Design Principles of a Cap and Trade System for Greenhouse Gases

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INTRODUCTION

No environmental challenge is more intertwined with our way of life than global climate change. Fundamentally, processes that produce greenhouse gases sustain our economy. Most of the energy sources we rely upon release substantial amounts of greenhouse gases. Other major sectors of our economy, such as the agricultural and forestry sectors, control the ebb and flow of greenhouse gases into the atmosphere through their ability to store carbon in organic forms.

No environmental challenge, as a consequence, is more difficult to tackle. In considering policy responses to global climate change, the heterogeneity of the causes and the wide range of potential solutions make a source-by-source government proscription a daunting and resource-intensive task. Yet, the problem's pervasiveness also demands a comprehensive response. For example, action aimed solely at the utility sector may prove meaningless in the light of unmitigated expansion of emissions from another sector.

Given this conundrum, many have suggested that California turn to regulatory approaches that provide broad market incentives that will permeate all levels of the economy without requiring any specific actions by any specific emitter. The promise of such market-based approaches is that with the right market signals, the creativity and energy of the economy will help direct emitters to find the most sensible emission reductions. The two main policies that fill this niche are a cap-and-trade permit system and a greenhouse gas tax. While the two approaches have their own benefits and drawbacks, the cap-and-trade approach has demonstrated more momentum in the current policy debates and is increasingly seen as a pragmatic solution to this complex problem.

In particular, the cap-and-trade method, if designed properly, has four attractive characteristics for policy-makers seeking to balance the various competing interests in the global warming debate: (1) it provides certainty of environmental performance; (2) it provides planning certainty for regulated entities; (3) it provides the flexibility needed to allow regulated entities to find the lowest-cost reductions in the economy; and (4) it requires lower costs to administer.

> ***Environmental certainty.*** A tax will only drive investment in emission reductions to the extent to which they are less costly than the tax. The levels of emission reductions are inherently uncertain and completely dependent on the price of the tax. And determining how the economy will respond – how much tax equals how much emission reduction – is seemingly an impossible task. In contrast, the cap-and-trade approach ensures that emissions will be reduced to a certain level – the "cap."

> ***Business certainty***. An oft-heard request from the regulated community is "[g]ive us a date, tell us how much we need to cut, give us the flexibility to meet the goals, and we'll get it done."[1] A cap-and-trade program would provide certainty in its emissions targets and guide businesses in evaluating long-term investments. On the other hand, a tax provides certainty as to the cost of their operations where a cap does not, but that certainty would come at the expense of the certainty of environmental performance. Finally, the

longer any program can be extended into the future, the greater the time horizon for planning.

Flexibility. The marginal cost of reducing greenhouse gases varies widely from source to source and from firm to firm, but a source-specific program would require each source to pay its reduction cost, no matter what the price tag. A properly designed cap-and-trade system, in contrast, would allow each firm to seek out the lowest-cost reductions in the entire system, minimizing the overall cost to the economy while still achieving the targeted reductions.

Administrative ease. In contrast to programs that demand a web of regulations that can require hosts of enforcement agents to administer – a cap-and-trade requires only accurate monitoring of the emissions of the covered entities and that the government verifies that each of the entities possess sufficient allowances to cover their emissions.

The most frequently cited example of a successful implementation of a cap-and-trade program is the Acid Rain program, found in Title IV of the 1990 revisions to the Clean Air Act and designed to control sulfur dioxide emissions. Everything about the program exceeded initial expectations in terms of the market's ability to reduce the cost of the program without sacrificing environmental performance. For example, prior to the enactment of Title IV, the expected market price for SO_2 allowances was in the range of $579-$1,935 per ton of SO_2; frequently costs of credits have fallen well below even the low end of this range and the high end of the range now seems like a doomsday estimate.[2] Additionally, compliance with the program has been similarly stellar. During the life of the program, participating facilities have a near 100% compliance rate.[3] In fact, during the first phase of the program, participating power plants reduced SO_2 emissions 22% - 7.3 million tons - below mandated levels.[4] As of 2004, the program has reduced SO_2 emissions by 40% compared to 1980 levels and 34% compared to 1990 levels.[5]

There are, of course, many subtleties to program design that will dictate whether any cap-and-trade system maximizes the benefits of the approach and best navigates the thicket between the theoretical conception of a system and its legal implementation. While this document will briefly discuss many of the most fundamental program design issues, it does not purport to cover all of those bases – later work from the Nicholas Institute and others shall tackle those questions after more research and analysis. Rather, this document is intended to fulfill the role its title suggests: to propose the basic design principles for any cap-and-trade program for the consideration of California's policy-makers.

The Basics of Cap-and-Trade

"Cap-and-trade" has several commonly understood meanings. In particular, there are two main designs for emissions trading systems, both of which are often called "cap-and-trade." In an effort to distinguish between the two, we will term the first design "baseline-and-credit," and the second design "cap-and-trade."

A baseline-and-credit system identifies a starting level of emissions – or baseline – for each source of targeted emissions, and then requires the sources to hold emissions to some percentage of that baseline. If a source decreases its emissions to a level below its baseline, it receives marketable credits equivalent to its overcompliance; if the source underperforms and fails to meet its target, it is obligated to secure credits equivalent to the shortfall.

