the extent that free allocation is employed, the basis for such allocation should be benchmarking, which provides early action incentives.***
- ***Offset credits should not be granted for early action, except in the special case where those credits can be removed from the stock of allowances available to other***

entities. Rather, the design of the allowance distribution method, direct regulation, and financial incentives should be used to promote early action.

Section 6.3 – Offsets:

- ***Offsets should be allowed as part of the overall cap-and-trade program.***
- ***Offsets should be real, additional, independently verifiable, permanent, enforceable, and transparent.***
- ***California should use a standards-based approach rather than case-by-case review to assign offset credits. The state should identify specific types of eligible projects, while taking a conservative approach to maximize the environmental benefits of using offsets.***
- ***The sense of the Committee is that California should reject geographic or quantitative limitations on offset credits so as to maximize the opportunity to reduce GHG emissions at the lowest cost. However, some members feel that this and other legitimate policy considerations (for example, social equity, air quality, predictability of prices for participants) warrant quantitative or geographic limitations or both, in which case such limitations could be introduced in initial phases of the program with a view to gradual relaxation or removal once other policy considerations have been adequately addressed. California should only accept offsets from other jurisdictions if they assure a similar level of accountability and project rigor; this may require formal MOUs for implementation.***
- ***Periodic reviews should be conducted to ensure that offsets do not result in local pollution "hot spots" or backsliding on emissions of non-GHG pollutants.***

Section 6.4 – Cost-Containment Mechanisms:

- ***California should issue allowances under the cap-and-trade program that do not expire and may be banked for use in any subsequent compliance period.***
- ***A compliance period of approximately three years in length might offer a reasonable balance between the goals of promoting compliance flexibility and assuring environmental integrity.***
- ***Borrowing of allowances from future compliance periods should not be permitted.***
- ***A safety valve should not be included.***

Section 6.5 – Potential Linkages with Other Cap-and-Trade Programs:

- ***Linkages with other mandatory GHG trading systems should be encouraged. Linkages can increase market liquidity and cost-effectiveness and improve the functioning of the cap-and-trade program without sacrificing environmental integrity or equity and without violating institutional constraints.***
- ***To actively promote a global carbon market, California should encourage linkage only with other mandatory systems, including the existing EU ETS and the***

Northeast RGGI, which is due to launch in 2009. In deciding whether to link with these and other systems, CARB should consider:

- ***the scope and stringency of the other system;***
- ***the integrity of the cap in the other system, including whether that system contains a "safety-valve" mechanism that suspends or otherwise undermines the cap;***
- ***the rigor of emissions monitoring, reporting, and verification requirements in the other system;***
- ***the integrity of allowed carbon offsets; and***
- ***the record of compliance and enforcement in the other system.***

8.2 Key Attributes of the Recommended Cap-and-Trade Program

8.2.1 Assuring environmental integrity

The proposed California cap-and-trade program establishes a clear limit on permissible GHG emissions from facilities covered by the program. To assure environmental integrity, the program must incorporate a rigorous system of mandatory emissions monitoring, reporting, and verification. The recommended program design also contains several elements designed to minimize the likelihood that efforts to lower GHG emissions in California will lead to "emissions leakage"—that is, increased emissions in other states or regions. If and when emissions-reducing activities outside the program boundaries are credited within California's cap-and-trade system, the recommended program design requires that strict rules are followed to ensure that claimed reductions are real, credible, and lasting.

8.2.2 Achieving cost-effectiveness

A key virtue of the cap-and-trade approach is its ability to bring about reductions in GHG emissions at lower cost than would otherwise be possible by harnessing market forces to promote reductions from those sources that face the lowest marginal abatement costs. Trading of emissions allowances among firms, institutions, and municipalities lowers the overall cost of the GHG program to California businesses and in doing so reduces costs faced by consumers and taxpayers.

The recommended cap-and-trade program design accounts for early action—emissions reductions achieved by regulated entities before the program goes into effect. Incentives will be provided to capture "low-hanging fruit"—that is, relatively low-cost near-term opportunities for emissions reductions—sooner rather than later.

8.2.3 Reinforcing direct regulation

The recommended cap-and-trade program does not undermine other regulatory programs. Firms with regulatory responsibility under other policies don't escape these responsibilities by participating in the cap-and-trade program. To the contrary, the cap-and-trade program can reinforce other programs by creating incentives for affected firms to go beyond otherwise required reductions: Firms will reap the financial benefits of avoiding the need to purchase allowances or of selling any excess allowances in the emissions trading market.

8.2.4 Encouraging technological innovation

The recommended cap-and-trade program provides a price signal (through the cost of allowances) that contributes toward internalizing the social cost of current and future environmental damages associated with GHG emissions. This price signal makes lower-carbon technology options more competitive in the market. The recommended program thus complements and reinforces the efforts of California's Economic and Technology Advancement Advisory Committee to promote investment in alternative technologies that offer the best long-term potential for de-carbonizing the California economy.

8.2.5 Addressing environmental justice concerns

The Market Advisory Committee believes that the cap-and-trade program must address important environmental justice concerns that have been raised by the Environmental Justice Advisory Committee and in stakeholder comments received during our public workshops. We note especially the concern about potential increases in non-GHG pollutant emissions in disadvantaged communities. We have taken these concerns into account in developing our recommendations.

The recommended cap-and-trade program design encourages in-state emissions reductions and in-state investments in low-emissions technologies. Our recommendations help assure no increases in local pollutant emissions. The cap-and-trade program could produce multiple benefits in affected communities by promoting actions and technology investments that simultaneously reduce emissions of GHGs and conventional air pollutants.

Some have argued that all GHG reductions stimulated by The Global Warming Solutions Act should occur in California so as to maximize co-benefits within the state. Although some Committee members favor specific limitations that would maximize direct benefits within the State, all Committee members agree that the flexibility offered by the cap-and-trade program will allow California to reduce global warming pollution at the lowest total cost.

8.2.6 Allowing for mid-course refinements

Periodic evaluation and review should be built into the program in recognition of its innovative character and to promote a process of "learning-by-doing." To take advantage of learning-by-doing, the recommended cap-and-trade program creates the opportunity for periodic refinements.

8.2.7 Building a bridge to the future

The recommended cap-and-trade program is just one of many efforts to reduce the risk of human-induced climate change. To achieve maximum benefits, California's efforts must be coordinated with—and reinforce the effect of—similar programs at the regional, national, and international levels. Our recommendations for a California cap-and-trade program have been developed with this objective in mind. The proposed cap-and-trade program design is intended to facilitate relatively easy linkages with other programs. Such linkages can help reduce costs to producers and consumers in and outside the state by expanding choices and thereby promoting emissions reductions where they can be achieved at the lowest cost.

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Contributors

Joshua Bushinsky, Pew Center on Global Climate Change
John Wells, BP
Irving Mintzer, MEG LLC
Mark Jacobsen, Stanford University
Stacey Davis, Center for Clean Air Policy
Joel Levin, California Climate Registry
Ralph Moran, BP America
Kate Hampton, Climate Change Capital
Suzanne Reed, Center for Clean Air Policy
Sonia Hamel, Center for Climate Strategies

California Environmental Protection Agency

Eileen Wenger Tutt
Andrew Altevogt

California Air Resources Board

Mike Scheible
Charles Shulock
Webster Tasat
Belinda Chen
Larry Hunsaker
David Kennedy

California Department of Finance

Robert Schladale

California Public Utilities Commission

Nancy Ryan
Julie Fitch
Scott Murtishaw

Appendix A: Acronyms

CA ISO: California Independent System Operator

CAA: Clean Air Act (federal)

CARB: California Air Resources Board

CCAR: California Climate Action Registry

CCX: Chicago Climate Exchange

CDM: Clean Development Mechanism

CEC: California Energy Commission

CFCs: Chlorofluorocarbons

CH_4: Methane

CO_2: Carbon Dioxide

CO_2e: Carbon Dioxide Equivalent

EPA: Environmental Protection Agency

EU ETS: European Union Emissions Trading Scheme

FERC: Federal Energy Regulatory Commission

GDP: Gross Domestic Product

GHGs: Greenhouse Gases

GWP: Global Warming Potential

HFCs: Hydrofluorocarbons

IOUs: Investor Owned Utilities

IPCC: Intergovernmental Panel on Climate Change

JI: Joint Implementation

LSE: Load-serving entities

MMT: Million Metric Tons

MOU: Memorandum of Understanding

MRTU: Market Redesign and Technology Upgrade

MWh: Megawatt-hour

N_2O: Nitrous Oxide

NAAQS: National Ambient Air Quality Standards

NERC: North American Electric Reliability Council

NOx: Oxides of Nitrogen

OMB: US Office of Management and Budget

OTC: Ozone Transport Commission

PFCs: Perfluorocarbons

PUC: Public Utilities Commission (California)

R & D: Research and Development

RACT: Reasonably Available Control Technology

RECLAIM: South Coast Air Quality Management District Regional Clean Air Incentives Market

RGGI: Regional Greenhouse Gas Initiative

SCAQMD: South Coast Air Quality Management District

SF_6: Sulfur Hexafluoride

SIP: State Implementation Plan

USD: US Dollar

WECC: Western Electricity Coordinating Council

Appendix B: Glossary

AB 32, The Global Warming Solutions Act (Health and Safety Code Sections 38560-38565): California state law enacted in 2006 that sets a goal of reducing greenhouse gas emissions to 1990 levels by 2020 and authorizes the California Air Resources Board (CARB) to develop a plan and adopt regulations to achieve that goal.

Additionality: Emissions reductions achieved through a given project over and above those that would otherwise have occurred in the absence of the project under a business-as-usual scenario. Additionality is a criterion for approval of project-based activities under the Clean Development Mechanism of the Kyoto Protocol as well as for offset projects allowed for credit under emissions trading programs.

Afforestation: Planting trees on lands that historically have not supported forests in order to provide carbon sinks.

Allocation: The process by which emissions allowances are initially distributed under an emissions cap and trade system. Authorizations to emit can initially be distributed in a number of ways. See "auctioning," "benchmarking," "grandfathering," and "updating."

Allowance: A government issued authorization to emit a certain amount. In greenhouse gas markets, an allowance is commonly denominated as one ton of CO_2e per year. See also "permit" and "credits (a.k.a. carbon credits)." The total number of allowances allocated to all entities in a cap and trade system is determined by the size of the overall cap on emissions.

Annex I Countries/Parties: Group of countries included in Annex I (as amended in 1998) to the United Nations Framework Convention on Climate Change (UNFCCC), including all the developed countries in the Organization of Economic Co-operation and Development, and economies in transition. By default, the other countries are referred to as Non-Annex I countries. Under Articles 4.2 (a) and 4.2 (b) of the Convention, Annex I countries commit themselves specifically to the aim of returning individually or jointly to their 1990 levels of greenhouse gas emissions.

Anthropogenic Greenhouse Gas Emissions: Greenhouse gas emissions resulting from human activities.

Auctioning: A method for distributing emission allowances in a cap and trade system whereby allowances are sold to the highest bidder. This method of allocation may be combined with other forms of allowance allocation.

Banking: The carry-over of unused allowances or offset credits from one compliance period to the next.

Baseline: The target, usually the historical emissions from a designated past year, against which emission reduction goals are measured. In California, the designated base year is 1990.

Benchmarking: An allowance allocation method in which allowances are distributed by setting a level of permitted emissions per unit of input or output.

Borrowing: A mechanism under a cap and trade program that allows covered entities to use allowances designated for a future compliance period to meet the requirements of the current compliance period. Borrowing may entail penalties to reflect the programmatic preference for near-term emissions reductions.

Cap and Trade: A system designed to limit and reduce emissions. Cap and trade regulation creates a single market mechanism as opposed to a command and control approach that prescribes reductions on a source-by-source basis. Cap and trade regulation sets an overall limit on emissions and allows entities subject to the system to comply by undertaking emission reduction projects at their covered facilities and/or by purchasing emission allowances (or credits) from other entities that have generated emission reductions in excess of their compliance obligations.

Carbon Dioxide (CO_2): A naturally occurring gas, it is also a by-product of burning fossil fuels and biomass, as well as other industrial processes and land-use changes. It is the principle anthropogenic greenhouse gas that affects the Earth's temperature. It is the reference gas against which other GHGs are indexed and therefore has a Global Warming Potential of one (1).

Carbon Dioxide Equivalent (CO_2e): The metric used to compare quantities and effects of various GHGs on a common basis. The CO_2e of a gas is equal to its emissions, by mass, multiplied by its global warming potential (see "global warming potential") and is commonly expressed in million metric tons ($MMTCO_2e$).

Carbon Market: A term for a trading system through which entities may buy or sell emissions allowances e.g., under the Kyoto Protocol or other agreements, such as that among member states of the European Union (EU). The term reflects that carbon dioxide is the predominant greenhouse gas and thus, other gases are measured in units called "carbon-dioxide equivalents."

Carbon sequestration: The storage of carbon or carbon dioxide (CO_2) , for example, in plants, soils, or subsurface geologic formations.

Carbon Tax: A surcharge on the carbon content of fossil fuels that aims to discourage their use and thereby reduce carbon dioxide emissions.

Chlorofluorocarbons (CFCs): Gaseous, synthetic substances composed of chlorine, fluorine and carbon. CFCs have been used as refrigerants, aerosol propellants, and cleaning solvents, and in the manufacture of plastic foam. As well as causing ozone depletion in the stratosphere, CFCs are greenhouse gases. Their use is being phased out under the Montreal Protocol. Some of their replacements are "ozone-friendly" but are, nonetheless, potent greenhouse gases.

Circuit breaker: A threshold or circumstance which, if met, would require action taken to either evaluate the operation of a system, make changes in system design, and/or suspend the system.

Clean Development Mechanism (CDM): One of the three market mechanisms established by the Kyoto Protocol to provide flexibility for compliance. The CDM is designed to promote sustainable development in developing countries and assist Annex I Parties in meeting their greenhouse gas emission reduction commitments. It enables industrialized countries to invest in emission reduction projects in developing countries and to share credits for the GHG reductions achieved.

Climate: The long-term statistical average of weather-related aspects of a region including typical weather patterns, the frequency and intensity of storms, cold spells, and heat waves. Climate is not the same as weather. A description of the climate of a certain place would include the averages and extremes of such things as temperature, rainfall, humidity, evapotranspiration and other variables that can be determined from past weather records during a specified interval of time.

Climate Change: Refers to changes in long-term trends in the average climate, such as changes in average temperatures.

Command and Control: A system of regulation that prescribes emission limits and compliance methods on a facility-by-facility or source-by-source basis and that has been the traditional approach to reducing air pollution.

Cost Containment Mechanisms: Design elements in a cap and trade program that reduce the risk of high compliance costs for affected facilities or industries.

Coverage: Refers to the scope of a cap and trade system, i.e., which sectors or emissions sources will be included.

Credits (a.k.a. carbon credits): Credits can be distributed by the government for reductions achieved by offset projects or by achieving environmental performance beyond a regulatory standard.

Deforestation: Conversion of land from a forested to a non-forested use.

Discounting: The process that adjusts future costs and benefits to reflect the time value of money and the preference for consumption sooner rather than later. It can also refer to a factor applied to certain allowances or credits to reflect risk or uncertainty that the emission reductions will be realized.

Downstream: See source-based (downstream).

Emissions: The release of substances (e.g., greenhouse gases) into the atmosphere. Emissions occur both through natural processes and as a result of human activities.

Emissions Cap: A mandated constraint in a scheduled timeframe that puts a "ceiling" on the total amount of anthropogenic greenhouse gas emissions that can be released into the atmosphere.