An advantage of the baseline-and-credit system is its simplicity. By allowing each entity to establish its own baseline, the system does not have to address directly the politically nettlesome question of how to allocate emissions permits. Existing business interests seeking planning certainty also are often more comfortable with the baseline-and-credit approach because it allows them to work from their individual company's baseline, and it assuages concerns about how reallocation of emissions permits might creep into the political debate. The system, however, tends to favor existing industries over new market entrants since it is, by definition, pegged to the existing emissions profile.

The second design is a true cap-and-trade, where the government defines the regulated sources and the total amount of pollution all sources can emit, the "cap," over a set period of time, usually one year. Typically, the cap is set in mass units (e.g., tons), is lower than historical emissions, and declines over time. The government creates allowances equal to the size of the cap and then distributes them to the regulated sources, a process called "allocation."

Typically, it is the allocation methodology that creates the most political controversy. Because the compliance obligation of any particular company will increase or decrease depending on the amount it is allocated, the political process to determine an allocation methodology invites intense political maneuvering. The creation of such a methodology, however, also creates political opportunity, as its development lends itself to the legislative deal-making necessary to maintain a workable majority. As one veteran of the legislative debate surrounding the acid rain cap-and-trade developed in the 1990 Clean Air Act noted, "the only allocation methodology that mattered was the one that could get 60 votes on the floor of the U.S. Senate."

A second attribute of a true cap-and-trade program is that it is better situated to guarantee environmental performance. Whereas a baseline-and-credit system requires a great deal of data to determine the appropriate baseline, which of course raises the possibility of calculation errors, a cap-and-trade only needs to identify a target cap, without an eye to past emissions.

Finally, some approaches merge the two design formats into a hybrid program. Such approaches usually cap the key sectors of the economy, and then allow non-covered entities to apply a baseline-and-credit approach to create credits that might be used to offset emissions from the capped sectors. The McCain/Lieberman Climate Stewardship Act, a pending bill in the U.S. Senate, uses this approach by creating a cap-and-trade for the covered sectors (utility, industrial, transportation, and commercial) and allowing a baseline-and-credit method to credit reductions made by individual entities in the non-capped agricultural and residential sectors.

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Specific Design Issues

I. Sectors to Cover and Questions of Upstream or Downstream

Painting with a broad brush, there are six main emitting sectors of the Californian economy: utility, transportation, industrial, commercial, agricultural and residential. Determining how much emissions to assign to any one sector is a more complicated question than it first might seem. The primary complicating factor is that often emissions could logically be assigned to more than one sector. The most problematic example of this is that emissions resulting from the generation of electricity could either be assigned to the sector generating the energy (primarily the utility sector) or the sectors consuming the energy. Without distributing emissions resulting from electrical generation, California's greenhouse gas profile has the following attributes: the transportation sector emits 41.2% of the emissions; the industrial sector contributes 22.8%; generation of electricity explains 19.6% of emissions; the agriculture emits roughly 8% of the emissions; and, other sectors share the remaining emissions.[6]

No matter how the emissions are allocated, the strong preference in terms of economic efficiency is for the program to cover as much of the economy as administratively and politically feasible. The larger the market for reductions, the more opportunities for efficiency gains, the more flexibility for the regulated parties, and the greater impact of the program. The degree to which the program covers the economy also determines the strength of the resulting market signal that greenhouse gas reductions are valuable. In addition, the less of the economy that a cap-and-trade program covers, the more likely it is that reductions will be illusory because emissions may shift to the non-covered sectors.

Putting an ideal market program together, however, is difficult in practice: not all emissions are easily monitored; not all sectors are equally suited for an emissions market; and, not all sources are created equally from a political vantage point. Thus, the designers of a cap-and-trade system must seek to balance the desire for the program to cover as much of the economy as possible with the administrative and political limitations of the sectors.

This challenge will inevitably open the related question of the optimal point in the economy to regulate greenhouse gases. This question boils down to whether greenhouse gases should be regulated "upstream" – at the point where fossil fuels and other greenhouse gas emitting agents are produced – or "downstream" – at the point where the gases are emitted into the air.

To generalize, most participants in the debate consider upstream regulation more administratively feasible, given the relatively small number of entities that produce fossil fuels and other greenhouse agents. However, upstream regulation is also seen as politically challenging, given that it will likely result in the internalization of the costs of cap-and-trade allowances in fossil fuel products, such as gasoline and natural gas. In contrast, a downstream system will present more administrative challenges, particularly in the diffuse transportation and residential sectors, but may lack the political challenges that result from the inclusion of allowance costs in consumer prices of fossil fuel products. Many commentators also believe that a downstream system more wisely distributes the regulatory burden, as it arguably puts the reduction obligation at the point where the greatest range of reduction options exists. Additionally, for many, downstream regulation is more intuitively appealing because it continues in the pattern of nearly all previous regulations, placing the obligation at the point of pollution.