Emissions trading: The process or policy that allows the buying and selling of credits or allowances created under an emissions cap.

European Union Emissions Trading Scheme (EU ETS): The world's largest greenhouse gas emissions trading system is the European Union's Emissions Trading Scheme, which limits CO_2 emissions from 12,000 facilities in the 25 EU member states. Launched in 2005, the ETS covers electricity and major industrial sectors (including oil, iron and steel, cement, and pulp and paper) that together produce nearly half the EU's CO_2 emissions. ETS rules are set at the regional level but decisions on emission allowance allocation are left to member states. An initial phase runs through 2007; a second will coincide with the Kyoto Protocol compliance period (2008-2012). Excess emissions incur a penalty (100 Euros/ton in phase II) and must be made up in the next phase. EU policymakers have said the ETS will continue beyond 2012 with or without new international climate agreements.

Global Warming: The trend of rising Earth's average surface temperature caused predominantly by increased concentrations of GHGs in the atmosphere. Strictly speaking, global warming refers only to warming trends. However, the term "global warming" has become a popular term encompassing all aspects of climate change, including, for example, the potential changes in precipitation that will be brought about by an increase in global temperatures. The term is used interchangeably with the term, "climate change."

Global Warming Potential (GWP): Greenhouse gases differ in their effect on the Earth's radiation balance depending on their concentration, residence time in the atmosphere, and physical properties with respect to absorbing and emitting radiant energy. By convention, the effect of carbon dioxide is assigned a value of one (1) (i.e., the GWP of carbon dioxide =1) and the GWPs of other gases are expressed relative to carbon dioxide. For example, in the U.S. national inventory, the GWP of nitrous oxide is 310 and that of methane 21, indicating

that a ton of nitrous oxide has 310 times the effect on warming as a ton of carbon dioxide. Slightly different GWP values for greenhouse gases have been estimated in other reports. Some industrially produced gases such as sulfur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs) have extremely high GWPs. Emissions of these gases have a much greater effect on global warming than an equal emission (by mass) of the naturally occurring gases. Most of these gases have GWPs of 1,300 - 23,900 times that of CO_2. The US and other Parties to the UNFCCC report national greenhouse gas inventories using GWPs from the IPCC's Second Assessment Report (SAR). SAR GWPs are also used for the Kyoto Protocol and the EU ETS. GWPs indicated in this document also refer to the IPCC's Second Assessment Report.

Grandfathering: A method by which emission allowances are freely distributed to entities covered under an emissions trading program based on historic emissions.

Greenhouse Effect: The heat-trapping effect of atmospheric greenhouse gases (e.g., water vapor, carbon dioxide, methane, etc.) that keeps the Earth's temperature about 60°F warmer than it would be otherwise. These gases absorb infra-red radiation emitted by the Earth and retard the loss of energy from the Earth system into space. The natural greenhouse effect has been a property of Earth's atmosphere for millions of years and is responsible for maintaining the Earth's surface at a temperature that makes it habitable for human beings. The Earth is currently experiencing an enhanced greenhouse effect due to an increase in atmospheric concentrations of greenhouse gases emitted by human activities.

Greenhouse Gases (GHGs): Greenhouse gases include a wide variety of gases that trap heat near the Earth's surface, slowing its escape into space. Greenhouse gases include carbon dioxide, methane, nitrous oxide and water vapor and other gases. While greenhouse gases occur naturally in the atmosphere, human activities also result in additional greenhouse gas emissions. Humans have also manufactured some gaseous compounds not found in nature that also slow the release of radiant energy into space.

Hydrofluorocarbons (HFCs): Synthetic industrial gases, primarily used in refrigeration and other applications as commercial substitutes for chlorofluorocarbons (CFCs). There are no natural sources of HFCs. The atmospheric lifetime of HFCs is decades to centuries, and they have "global warming potentials" thousands of times that of CO_2, depending on the gas. HFCs are among the six greenhouse gases to be curbed under the Kyoto Protocol.

Investor Owned Utilities (IOUs): Entities that generate and distribute electricity for a profit, and that are owned by stockholders who are not necessarily the users of the supplied electricity.

Inventory: A greenhouse gas inventory is an accounting of the amount of greenhouse gases emitted to or removed from the atmosphere over a specific period of time (e.g., one year). A greenhouse gas inventory also provides information on the activities that cause emissions and removals, as well as background on the methods used to make the calculations. Policy makers use greenhouse gas inventories to track emission trends, develop strategies and policies and assess progress. Scientists use greenhouse gas inventories as inputs to atmospheric and economic models

Intergovernmental Panel on Climate Change (IPCC): Recognizing the problem of potential global climate change, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. It is open to all members of the UN and WMO. The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation. The IPCC does not carry out research nor does it monitor climate related data or other relevant parameters. It bases its assessment mainly on peer reviewed and published scientific/technical literature.

IPCC Guidelines: The IPCC Guidelines for National Greenhouse Gas Inventories provide internationally accepted methodologies for estimating national inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases. The IPCC Guidelines were prepared in response to an invitation by the Parties to

the UNFCCC, for fulfilling their commitments under the UNFCCC on reporting on inventories of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol.

Joint Implementation (JI): A mechanism under the Kyoto Protocol through which a developed country can receive "emissions reduction units" (ERUs) when it helps to finance projects that reduce net greenhouse gas emissions in another developed country (in practice, the recipient state is likely to be a country with an "economy in transition"). An Annex I Party must meet specific eligibility requirements to participate in joint implementation.

Kyoto Mechanisms: Three procedures established under the Kyoto Protocol to increase the flexibility and reduce the costs of reducing greenhouse-gas emissions; they are the Clean Development Mechanism (CDM), emissions trading, and joint implementation (JI).

Kyoto Protocol: An international agreement signed at the Third Conference of the Parties to the UN Framework Convention on Climate Change in Kyoto, Japan (December 1997). The Protocol sets binding emission targets for industrialized countries that would reduce their collective emissions by 5.2 percent, on average, below 1990 levels by 2012.

Leakage: Leakage occurs when activities that reduce greenhouse gas emissions (or increase carbon in plants and soils) in one place and time result in increases of emissions (or loss of soil or plant carbon) elsewhere or at later times. For example, a steel firm in a country covered by the Kyoto Protocol makes reductions by closing one facility and replacing its output with production from a steel plant operating in another country that does not have a GHG constraint. Similarly, a forest can be protected in one location and cause harvesting of forests elsewhere.

Linking: Authorization by the regulator for entities covered under a cap and trade program to use allowances or offsets from a different jurisdiction's regulatory regime (such as another cap and trade program) for compliance purposes. Linking may expand opportunities for low-cost emission reductions, resulting in lower compliance costs.

Load-based system: A system in which the covered emitters are electricity retailers responsible for all the emissions associated with the generation of the electricity that they provide to customers, including electricity imported from other states.

Methane (CH_4): One of the six greenhouse gases to be curbed under the Kyoto Protocol. Atmospheric CH_4 is produced in nature, but human related sources such as landfills, livestock feedlots, natural gas and petroleum systems, coal mines, rice fields, and wastewater treatment plants also generate substantial CH_4 emissions. CH_4 has a relatively short atmospheric lifetime of approximately 10 years, but its 100-year GWP is currently estimated to be approximately 21 times that of CO_2.

Nitrous Oxide (N_2O): One of the six greenhouse gases to be curbed under the Kyoto Protocol. N_2O is produced by natural processes, but substantial emissions are also produced by such human activities as farming and fossil fuel combustion. The atmospheric lifetime of N_2O is approximately 100 years, and its 100-year GWP is currently estimated to be 310 times that of CO_2.

Offset: Projects undertaken outside the coverage of a mandatory emissions reduction system for which the ownership of verifiable GHG emission reductions can be transferred and used by a regulated source to meet its emissions reduction obligation. If offsets are allowed in a cap and trade program, credits would be granted to an uncapped source for the emissions reductions a project (or plant or soil carbon sink) achieves. A capped source could then acquire these credits as a method of compliance under a cap.

Perfluorocarbons (PFCs): PFCs are among the six greenhouse gases to be curbed under the Kyoto Protocol. PFCs are synthetic industrial gases generated as a by-product of aluminum smelting and uranium enrichment. They also are used in the manufacture of semiconductors. There are no natural sources of PFCs. PFCs have atmospheric lifetimes of thousands to tens of thousands of years and 100-year GWPs thousands of times that of CO_2, depending on the specific PFC.

Point of Regulation: The point of program enforcement, or where specific emitting entities covered under a cap and trade program are required to surrender enough allowances to match their actual emissions within a compliance period.

Price Trigger: A general term used to describe a price at which some measure will be taken to stabilize or lower allowance prices. For example, RGGI uses price triggers to expand the amount of offsets that can be used for compliance.

Reforestation: Replanting of forests on lands that have previously contained forests but that have been converted to some other land use. (see comments on Afforestation)

Regional Greenhouse Gas Initiative (RGGI): The Regional Greenhouse Gas Initiative (RGGI) is establishing the first mandatory U.S. cap and trade program for carbon dioxide, and currently includes ten Northeastern and mid-Atlantic states. The governors of Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont established RGGI in December 2005. Massachusetts and Rhode Island joined in early 2007, and Maryland is expected to join later in June 2007 under a law passed last year. Additional states can join the program with the agreement of the participating states. RGGI sets a cap on carbon dioxide emissions from power plants and allows sources to trade emission allowances. The program will cap emissions at current levels in 2009 and then reduce emissions 10% by 2019. Each state that intends to participate in RGGI must adopt a model rule through legislation or regulation and determine how to distribute emissions allowances. Member states agree to set aside at least 25% of their emission allowances for public benefit.

Registries, registry systems: Electronic databases that track and record emissions and emission allowance holdings, retirements, cancellations and transfers.

Revenue Recycling: The process of using revenue collected from a program or activity in a way that directly addresses the goals of the program.

Safety Valve (Price Cap): Generally, an optional design element of a cap and trade program that seeks to provide cost certainty by making allowances available at some threshold price to ensure that the allowance price does not rise above a certain level.

Sink (or carbon sink): A naturally occurring process, activity, or mechanism that removes a GHG from the atmosphere. Examples of sinks are oceans, forests, and photosynthesis.

Source: Any process or activity that results in the net release of greenhouse gases, aerosols, or precursors of greenhouse gases into the atmosphere.

Source-based (downstream) system: Also known as a downstream system, a source-based cap and trade system is one in which the point of regulation coincides with the point of emission of covered greenhouse gases. Examples of a source-based approach include the Regional Greenhouse Gas Initiative's cap on power plant CO_2 emissions or the cap on large industrial sources in the European Union's Emissions Trading Scheme.

Sulfur Hexafluoride (SF_6): One of the six greenhouse gases to be curbed under the Kyoto Protocol. SF_6 is a synthetic industrial gas largely used in heavy industry to insulate high-voltage equipment and to assist in the manufacturing of cable-cooling systems. There are no natural sources of SF_6. SF_6 has an atmospheric lifetime of 3,200 years. Its 100-year GWP is currently estimated to be 22,200 times that of CO_2.

Updating: A form of allowance allocation in which allocations are reviewed and changed over time and/or awarded on the basis of changing circumstances (such as output) rather than historical data (such as emissions, input or output). For example, allowances might be distributed based on megawatt-hours generated or tons of a product manufactured.

Upstream system: An upstream approach to a cap and trade system matches the point of regulation with the point of entry of fossil fuels into commerce within the covered region.

Verification: The act of checking or testing, by an independent and certified party, to ensure that an emission reduction project actually achieves emission reductions commensurate with the credits it receives.

Weather: State or condition of the atmosphere in a particular locality with respect to heat or cold, wetness or dryness, calm or storm, and clearness or cloudiness for a certain period of time.

Appendix C: Lessons Learned from Experiences with Other Cap and Trade Systems

In designing a cap-and-trade program for California, there is an opportunity to learn from the successes and limitations of earlier trading system designs. Accordingly, this section reviews key examples of prior applications of cap-and-trade policies. In each case we draw out potential lessons learned for California.

B.1 Allowance Markets for Local and Regional Air Pollutants

Most experience with cap-and-trade systems has been to reduce emissions of criteria pollutants such as SO_2 and NO_x. These pollutants differ from greenhouse gases in several respects. They are short-lived in the atmosphere compared to persistent GHG lifetimes in the tens or hundreds of years. In addition, the impacts of some criteria pollutants can be felt near the source of pollution, although prevailing winds can transport these compounds hundreds of miles across state or national borders. In contrast, greenhouse gases do not have local effects and are well-mixed in the global atmosphere. These features make greenhouse gases the prototypical pollutants for regulation with cap and trade, according to the voluminous economic and policy literature that has studied cap and trade, because greenhouse gases do not have temporal or spatial effects. Another key difference relates to the expected economic value of the emissions markets. The EU ETS, for example, is a larger market than the US SO_2 market, although it isn't yet clear how a California GHG market might compare in size to these other systems. Despite these differences, there is a lot to learn about the different design elements of criteria pollutant trading systems and how they contribute to a functioning allowance market.

This section reviews experiences with three of the leading US criteria pollutant trading systems: the SO_2 Acid Rain Trading Program, the Southern California Regional Clean Air Incentives Market, and the NO_x Budget Program.

B.1.1 SO_2 Trading under the Clean Air Act

Title IV of the 1990 Clean Air Act Amendments (CAAA) set a goal of reducing annual SO_2 emissions by 10 million tons below 1980 levels. To achieve 8.5 million tons of these reductions, the CAAA established a cap and trade system—the Acid Rain Trading Program—to reduce emissions of SO_2 from fossil-fuel burning power plants located in the continental 48 states of the United States.

Trading Program Design

The Acid Rain Trading Program consisted of two phases. Phase I, from 1995 to 1999, covered 263 electric generating units larger than 100 MW. Emissions caps for these Phase I units were provided in the Act. In Phase II, beginning in 2000, additional plants having generating units larger than 25 MW were added to the program. Phase II limited emissions to an annual cap of 8.95 million tons. This cap level is about half of the total electric utility SO_2 emissions in 1980. Additionally, Phase II generating units had the option of opting-in to the allowance market in Phase I, and non-utility industrial units emitting SO_2 had the option of participating in the trading program, starting either in Phase I or in Phase II.

Caps on emissions were implemented by issuing tradable allowances that in total equaled the annual cap level. Allowances were allocated in 1993 to each Phase I source for 1995 and every year thereafter, and to each Phase II source for 2000 and every year thereafter. This provided sources with certainty as to their future obligations under the program. To comply, sources were required to surrender one allowance for each ton of emissions. Allowances not used in the year they were issued could be banked for future use. Most of the allowances were issued to sources on the basis of each unit's average annual heat input during the three-year baseline period, 1985 to 1987, multiplied by a specified emissions rate, which in turn depended on the plant category. In all, there were 29 formulas governing allocations for different types of plants, but these formulas were guided by an overarching principle relating allocation to performance standards and historic utilization of these plants. A small share (2.8 percent) of allowances was sold through an annual auction conducted by EPA to ensure the availability of allowances for new generating units. The revenues from these sales were returned on a pro rata basis to the owners from whose allocations the allowances were withheld. In addition, 3.5 million bonus allowances were awarded to plants that utilized scrubbers to achieve compliance and 300,000 bonus allowances were available to utilities that either installed renewable generation facilities or implemented demand-side energy conservation programs to reduce emissions. Allowance distributions for Phase I units were specified in the Act.