The complexity of the decision regarding the optimal point of regulation becomes clearer when specific examples are considered. The simplest pollution source to tackle is the coverage of large point sources of greenhouse gases, such as power plants and manufacturing plants. At such facilities, the fuel input is well-known and easily monitored, which would allow the simple implementation of an upstream cap-and-trade system. At the same time, however, continuous emission monitoring systems could easily record the gases emitted from the smokestacks of these facilities, creating similar ease in monitoring downstream emissions. Finally, due to concerns of "leakage" – that emissions might "leak" outside California's borders where there will be no greenhouse gas limit – regulation could occur at the level of the distribution of electricity by making companies distributing electric load accountable for the greenhouse gases produced in the production of that electricity. For lack of a better word, we will call this approach "midstream."

Policy proposals have taken different approaches to the regulation of large point sources. The recent proposal by the National Commission on Energy Policy placed the obligation upstream. However, the majority of approaches – those proposed in McCain/Lieberman, in the Northeastern States' Regional Greenhouse Gas Initiative, and in Europe – have placed a downstream cap on large point sources. But whatever the final decision, it seems clear that industrial and electric utility sources – which account for slightly more than forty percent of overall California emissions[7] – should be covered in any greenhouse gas cap-and-trade program because they are already regulated, easily monitored, and account for a large share of California's greenhouse gas emissions.

California's largest emitting sector – the transportation sector – is decidedly more difficult to cover in a cap-and-trade program. A purely downstream approach is extremely unlikely: with approximately 30 million personal automobiles registered in California[8] and virtually all emitting greenhouse gases out of their individual tailpipes, it is administratively daunting to incorporate each of these individual sources into a trading system. The political and administrative feasibility of placing regulatory obligations on individual drivers is even worse. Other proposals to hold vehicle manufacturers accountable for the emissions of their products through a cap-and-trade program are extremely difficult to implement, as the manufacturers do not have absolute control over the purchasing decisions of individual car owners. The time lag between implementing a program and the turnover of the fleet of automobiles further complicates this approach.

Thus, the only proposals offered to date that attempt to incorporate the transportation sector into a cap-and-trade system have approached the sector from an upstream perspective. On the federal level, both the National Commission on Energy Policy proposal and the McCain/Lieberman Climate Stewardship Act would hold oil refiners accountable for the greenhouse gas content of their products. The political viability of this approach has yet to be sufficiently tested. However, it should be noted that to neglect the transportation sector also creates its own political difficulties, as the other sectors of the economy will resist taking the lead if the transportation sector is not included in the program. Moreover, given the amount of California's emissions that come from mobile sources, ignoring the transportation sector would leave a huge piece of the problem out of the program.

A substantive critique of these upstream transportation caps stems from the lack of compliance options for the refiners. Apart from the introduction of more renewable fuels, the refiners do not have obvious compliance options, but they do have an unrestrained capability to pass the price of the allowances through to the consumer. Many stakeholders from other sectors believe that this dynamic would result in the upstream transportation entities driving up the price of permits, as they have little incentive or capability to reduce their emissions, causing hardship for all economic actors. To counter this concern, an alternative driver to lowering the emissions of vehicles might be developed to complement a cap-and-trade program. In California, in fact, the Pavley legislation may provide this driver.

Transportation emissions are the largest single source of greenhouse gases in California. In recognition of this, the 2002 session of the legislature passed AB 1493, also known as the Pavley bill, which required the California Air Quality Board to adopt regulations to reduce vehicular greenhouse gas emissions. According to the standards set forth by the Pavley bill, automakers will have until the 2009 model year to produce a new fleet of cars and trucks for California that will collectively emit 22% percent less greenhouse gases by 2012 and 30% less by 2016.

In December, 2004, a conglomeration of automobile manufactures and dealers filed a federal lawsuit that challenges AB 1493. While the Pavley bill is still entangled in litigation, the final rule was promulgated September of this year. If it survives, the legislation will provide a powerful driver to reduce greenhouse gas emissions in the transportation sector. Any potential greenhouse gas cap-and-trade program would have AB 1493 as an overlay. As discussed in this report, California will likely have to rely on programs like those introduced in the Pavley bill, instead of a cap-and-trade, to ensure necessary efficiency gains in the transportation sector.

If the Pavley bill fails in court, it is uncertain what California will do. Given the significant contribution the transportation sector makes to California's total greenhouse gas emissions, it seems prudent to begin developing a specific alternative plan in the event that California suffers a loss in court. In order to achieve meaningful greenhouse gas reductions in the transportation sector, the State needs some mechanism that provides a powerful incentive to curb emissions from motor vehicles.