The trading program relies on emissions monitoring equipment and tracking provisions. All participating units are required to use continuous emissions monitoring systems (CEMS) or an approved alternative measurement method, which are reviewed for accuracy and reliability. These systems report hourly emissions electronically and these data are verified and recorded by EPA. The data are made available on the internet to ensure program transparency. At the end of the year, compliance is demonstrated by comparing each unit's allowances to the unit's annual SO_2 emissions. Units with too few allowances are subject to two penalties: a fine and a requirement to make up the excess emissions with an equivalent number of allowances.[70]

The Acid Rain Trading Program did not use offsets or safety valves—compliance flexibility and cost containment mechanisms commonly discussed in connection with a cap-and-trade system for greenhouse gas emissions. Moreover, the issue of granting credit for early actions was addressed by using a historical period as the basis for allowance allocations. By using 1985-87 data to determine applicability and allocations, actions taken to reduce emissions between 1985-87 and the enactment of the law in 1990 and the start of the program in 1995 (for Phase I units) and 2000 (for Phase II units) were automatically recognized without special provisions. For example, if a unit reduced its emissions early, but not sufficiently to reach its allocated amount, it simply needed to spend less on control, or buy fewer allowances to comply. If the unit reduced emissions early below its allocated amount, it would have allowances to use at another unit, sell, or save for future growth.

In 2005, the Bush administration promulgated the Clean Air Interstate Rule (CAIR), which achieves a reduction in emissions in the future by effectively reducing the emission cap. The important precedent is that the cap is reduced while preserving the value of early reductions that are captured in banked emission allowances. The cap is tightened by changing the denomination for emission allowances that are issued for 2010 and later years. Emission allowances issued for earlier years retain their value in terms of tons/allowance. Therefore, banked emission allowances retain the value for the year (vintage) that they were issued. This design indicates one way that program adjustments can be achieved without undermining the solvency of the market or the value of early emission reductions.

Program Implementation and Assessment

[70] See *Fundamentals of Successful Monitoring, Reporting, and Verification under a Cap-and-Trade Program*, John Schakenbach, Robert Vollaro, and Reynaldo Forte, U.S. Environmental Protection Agency, Office of Atmospheric Programs, Washington, DC. J. Air & Waste Manage. Assoc. 56:1576–1583. Volume 56 November 2006 at http://www.epa.gov/airmarkets/cap-trade/docs/fundamentals.pdf and US EPA. Plain English Guide to the Part 75 Rule, U.S. Environmental Protection Agency, Clean Air Markets Division. September 2005

The Acid Rain Trading Program was implemented quickly[71] and on schedule and achieved near-100 percent compliance. Under this program, power sector SO_2 emissions declined from 15.7 million tons in 1990 to 10.2 million tons in 2005, a 35 percent reduction as a result of the acid rain trading program (EPA, 2005). While there may have been some emissions leakage from capped to uncapped power generators in Phase I of the program, emissions have continuously declined over time, and cumulative reductions are well below what is required under the Acid Rain Trading Program.

Further, costs were much lower than originally predicted. While estimated costs at the time of enactment of the alternative technology-based program range from $3.5 to $7.5 billion per year, current estimated costs of the Acid Rain Program by 2010 are just over $1 billion per year (Ellerman, 2003b).[72] Greater flexibility in the compliance methods of the emissions trading system is considered to be the biggest cost-saving factor by allowing affected sources to choose the lowest-cost pollution abatement methods. However, while there is no question that the Acid Rain Trading program achieved significant cost savings over what was predicted *ex ante*, there is some disagreement over the degree to which the emissions trading mechanism was responsible for these savings. The two major studies of cost savings (Carlson et al., 2000 and Ellerman, 2003b) are in general agreement that savings were about 43% - 55% of total compliance costs under a uniform emission rate standard. Carlson et al. cite savings of over 65% compared to a policy that might have forced post-combustion controls (scrubbing) to achieve the same level of emissions.

According to a study by the US Office of Management and Budget (2003) covering the early years of the Acid Rain Trading program, the annual benefits of acid rain SO_2 regulations ($78 to $79 billion USD) far exceeded the costs ($1 to $2 billion USD), with most of the benefits due to health benefits from reducing ambient levels of fine particulate matter (OMB, 2003).[73,74] Furthermore, it requires only about 50 people to administer the program, including engagement with over 4000 sources, auditing of all hourly emissions data, tracking several thousand allowance transfers per year, annual compliance determination, and annual program assessment.

Part of the success of the Acid Rain Trading Program can be attributed to emissions banking. The emissions banking provisions of the Acid Rain Trading Program have resulted in significant levels of early emissions reductions and, therefore, greater cumulative emissions benefits than would otherwise have occurred. See, for example, Ellerman (2003b) and Burtraw and Mansur (1999).

Finally, several studies have found that the Acid Rain Trading Program has not resulted in emissions "hotspots," a particular concern for low income and minority communities living near industrial sources, because 1) the program reduced emissions by a substantial amount, and emissions reductions typically happened at the largest sources due to economies of scale; and 2) the program did not affect existing regulations for other pollutants. Swift (2000) found that emissions were below allotted levels in nearly all states (slight increases in MA, MS and IL) and in the three major power producing regions (Mid Atlantic, Midwest, Southeast) during the first four years of the program. Birnbaum (2001) also confirmed no significant regional emission shifts or in-flows; indeed, the greatest emission reductions had occurred in the high emitting Midwestern states where the cost per ton reduction was the lowest. To the extent that power plants in this region had been creating local hot spots, emissions trading may be accountable for cooling hot spots. Corburn (2001) found no strong evidence suggesting that SO_2 emissions from Phase I power plants were disproportionately concentrated in the poor communities of color. And in the event that hotspots are identified,

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[71] Emissions reductions from Phase I sources of 3.4 million tons were achieved in the fifth year following passage of the enabling legislation. Explanations for this quick progress include the absence of lawsuits and the relatively modest administrative requirements associated with the trading program compared with the traditional US command-and-control approach to regulation.

[72] *Ex ante* estimates of the cost of a trading system were also significantly higher than actual costs, from $2.3 to $6.0 billion.

[73] The Acid Rain Program reduces SO_2 emissions that are precursor pollutants that contribute to the formation of secondary fine PM.

[74] A more recent study (Chestnut *et al.*, 2005) estimates the benefits of the SO2 and NOx reductions at $122 billion and the costs at $3 billion ($2 billion for SO2 and $1 billion for NOX).

states and localities have authority to address local air quality problems (including setting facility permit levels that would preclude use of allowances to exceed those levels).

Lessons Learned

Some of the specific lessons learned from the Acid Rain Trading Program include the following:

- Regulators should support development of a robust emissions market by capping emissions below the expected business-as-usual level, and providing for unrestricted trading and banking.
- Given the importance of accurate data in a cap-and-trade program, it is necessary to monitor, report, and verify all emissions from all sources. Further, to support public confidence in a trading program, emissions and allowance transfer data should be transparent and available to the public.
- An effective way of encouraging high levels of compliance is to provide for automatic penalties for non-compliance.
- To provide certainty to capped entities, facilitate compliance planning and minimize price fluctuations, it is desirable to put final rules in place at least 2 years prior to the compliance date.
- To minimize inter-sector emissions leakage, it is desirable to regulate all sources within a given sector above a de minimus size or emissions level.
- Future program adjustments, including adjustments to the cap level to increase program stringency or lower costs, can be managed in order to preserve the value of early investments and banked tradable allowances.

B.1.2 RECLAIM

The California South Coast Air Quality Management District established the Regional Clean Air Incentives Market (RECLAIM) program in 1993 for NO_x and in 1994 for SO_2 to bring the region into attainment for ozone and particulate matter, and to meet the aggressive emission reduction targets and quick deadlines called for under the 1990 Clean Air Act Amendments. Some of the reasons a cap-and-trade program was selected were to overcome insufficient information about control technologies and provide for flexibility in meeting emissions reduction goals.