Efforts to address the agricultural and residential sectors pose difficulties similar to those experienced in the transportation sector. While there has been increasing consolidation of holdings in the agricultural sector, emissions still emanate from a diffuse set of sources that are not easily monitored. Additionally, with political clout strengthened by the stressors on the farm economy in recent years, agricultural interests have also shown the ability to fight off any attempts to expand their regulatory obligations. As for the residential sector, it seems unlikely, both for administrative and political reasons, that the government would want to regulate the emissions from furnaces and water heaters in individual homes. As mentioned previously, an upstream cap on the fossil fuel products used in those homes also would be political nettlesome because it would likely result in increased prices on those products. Thus, in the end, most proposals including the agricultural and residential sectors opt not to cap their emissions, but rather allow reductions within these sectors to offset emissions from capped entities.[9]

II. What Greenhouse Gases Should Be Included?

As originally defined in the Kyoto Protocol, there are six commonly accepted greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFCs), and hydrofluorocarbons (HFCs). Of this mix, CO_2 accounts for approximately 85 percent of California's emissions,[10] and the thrust of a cap-and-trade program should be aimed at those emissions. However, the balance of the emissions budget is derived from the other gases, and some of the lowest cost reductions could be achieved by reducing the emissions of these non-CO_2 gases. This fact is born out in nearly every economic analysis conducted of global warming regulatory approaches, which demonstrate a dramatic cost savings from the more comprehensive approach.[11]

A more comprehensive approach also will avoid the possibility of perverse shifts from emissions from carbon dioxide to unregulated greenhouse gases. For example, increases in natural gas combustion might make perfect sense in a CO_2-only market, but in a system fraught with pipeline leaks it could actually increase the total warming effect of greenhouse gases in the atmosphere. A shift from gasoline to biofuels could result in nitrous oxide emissions that possess a global warming potential far in excess of the averted CO_2 emissions.[12] Such perverse results would be better controlled under a comprehensive cap-and-trade program.

One possible disadvantage to more comprehensive coverage, however, is the monitoring challenges that the non-CO_2 gases might pose. Many of these emissions are more diffuse and difficult to estimate. Calculating methane emissions resulting from decomposition of landfill wastes is much less straight forward than emissions from a coal-burning smoke stack. These concerns could be mitigated by choosing to include only the more certain emissions sources in the program, and by introducing discounting techniques for less certain emissions sources.[13]

More recently, a new concern has arisen. While the state of science is still developing, there is a good body of evidence supporting the net warming impacts of black carbon.[14] Black carbon aerosols in the United States are largely the product of combustion of diesel fuels and the burning of biomass – both practices that also cause dangerous air pollution and adverse health effects. Black carbon aerosols have a direct radiative forcing effect because they scatter and absorb solar and infrared radiation in the atmosphere. These aerosols also alter the formation and precipitation efficiency of liquid water, ice and mixed-phase clouds, thereby causing an indirect radiative-forcing effect associated with these changes in cloud properties.[15]

The large range of uncertainty regarding black carbon's warming effects, however, make it both administratively and politically difficult to incorporate into a cap-and-trade system. In contrast to Kyoto Protocol's basket of gases, black carbon does not have a well-defined global warming potential that allows for an obvious exchange rate for trades between black carbon emissions and other greenhouse gases. The uncertainty also creates apprehension regarding the certainty of environmental performance. If projections of black carbon's significance as a warming agent are revealed to be overstated, to the extent that reductions in the cap-and-trade come from black carbon, the program's progress will be illusory.

Nonetheless, it also is equally problematic to ignore the question of black carbon entirely. With some scientists proposing that black carbon may possess a warming potential greatly in excess of that of carbon dioxide,[16] a lack of black carbon reductions could render ineffective a program based only in the Kyoto gases. Thus, it appears wise to have, at a minimum, some contingent program to incorporate black carbon aerosols into a cap-and-trade.

Two possible design concepts suggest themselves to balance the interests regarding black carbon. First, a cap-and-trade program could be designed to incorporate black carbon reductions if, and only if, the scientific certainty regarding its effect narrows to an acceptable degree. Such an approach would protect the system from illusory reductions, but provide an incentive for investment in the research necessary to narrow the uncertainty and include the black carbon in the market. This approach was chosen in legislation originally proposed by Senators Brownback and Corzine to create a comprehensive, national greenhouse gas emissions database. The language passed the Senate in both 2002 and 2003 as part of an omnibus energy bill, but never was signed into law.

A second design possibility for black carbon would be to include it in the cap-and-trade, but to discount its value in the market in a way that reflects the uncertainty of its global warming effects. The discounting rate can be reduced as the uncertainty decreases. Black carbon reductions therefore will be less likely to swamp the market, given their lower value, and this would provide an incentive for parties to invest in research to narrow the uncertainty.

III. Allocation

Once the decision is made to implement a cap-and-trade program, no question becomes more politically significant than how to distribute the allowances. From the perspective of the overall economy, this decision has little import – the cost of a program is much more correlated to the overall demands of the program than the allocation of the permits. But for the specific entities covered by the program, the allocation methodology is the most important decision, because it will dictate whether they secure a competitive advantage or disadvantage vis-à-vis their competitors.

The first tenet of a successful allocation methodology, however, is the proper definition of the pool of allowances to be allocated. As discussed in further detail below, one of the downfalls of the RECLAIM program is that the South Coast Air Quality Municipal District created an over generous pool of credits.[17] If the pool of permits is not properly restrained, the program will gain neither the environmental performance it desires nor send the proper market signal for change to the regulated entities.

Once the pool of permits is defined, there are many options available to the government for allocation. These options can be broken down into two main categories: (1) free allocation (through devices such as grandfathering or generation performance standards); and (2) government sale of permits (through an auction or participation of a government proxy in the market).

The decision between these two approaches is assured to be controversial. Many regulated entities are extremely resistant to any program that allocates permits through government sale, as they contend that they will pay twice as a result – first by complying and then by purchasing permits. However, research has shown that full free allocation to emitting entities may inure to their benefit, as they receive permits valued at the market's marginal cost of abatement, providing them with a valuable set of assets, while the average cost of their own compliance is somewhat lower. Thus, full free allocation would, on average, become a financial windfall to regulated entities. Moreover, the sale of permits by the government provides a pool of resources that can assist with the economic transition to the global warming program. In the end, policies such as those in Title IV of the Clean Air Act and the McCain/Lieberman legislative proposal created a hybrid of these two approaches, with some percentage allocated for free and some percentage sold by the government. At a minimum, a small percentage of permits are held back to allow for new entrants into the program into covered sectors of the economy. The Northeastern States' Regional Greenhouse Gas Initiative also is considering a hybrid approach.

Once policy-makers decide whether the allocation system will give away or sell permits, an equally contentious question will follow: how to allocate the permits to individual entities. This decision will also create winners and losers. While many allocation methodologies exist, the two most commonly relied upon are grandfathering and generation performance standards. Grandfathering allocates permits to emitters on the basis of their historic emissions, creating an advantage for the biggest emitters of greenhouse gases. This approach is the most intuitive, particularly for those used to a "baseline-and-credit" system, but may create perverse incentives that reward emitting behavior at the expense of efficiency gains. The alternative approach, generation performance standards (GPS), would shift the focus from historic emissions to the efficiency of the source. Thus, for a utility, allocations would occur on the basis of how many kilowatts it contributed to the grid, and efficiency gains that allowed more power per emissions would be rewarded by an increased allocation, rather than punished by a grandfathering model pegged to emissions. The generation performance standard construct, however, is more difficult to apply to other economic sectors, where products are not so easily compared.

If a program approaches cap-and-trade by "allocating to load," or taking the "midstream" approach discussed above, the free allocation debated does not change significantly. The most often proposed allocation methodologies for such a "midstream proposal" parallel the grandfathering/GPS debate. Fundamentally, the free allocation in such a midstream proposal would still be conducted on the basis of the historic carbon footprint of a company's electric supply (a value for which the data may not exist) or on the basis of the amount of electricity that it historically distributes.

For a program that allocates through government sale, the question becomes one of how to allocate the program's benefits. This is by nature a political question, as such a program could generate millions of dollars to assist political constituencies with the transition to greenhouse gas constraints. Oft-proposed targets for distribution include users of electricity and fossil fuels that may experience price increases, disaffected workers, other interests (such as wildlife conservation areas or coastal communities) that would benefit from help adapting to global warming, and programs to encourage the dissemination of technology to regulated entities.

IV. Offsets

Unless the cap-and-trade program is designed to be truly comprehensive, there will be sources of emissions that are not regulated. The program can still create incentives for reductions from those sources if it incorporates provisions to allow emissions from regulated sectors to be offset by reductions in emissions or net increases in sequestration from non-regulated sectors. As noted above, this could be structured by creating a "baseline-and-credit" system for the non-covered entities, the credits from which could offset allowance obligations in the "cap-and-trade" for the covered sectors.

More specifically, offset provisions allow investors – even those not subject to the cap-and-trade – to develop emission reduction credits from projects involving unregulated sources. Once a project investor adequately demonstrates a verifiable reduction, the State could then certify the reduction and award the investor credits, which can be sold to sources regulated by the cap-and-trade program. In other words, the credits are fungible: they can be exchanged with allowances and used for compliance. The purpose of offset provisions is to allow entrepreneurs and technology developers to find innovative, low-cost emission reductions throughout the entire economy. Offsets also provide a political advantage, in that they provide money-making opportunities to parts of the economy that otherwise would have no interest in the program.

Including offsets in a cap-and-trade program leads to several second order issues, including: (1) whether the system should restrict the amount of offsets used to comply with the program; (2) whether the system will issue credits for offsets outside of California; and (3) whether the system will credit carbon sequestration (or "sinks") as offsets.

Answering these questions requires policy-makers to balance the various purposes of the program, which sometimes will conflict with each other. For example, with regard to limiting the amount of offsets allowed in the system, an unlimited use of offsets would ensure that regulated entities were able to secure the lowest cost emissions reductions available. However, unlimited offsets, if too abundant, might destroy the incentive to reduce greenhouse gases within the regulated sector itself. If part of the program's intent was to stimulate technology development within a particular sector, unconstrained offsets might undercut the formation of a market signal sufficient to promote such investment. Offsets are also often gained from sectors that are difficult to monitor effectively, lowering the certainty that the offsets represent real reductions and will gain the results desired.

There are precedents for balancing these considerations. One means of controlling for the need to create technology drivers within a particular sector is to limit the percentage of emissions that can be offset. This strategy provides some flexibility in the form of offsets but still creates a system in which entities in the covered sectors foresee the need to make on-site reductions and invest in new technologies. This approach also minimizes the damage to the system's integrity if some of the offsets are illusory. Such a system was incorporated into the McCain/Lieberman proposal, in which covered entities were allowed to offset up to 15 percent of their total emissions.