Trading Program Design

The RECLAIM program applied to more than 350 affected sources, including power plants, refineries, cement plants, and other industrial sources that emitted four or more tons of NO_x (or SO_2)—essentially, all but the smallest sources. Despite the large number of affected sources, participating sources represent only about a quarter of the area's ozone-forming air pollution. The majority of NO_x emissions in the SCAQMD region come from the transportation sector, which was ultimately not included in the RECLAIM program.[75]

Sources were assigned a quantity of RECLAIM Trading Credits based on past peak production levels and the requirements of existing rules and control measures. The overall goal of RECLAIM was to reduce NO_x emissions by 73 tonnes per day, an overall reduction of 70 percent from affected sources, by 2003.

One important aspect of the RECLAIM program was its restriction on emissions banking to ensure that the desired reduction levels are achieved in the compliance year. All allowances needed to be used in specific compliance years and could not be applied to future compliance requirements.

[75] Note that while the original design of the RECLAIM program permitted trading between stationary and mobile sources, in the end, EPA approved only a limited trading program. Allowing participants to invest in and trade with mobile sources would have added compliance flexibility but may have increased the potential for emissions hotspots.

Program Implementation and Assessment

The RECLAIM program has been the subject of significant criticism for its initial over-allocations, its failure during California's 2001 electricity crisis, and for insufficient progress in addressing emissions hotspots. However, there is also evidence that the program reduced overall emissions and lowered compliance costs.

One problem with the RECLAIM program related to initial allowance allocations. Emissions forecasts and allocations were based on years of higher economic activity. The point at which actual emissions exceeded the initial allocations was around the year 2000. Before then emissions were consistently below total NO_x allocations and emissions reductions were not needed because there was no scarcity.

A second critical problem related to non-compliance during the State's 2000/1 electricity crisis. With some power generators serving California load shut down from operation due to illegal exercise of market power during a period of above average power demand, many power plants subject to the RECLAIM program had to operate at higher-than-usual capacity factors. These plants required more allowances than normal to comply with RECLAIM. In total the number of allowances needed nearly doubled. With no incentive for early investments in post-combustion controls to save a bank of allowances, many units lacked these controls during the crisis. Moreover, with no banked allowances from earlier periods, no current year investments from power generation facilities in the RECLAIM area, no excess allowances available within the basin, and very little experience working within a functioning emissions market, achieving the needed emissions reductions was a virtual impossibility. The result was that total emissions exceeded the total allocation by nearly 20 percent (SCAQMD, 2003). In terms of program compliance beyond the electricity crisis, there was one widely reported case of fraud, but otherwise, facilities subject to RECLAIM were largely in compliance.

A third area of criticism related to concerns raised by the Environmental Justice community who disagreed with the right of plants to pollute and were concerned about emissions hotspots. These groups contend that there is little evidence of technological innovation and that, in contrast, RECLAIM bought 5 more years of not installing control technologies.

On the other hand, there is evidence that the RECLAIM program achieved significant emissions reductions and lowered costs. In terms of emissions reductions, according to the SCAQMD Annual RECLAIM Audit in 2004, the RECLAIM program contributed to a more than 60 percent reduction in NOx emissions and a more than 50 percent reduction in SO_2 emissions between 1994 and 2004. In terms of cost, initial estimates for RECLAIM show that the prices of traded RECLAIM credits have been well below the prices projected at the time the system was established. For example, in 1993, RECLAIM staff estimated that NOX allowance prices would trade at roughly $9,000 per ton in 1996-98, but actual prices were no higher than $600 per ton. The degree to which these low prices were due to lack of scarcity as opposed to the ability of the trading system to incent low cost compliance options is not clear.

An ex-ante assessment of the cost savings from RECLAIM, quoted by Stavins (2000), estimated that these savings would amount to some $58 million annually, a saving of some 42 percent compared to command-and-control compliance costs.

Lessons Learned

Lessons learned from the RECLAIM program include the following:

a. Regulators should avoid over-allocation of allowances in order to create scarcity and a functioning allowance market. It may help to develop alternative scenarios for economic activity and other factors that contribute to future emissions projections.
b. Cap-and-trade programs should allow for emissions banking to facilitate compliance in years where unforeseen activities lead to higher than expected emissions. Banking allows industry to plan for these kinds of risks by pursuing early emissions reductions.

c. It is important to anticipate and address concerns about emissions hotspots up front in the design process so that there is a common understanding of potential impacts and how any hotspot issues will be identified and addressed.

B.1.3 NOx Budget Program

Section 176 of the Clean Air Act permits the creation of air pollution transport commissions to deal with regional transport of air pollution, and Section 184 of the Act specifically created the first such commission, the Ozone Transport Commission (OTC), to coordinate actions among the thirteen Northeastern and Mid-Atlantic states and the District of Columbia to end the persistent "non-attainment" (failure to attain the National Ambient Air Quality Standards, or NAAQS) for ozone. In 1994, these jurisdictions signed a Memorandum of Understanding that established a "NO_x Budget Program" to control NO_x emissions from electric utilities and large industrial boilers.

Trading Program Design

The NO_x Budget Program was implemented in three phases. Phase I was equivalent to the Reasonably Available Control Technology (RACT) standard in 1995. Phases 2 and 3, starting in 1999 and 2003, consist of a progressively more stringent cap-and-trade program for the entire region during the May to September ozone season. The states worked together to develop a model emissions trading rule that all could adopt. EPA developed and operated the Allowance Tracking System, the Emissions Tracking System, and the end-of-year allowance/emissions reconciliation process for the states. And each state retained control over how to allocate allowances within their state. While similar to the Acid Rain Trading Program described earlier, a key difference entailed limits placed on banking of allowances through a system (known as progressive flow control) designed to prevent adverse health effects from use of banked allowances during the ozone season.

In late 1997, under Section 110 of the 1990 CAAA, the EPA proposed to require states in a broader region to impose restrictions on electricity generators and industrial sources of NO_x emissions to help downwind states comply with the ozone standard. The result was the NO_x SIP Call trading program, which affected sources in 19 eastern states and the District of Columbia, beginning in 2003. Rather than initiate the third phase of the NO_x Budget Program, the states in the OTC region chose to comply with the SIP Call restriction. Thus this program provided a precedent for tightening the requirements of a cap and trade program over time and expanding its coverage to include neighboring states. As part of general provisions in the NO_x SIP Call that gave credit for early actions, a portion of the banked allowances from the NO_x Budget Program were carried forward into the NO_X SIP Call trading program.

Program Implementation and Assessment

The OTC NO_x budget program got off to a somewhat rocky start (Farrell, 2000). There were delays in the state laws needed to implement the program, and delays in issuance of early reduction credits, creating uncertainty in the market. In fact, "although a few emissions trades were announced as early as January 1998, the (trading) system was not on line until September 1998 and trading did not begin in earnest until the beginning of 1999"—just before the first May to September compliance period (Farrell, 2000). These uncertainties led to high degrees of price volatility in the first year of the program. At the same time, the market provided the signals needed to correct the short supply of allowances as well as tools to manage future risks, and prices leveled out in the next year without adverse impacts on reliability or emissions (Farrell, 2000).

Emissions sources in the Ozone Transport Region NO_x Budget Program reduced regional summertime ozone emissions from roughly 429,098 tons in 1990 to 290,000 tons in 1995 (the year that RACT requirements kicked in) to 193,000 tons in 2002, the final year of the Phase II NO_x budget period.

A portion (roughly 27 percent) of the allowances banked in the Ozone Transport Region resulting from over compliance during the Phase II budget period will be allowed to be used to help meet the tougher ozone season emissions levels that were established by the NO_x SIP Call trading program, described below. The rest of the allowances will effectively be retired, representing permanent emissions reductions.