For the question of extrajursidictional offsets, the inquiry again must start with the program's purposes. If the purpose of the program is to drive change in California, then the crediting of extrajurisdictional offsets might undercut that goal. In addition, to the degree that offsets are used as a sweetener to the political mixture which provides sufficient political support to create such a program, then to allow these sweeteners to leave California also may be counterproductive to the political success of the program. These interests must be weighed against the economic efficiency of allowing covered entities to search for the lowest-cost offsets available. Given the potential size of a California offset market, and the possible limitation of the offset market, it seems likely that a California-only offset market would be sufficiently liquid and robust to provide low-cost offsets to covered entities.

Finally, the question of offsets from sinks also requires a similar balancing of considerations that tilt in favor of their inclusion. Depending on the biological system, the certainty regarding the results of carbon sequestration efforts can vary widely. Forested ecosystems, for example, pose far fewer challenges in calculating sequestered tons of greenhouse gases than most agricultural ecosystems. In addition, all sequestered greenhouse gases, by definition, may potentially be re-released in the atmosphere, which creates concerns about the permanence of such offsets. The inclusion of sequestration offsets, however, provides a much greater pool of low-cost offsets and would maximize the economic efficiency of the system. Sequestration offsets also expand political participation in the cap-and-trade system and may provide substantial co-benefits through increased conservation and sustainable land management.

Thus, if California wanted to gain the benefits of sequestration offsets but control for concerns about uncertainty and permanence, it would simply need to apply some accounting principles to the management of the sequestration offset market. With regard to uncertainty, the value of the offsets could be discounted for the uncertainty of the desired results, so that, on the statistical average, the sequestration offsets could reflect the certainty of physical sequestration. This effort would also create an incentive for investment in scientific research to narrow the uncertainties, which would in turn increase the offsets' values. With regard to questions of permanence, there simply needs to be an accounting of the claimed sequestered tons and their actual existence, with an obligation of an entity to pay back claimed offsets with emissions allowances should the sequestered tons no longer exist. Finally, as was noted above, the program can control these risks by a simple limitation on the amount of sequestration offsets allowed into the system.

V. Leakage

In considering the design of a greenhouse cap-and-trade system, California is well aware that the program might suffer from leakage problems, meaning that reductions in California may lead to increases of emissions elsewhere. A leaky system relocates emissions rather than reduces them. For example, consider the utility sector, which is of primary concern when attempting to reduce greenhouse gases but is also prone to leakage. California's electrical grid extends well beyond the State's boundaries. When designing a program to reduce emissions in California's energy sector, a primary concern should be assuring that reductions within California do not merely cause generation facilities elsewhere to produce more energy, and hence more emissions, in their efforts to service the California market.

The chief proposal to address this concern is to place the reduction obligations, and hence provide the allocations, to the load-serving entities (the "midstream" proposal outlined above). In other words, the program would require electricity providers to be accountable for the greenhouse gas footprint of their electricity, regardless if such energy is generated in California or not. California has already noted that there are a number of practical questions with this approach, particularly with regard to monitoring and enforcement of the system. This document will not explore these issues beyond observing that the existing infrastructure is unlikely to allow for such a system.

Assuming that a new infrastructure could be built efficiently, the Constitution imposes additional challenges in the way that it limits states' jurisdiction to regulate commerce. While this analysis does not claim to serve as a dispositive analysis of the legal questions involved, we merely point out that California will have to confront these possible constitutional pitfalls.[18]

The most substantial constitutional barrier arises out of "the dormant Commerce Clause."[19] Article I, Section 8 of the U.S. Constitution explicitly grants the Congress the power to regulate commerce. The judiciary has interpreted this grant of power to mean two things: (1) Congress can regulate commerce and (2) by inference, states are generally prohibited from regulating interstate commerce in a way that unevenly burdens interstate commerce. This second limitation is known as the dormant Commerce Clause. While the dormant Commerce Clause does not impose an absolute ban on states attempting to control commerce beyond their borders, it creates real restraints on state actions that affect other jurisdictions.

To analyze the legality of an action under the dormant Commerce Clause, the federal courts perform a two-stage analysis. First, the court determines whether the state action is "evenhanded," "with only 'incidental' effects on interstate commerce," or whether it provides "differential treatment of in-state and out-of-state economic interests that benefits the former and burdens the latter." If a restriction on commerce is found to be discriminatory, it is "virtually per se invalid." In evaluating whether a state law is discriminatory, the courts will look to both the text of the law and the law's purpose and effect. Regulations that are found to be "evenhanded" are valid unless "the burden imposed on such commerce is clearly excessive in relation to the putative local benefits."[20]

As a result, if California chooses to address the leakage question with allocation to load-serving-entities, it must, in the first instance, ensure that the program does not contain any differential treatment for power generated out of the State versus within California's boundaries. If such neutrality is retained, California should document the local benefits, including limiting leakage and reducing the administrative burden that comes from allocating to load-serving-entities to justify the approach in the face of the burden on commerce. By documenting how including out-of-state companies in the cap-and-trade program help minimize leakage and make the program much easier to administer will allow California to counter the argument that its allocation technique is nothing more than an economic protectionist measure.[21]

VI. Cost Control

Many participants in the climate change debate contend that, because of the uncertainties involved in the implementation of a climate change program, a cap-and-trade should incorporate devices to constrain potential costs of the program. The two leading devices to secure such certainty are a "safety valve" and a "circuit breaker." A safety valve allows covered entities to avoid the need to secure an emissions allowance once the price for such allowances exceeded a certain price, by setting a price ceiling for emissions allowances. On the other hand, a circuit breaker creates a constantly declining emissions cap, but freezes the cap's decline if the allowance price exceeds a set price. With the circuit breaker, there is no guarantee that the price of an allowance will not continue to rise, but the circuit breaker ensures that the supply of allowances will not continue to shrink.

No topic has engendered more debate at the national level than the safety valve. Proponents of the measure argue that the cost certainty offered by the device is necessary to overcome opposition to a cap-and-trade program. A safety valve would also guarantee a minimum market signal for the development of technology, equivalent to the safety valve price.

Others stakeholders, however, vehemently oppose the use of a safety valve because it would allow the emissions cap to be exceeded to an unlimited degree, eliminating the program's environmental certainty. The device also might discourage investment in some technologies that are only seen to be justified on the basis of an allowance price higher than the safety valve. Risk-averse managers in particular may find it more desirable to cost out the sure price of the safety valve rather than speculate on the cost of emissions reductions. Finally, some commentators have pointed out that the safety valve does not truly avoid an emissions reduction; rather, given the lifespan of greenhouse gases in the atmosphere, the emissions released as a result of the safety valve will only have to be offset by additional emissions reductions sometime in the future. Thus, the safety valve would force the emitter to pay a safety valve fee today, and still require future payments for the emissions reduction to compensate the use of the safety valve.

A cap-and-trade market therefore would operate much more effectively, both in terms of its environmental performance and its economic efficiency, if a safety valve was not included. It is much preferable to set the emissions target at a level that does not create fear of exorbitant allowance prices. Moreover, to mollify cost concerns, a more robust use of an offset market seems to be a more attractive alternative to the safety valve.

A circuit breaker does not create the same impassioned debate as the safety valve because it would not allow the cap to be exceeded. If a constantly declining cap was included in the program, it seems reasonable to include a circuit breaker in order to ensure that the pace of the cap's decline does not greatly outpace the development of technology and other solutions. There is no indication at this point, however, that a constantly declining cap is something that California will likely pursue.

VII. Banking/Borrowing

Banking and borrowing are devices to allow temporal flexibility of a cap-and-trade program. "Banking" allows entities to opt to reduce their emissions beyond the amount of allowances that they hold, and "bank" the remainder for use in future years. "Borrowing" allows entities to emit more greenhouse gases than held allowances and "borrow" from future years' emissions.

There seems no reason not to allow banking in a cap-and-trade system. By incorporating banking, the system creates an incentive for early over compliance – and hence greater reductions than required by the cap. In addition, the ability of entities to build a bank of allowances provides covered entities the opportunity to build a buffer against shocks to the market. As noted elsewhere, this was a key design flaw in the RECLAIM program, which did not include a significant banking provision, and therefore did not create the buffers against the shocks of the 2001 energy crisis.[22]

Borrowing creates more apprehension as a concept, as it allows an increase in emissions in excess to the cap, but those concerns can be addressed with the application of commonly accepted accounting principles and monitoring. In particular, allowances "borrowed" from future years could be required to be paid back with interest, so that the reduction in emissions in the future would be sufficient to offset the early emissions increase. Careful accounting could ensure that the reductions "borrowed" from the future truly become a reality. Despite the concerns, allowing limited borrowing would be a useful addition to the system. It helps respond to concerns that technology change may not happen quickly enough to meet reduction needs, particularly because of limitations in labor or materials. Borrowing would allow a smoother transition in energy infrastructure by allowing some flexibility in the event that technological advances are lagging behind the required reductions.

VIII. Controlling for "Hot Spots"

One common and serious concern raised over cap-and-trade programs is the degree to which such programs could result in the development in localized hot spots. The rationale behind such these concerns is that, in the drive to find least cost reductions, the cap-and-trade program may result in an uneven distribution of reductions or, even worse, that particular sources will raise their emissions as a result of a program.

In examining these concerns, one advantage possessed by a cap-and-trade proposal for greenhouse gases, in contrast to cap-and-trade proposals for other pollutants, is that greenhouse gases for all intents and purposes do not create localized effects. This contrasts significantly to other proposals — for example, the Bush Administration's recent proposal to create a cap-and-trade for mercury or the RECLAIM program's trading of SOx and NOx. To some degree, therefore, greenhouse gases are the poster children for a cap-and-trade system.[23]

In fact, it is most likely that the adoption of a cap-and-trade program for greenhouse gases will result in positive co-benefits for other pollutants, rather than the reverse. A cap-and-trade would drive capped entities to adopt more efficient processes and cleaner technologies, both of which would result in the reduction in the emissions of other air pollutants.