In 1998, EPA issued the NO_x SIP Call rule, which expanded the OTC NO_x Budget Program from 12 to 21 states, and from 1,000 electric generating and industrial combustion units to over 2,500. Under the expanded NO_x Budget Trading Program, EPA and the states again jointly managed the cap and trade program but with EPA setting an emissions budget for each state and establishing monitoring requirements. EPA tracks allowances and emissions and determines compliance for this program while each state determines allowance allocations for its sources. NO_x emissions have declined from 1.86 million tons in 1990 to 0.49 million tons in 2006 with over 99 percent compliance.

Lessons Learned

Lessons learned from the NO_x Budget Program include:

- To avoid unnecessary price fluctuations, it is desirable to put all rules and requirements in place well before the first compliance period.
- A regional planning process can effectively coordinate state efforts to achieve important environmental goals.
- The program provides a precedent for expanding the coverage of a cap and trade program to include neighboring states.

B.2 GHG Allowance Markets

While there has been considerable experience with use of cap-and-trade programs to reduce emissions of conventional air pollutants, there has been less experience with cap-and-trade programs that reduce emissions of greenhouse gases. Here we look at two model cap-and-trade programs: The European Union Emissions Trading Scheme (EUETS) and the Northeast Regional Greenhouse Gas Initiative (RGGI).

B.2.1 The European Union Emissions Trading System

The European Union Emissions Trading System (EUETS) is the largest cap-and-trade system implemented across the globe. The legislation establishing it was adopted in October 2003 and the system began operation in January 2005. The EU ETS includes more than 10,500 installations and about half of the EU's CO_2 emissions. Emissions trading was selected to maximize action for a given economic cost and to provide certainty of the level of emissions reductions. The European approach to meeting Kyoto obligations includes the EUETS as well as a number of other policies, including direct regulation.

Trading Program Design

Some key characteristics of the EUETS design include a downstream point of regulation, use of a "learning" phase, and largely free allocations to emitters.

The EUETS regulates emissions "downstream" at the point of emission and covers only large emitters in several industry sectors, including combustion installations over 20 MW, oil refineries, coke ovens, ferrous metal production (except aluminum), cement, glass and ceramics, and pulp and paper production. The transportation sector and direct emissions from the commercial and residential sector are not included in the

cap. In all, the program covers about half of CO_2 emissions in the European Union. The EU relies on policies and measures apart from the emissions trading system to reduce emissions from uncovered sectors. For example, taxes on gasoline are considerably higher than those in California, leading to prices over $6 per gallon.

The program is being implemented in phases. The first phase, lasting from 2005 to 2007, is a "learning phase" in which only CO_2 is traded and penalties for non-compliance are lower (40 Euros per ton). A planned review will occur towards the end of this learning phase to make mid-course corrections and improvements in the program design that would be effective in the third phase of the EU ETS. The second "Kyoto Commitment Period" phase, which runs from 2008 to 2012, is geared towards achieving compliance with the EU's obligations under the Kyoto Protocol. This second phase may include additional greenhouse gases and entails more significant penalties (100 Euros per ton) for noncompliance. The system continues in successive five-year phases thereafter, with the third phase set to run from 2013 to 2017.

The EU ETS rules establish a largely decentralized process when it comes to cap-setting and allocation. In advance of each multi-year phase, each Member State produces a national allocation plan for how the cap will be applied in that State, including how allowances will be allocated. These plans must be consistent with criteria set out in the legislation and are subject to an assessment by the European Commission as to whether each allowance plan adequately respects the criteria. Member States use different approaches to set the caps taking into account factors like energy mix, relative carbon intensive energy supplies, GDP and expected growth rates. The EU ETS further requires a majority (95 percent) of allowances to be allocated by member States for free to the regulated entities in the learning phase (2005-2007). In the second phase (2008-2012) this requirement reduces to 90%; and the legislation makes no provision for a minimum level of free allocation in future phases.

In terms of offsets, the rules allow capped companies to surrender credits created under the UN flexibility mechanism infrastructure, i.e. the Joint Implementation and Clean Development Mechanism, in lieu of allowances. This route was chosen as it replaces the need to develop and implement rules and infrastructure for the generation of offsets within Europe and thereby saves administration costs. The use of offsets from JI and CDM is limited in two ways. First, some types of credits (nuclear and sinks) are not recognized. Second, the use of offsets is subject to a quantitative limit that is set by each Member State in the national allocation plan.

The EU's approach to emissions monitoring is also different from typical US environmental programs, in part because of the differing capabilities of the EU Member States. Firms report their emissions annually but must have a third-party verifier attest to the accuracy of the emissions data (similar to the use of an accounting firm to attest to the accuracy of a firm's financial statement). In contrast to the Acid Rain Program, fewer measures are in place in the EU system to ensure that monitoring data are complete (e.g, through use of substitute data measures) and enforcement actions for failure to report emissions data has not been consistent across all Member States. The current review process addresses some of these concerns and is described below.

Program Implementation and Assessment

Overall, the EUETS has produced a functioning market system in a short time—the first phase of the scheme started just 15 months after the legislation entered into force—with over 99 percent compliance. Further, there is early evidence that the carbon price has produced behavioral impacts, including a much higher level of boardroom attention. At the same time, there have been a couple of start-up issues related to market price fluctuations and over-allocations. The planned review period has addressed some of these concerns.

One issue is that the allowance market price has varied based on expectations of scarcity. While price fluctuations are expected in a new trading system as players gain experience with the new market, price fluctuations have been somewhat greater in Europe. This is due in large part to the absence of emissions data at the start of the EUETS program. Verified emissions data only became available in mid May 2006, after two years of active trading in allowances. These data revealed an over-allocation of allowances in the first phase (2005 to 2007). The over allocation has been addressed with new (lower) allocations for member states that will apply to the Kyoto phase of the program.

Other factors that affected price volatility include the fact that the program started operation at a time of significant energy price volatility as well as delays in finalizing national allocation plans and issuing allocations, and delays in approving emissions registries. Volatility early on was also due to the fact that only power generators were actively using the market, while other industrial sectors were sitting on the sidelines and withholding surplus allowances from the market. A final issue related to price volatility relates to limits on emissions banking across compliance periods. The first phase of the EU ETS terminates in December 2007 with no banking of allowances into the next phase. Consequently the value of any extra allowance will fall to zero. This "walling off" of the program in Phase 1 created the inevitable price volatility and ultimate collapse in market prices.

A second issue that has sparked debate within the EU ETS relates to the distributional consequences of largely free allocations. As one may expect, the power sector has largely passed on the value of allowances. In the UK, the full pass-through of costs to the power sector has resulted in an increase in annual profits of nearly $1.6 billion, which represents "a direct transfer of value from electricity consumers." An ex-poste study concluded the impact on the electricity generation sector would have remained neutral with only 35% of its initial allocation of 130MtCO2 (IPA, 2005).

Other sectors have found it more difficult to price in the value of allowances. The windfall profits accrued by the power sector in the early years of the program have motivated most Member States to reduce allocations to the power sector in the second compliance period. For example, Spain is granting free allocations to the power sector equivalent to 45% less than what the sector emitted in 2005.

At this stage, the EU program has had just over two years of implementation experience. Consistent with the goals of the learning period, the program is currently going through a planned early review aimed at improvements to and potential expansion of the EU ETS that would go into effect in the third compliance period. The review focuses mainly on the overall program scope, including coverage of sectors and greenhouse gases, the cap level, allowance allocation, and the conditions for linking the EU ETS to other emerging schemes around the world. Thus far, several modifications have been made, including improvements to ensure greater harmonization in monitoring across the EU. In addition, legislation was proposed in late 2006 to extend the EU ETS to the aviation sector.

In view of the tight implementation schedule and the "historical first" the EU ETS presents in European environmental policy, the system's operation represents a success. While there have been some bumps in the system, which should not come as a surprise in view of both the size and novelty of the program, overall, the EU ETS has produced a functioning market system in a short time with very high rates of compliance. The volume of allowances transacted is growing steadily and has reached a level of around 100 million allowances per month in early 2007. Further, there is early evidence that the carbon price has produced behavioral impacts, including a much higher level of boardroom attention.

Lessons Learned

Lessons learned from the EU ETS include:

- To avoid unnecessary price fluctuations in the early years of a trading program and the resulting political uncertainty, for potentially affected sources and sectors that do not already have monitoring, reporting and enforcement infrastructure, sufficient time is needed between adoption of a cap-and-trade program and the start of implementation to develop rules and issue or auction allowances.
- Moreover, to avoid price volatility towards the end of compliance periods, it is desirable retain the value of banked allowances from one compliance period to the next. Absent banking of allowances across compliance periods, the price of allowances will drop towards the end of a compliance period as unused allowances flood the market.
- It is important to have good data as a basis for allocation decisions to avoid over-allocation of allowances and to create the necessary market scarcity. Moreover, it is desirable to avoid over-allocations to particular

companies in order to avoid granting unearned profits above and beyond actual losses incurred as a result of the program.

- A learning phase can be helpful, particularly when there is no experience with emissions trading and when there is less time available between program adoption and implementation, as it provides a framework for making improvements based on actual experience. A learning phase could also be helpful to test out design innovations. Fortunately, in the U.S. and California, there are decades of experience to draw from.
- Under a program involving multiple jurisdictions, it is important to have some consistency in allocations to help avoid competitive distortions.

B.2.2 The Regional Greenhouse Gas Initiative

On December 20, 2005, seven states (Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York and Vermont) announced an agreement to implement the Regional Greenhouse Gas Initiative, or RGGI, as outlined in a Memorandum of Understanding signed by the Governors of the participating states. Several additional states (Maryland, Massachusetts and Rhode Island) have since joined the RGGI. For the program to take effect, each state must pass the same MOU, with the same rules. With a launch date of January 1, 2009, the RGGI promises to be the first mandatory regional cap-and-trade program for CO_2 in the United States and will assist participating states in meeting their statewide and regional GHG emissions targets.

Trading Program Design

The RGGI program is applied downstream at the generator level—the point of power sector emissions. Few additional monitoring costs are imposed on firms because US power plants are already required under the federal Acid Rain Program to report their hourly CO_2 emissions data to EPA every quarter.

The RGGI limits CO_2 emissions for the power sector to current levels in 2009-2014 and calls for a 2.5 percent per year decline thereafter, achieving a cap level of 10 percent below current levels by 2019. This is roughly equivalent to 13 percent below 1990 levels and 35 percent below projected business-as-usual levels.

An innovation of the RGGI program is a decision to require a minimum of 25 percent of allowances to be used for consumer benefits such as spending on energy efficiency. States can choose to freely allocate or auction the remaining 75 percent of allowances. Several states (New York, Massachusetts, Maine and Vermont) have proposed to auction a full 100 percent of allowances. New Jersey calls for auction of "up to 100 percent." A main rationale for choosing an auction was to avoid over-allocation of emissions allowances to covered sectors that would compensate firms for more than the expected loss of shareholder value. Because power generators in deregulated power markets can pass a large portion of compliance costs to their customers, and because some generators may have access to GHG reduction opportunities that cost less than the market price of allowances, free allocation of allowances under a cap and trade program has the potential to compensate shareholders for costs they do not incur, resulting in profits to shareholders.

Another innovation of the RGGI program is use of performance standards for offsets. Whereas the international Kyoto regime has adopted use of the Clean Development Mechanism, a program under which offset projects in developing countries are individually approved, the RGGI offset program establishes detailed standards for a small number of offset categories, reducing the transaction costs. The RGGI program also establishes numerical and geographic limits on offsets so as not to undermine the central goal of reducing emissions from the power sector. These limits expand with certain price triggers.

A final key aspect of the RGGI program design is the adoption of complementary energy policies to ensure net economic benefits. It is anticipated that some of the revenues from auctioned allowances will be used to support energy efficiency, reducing emissions leakage and lowering overall compliance costs.

While the RGGI program is moving forward to implementation, the design is still not complete. Efforts are underway to address concerns about emissions leakage. And following the initial implementation stage, it is anticipated that the RGGI program will expand to include other sectors of the economy.

Program Assessment

The RGGI is not slated for implementation until 2009, so it is too early to assess the outcome. That said, members of the Market Advisory Committee have the following thoughts about the implications of the RGGI program for the design of a cap-and-trade program in California:

- Allocations can lessen the impacts of the pr*ogram. In particular, if auction revenue*s are used to support energy efficiency, the resulting lower power demand reduces the necessary power supply, and makes it easier and less costly to comply with the cap while also reducing the potential for emissions leakage.
- An offset program should be designed carefully to promote integrity of offsets. A standards approach to offsets is a good model that can balance high quality standards with lower transaction costs for a limited number of offset "types" while facilitating timely offset development.
- A regional planning process can result in the development of a cap-and-trade system involving multiple states in addressing GHG emissions.

Appendix D: California Greenhouse Gas Emissions in 2004

TABLE C-1

California Emission Sources (2004 Data)		CO2	CH4	N2O	HGWP	Total	%
Stationary Combustion Total		**224.3**	**1.2**	**0.2**		**225.739**	**45.7%**
Residential		27.9	0.5	0.1		28.4	5.8%
Commercial		12.2	0.1	0.0		12.3	2.5%
Industrial		68.0	0.3	0.1		68.4	13.8%
Electricity Generation		115.9	0.2	0.0		116.2	23.5%
	Electric Generation (In State)	*55.1*	*0.2*	*0.0*		*55.4*	*11.2%*
	Electric Generation (Imports)	*60.8*	*0.0*	*0.0*		*60.8*	*12.3%*
Waste Combustion		0.1		0.0		0.1	0.0%
Non-Specified		0.2	0.0	0.0		0.2	0.0%
Transportation		**187.2**	**0.6**	**12.0**		**199.9**	**40.4%**
On-Road		159.6				159.6	32.3%
Railroad		3.1				3.1	0.6%
Watercraft (Domestic)		0.6				0.6	0.1%
Aircraft (Domestic)		22.5				22.5	4.6%
Other		1.4				1.4	0.3%
Industrial Process and Product Uses		**7.2**		**0.2**	**14.2**	**21.6**	**4.4%**
Cement		6.5				6.5	1.3%
Lime		0.1				0.1	0.0%
Limestone and Dolomite Consumption		0.3				0.3	0.1%
Soda Ash Consumption		0.2				0.2	0.0%
Carbon Dioxide Consumption		0.1				0.1	0.0%
Nitric Acid Production				0.2		0.2	0.0%
ODS Substitutes					12.6	12.6	2.6%
Semiconductor Manufacture					0.6	0.6	0.1%
Electricity Transmission and Distribution					1.0	1.0	0.2%

Fugitive emissions	**0.0**	**1.9**	**0.0**	**0.0**	**1.9**	**0.4%**
Petroleum and natural gas supply systems		1.4			1.4	0.3%
Natural Gas Supply		0.5			0.5	0.1%
Biological/anaerobic	**0.0**	**24.1**	**21.2**	**0.0**	**45.3**	**9.2%**
Landfills (CH4)		8.4			8.4	1.7%
Enteric Fermentation (CH4)		7.2			7.2	1.4%
Manure Mangement (CH4)		6.0	0.9		6.9	1.4%
Flooded Rice Fields (CH4)		0.6			0.6	0.1%
Burning Ag Residue (CH4)		0.1	0.1		0.2	0.0%
Wastewater treatment		1.7	1.1		2.8	0.6%
Agricultural Soil Management			19.2		19.2	3.9%
Total	**418.7**	**27.8**	**33.6**	**14.2**	**494.3**	**100.0%**
Land-Use Change and Forestry	-14.9					
Emissions	6.1					
Sinks	-21.0					
International Bunker Fuels	**26.5**					
Ships (International)	12.8					
Aircraft (International)	13.6					