However, there exists a second order concern that a greenhouse gas trading system may result in increases in other pollutants that often are emitted along with the greenhouse gases. While the ubiquitous nature of greenhouse gases is generally a major problem when attempting to reduce them, this property ends up acting as a helpful deterrent to the formation of localized hot spots of gases associated with releases of greenhouse gases. With many emissions, a cap-and-trade program would run the risk that covered entities would merely switch fuels or alter their processes to control for a particular emission. However, because greenhouse gases are found in nearly every stream of emissions, it is much more likely that the adoption of a cap-and-trade program for greenhouse gases will result in positive co-benefits for other pollutants, rather than the reverse. Such a cap-and-trade would drive capped entities to adopt more efficient processes and cleaner technologies, both of which would result in the reduction in the emissions of other air pollutants.

Additionally, without dismissing the possibility that a cap-trade system may result in localized increases in some of these associated pollutants, it is important to remember that a greenhouse gas trading system will not supplant current air quality regulations but rather supplement them. Importantly, to the extent that facilities emit pollutants prone to localized effects along with greenhouse gases are included in the trading system, such facilities will still need to comply with pollution limitations set forth in the Clean Air Act, its implementing regulations, and each facility's operating permit. Currently, many regulated entities emit the pollutants allowed for under the law. As a result, it is even less likely that a greenhouse cap-and-trade will exacerbate existing hot spot problems. Under a greenhouse cap-and-trade, only those facilities that currently emit the lowest concentrations of regulated pollutants would be legally able to increase emissions of them, and they would only do so if it were to their benefit under a greenhouse gas trading program. Further, those with regulated pollutants would have additional incentives to lower their emissions from existing programs.

In California, there are several laws that require public disclosure relevant to hot spot formation. Specifically, the Air Toxic "Hot Spots" Information and Assessment Act of 1987 (A.B. 2588), Health & Saf. Code § 44300, et seq., requires industrial facilities to prepare a health risk assessment that analyzes and discloses risks created by its emissions. Additionally, for toxic emissions the federal Emergency Planning & Community Right to Know Act (EPCRA), 42 U.S.C. 11001 et seq., requires industrial facilities to report to the EPA on an annual basis any releases of hazardous chemicals, including air emissions. EPCRA's disclosure requirement is supplemented in California by Proposition 65, which requires businesses to provide disclosure of any business-caused exposure, either by use or release, of any substance listed by the State as a substance known to cause cancer or reproduction toxicity. These disclosure laws will assist the State in monitoring the formation of hot spots.

Finally, while it is unlikely that hot spots will form due to a greenhouse gas trading program, policy-makers may still wish to incorporate anti-backsliding provision into the program. This would make it impermissible to make emission trades that would result in a "backsliding" in localized air quality. Such a provision would slightly increase the transaction cost of the trading system, because any trade would require a showing of compliance with the anti-backsliding provision, but this should not be overly burdensome.

In sum, due to the promise of substantial co-benefits of a greenhouse cap-and-trade, a careful analysis of a cap-and-trade proposal could lead those concerned about hot spots to support such a proposal, as it could be seen as an opportunity to achieve forward progress on already existing pollution problems. If this in not persuasive in the end, however, there are policy mechanisms such as the aforementioned "anti-backsliding" language that could control for hot spot concerns.

RECLAIM

In 1993, the South Coast Air Quality Management District (SCAQMD) adopted the Regional Clean Air Incentives Market (RECLAIM) program. The program created a cap-and-trade emissions trading program for industrial facilities emitting nitrogen oxides (NOx) and sulfur oxides (SOx) in the District's air shed. In adopting RECLAIM, SCAQMD hoped to improve the region's air quality without imposing unnecessary costs on industry.

In the academic literature, as well as the political debate, there has been a great deal of criticism of RECLAIM. At this point, there is little doubt that RECLAIM has its problems. The quandary, however, is what the RECLAIM experience can teach us that will help improve other cap-and-trade programs. The criticisms of RECLAIM, putting aside their validity, are useful in flagging important issues for policy makers creating any cap-and-trade emissions program. After each criticism, this section highlights what can be learned from the criticism of RECLAIM.

(1) CRITICISM: In RECLAIM initial permit allocations assumed much greater emissions reduction than were actually occurring. As a result, no real reductions were obtained, only "paper reductions."

LESSON LEARNED: Market details deserve careful attention so that permit allocation reflects reality and leads to real reductions and adequate price signals.

(2) CRITICISM: RECLAIM allowed industry to game the system through various overestimates an underestimates. To a large extent, this criticism focuses on the Rule 1610 "Car Scrapping" Program, which allowed stationary sources to obtain pollution credits by purchasing and dismantling older cars.

LESSONS LEARNED: Cap-and-trade programs need adequate compliance and monitoring provisions. Such provisions increase the public transparency of the market and allow policy-makers to understand the market, which means that improvements can be made where problems have emerged.

(3) CRITICISM: RECLAIM resulted in the development of localized pollution hot spots.

LESSONS LEARNED: Cap-and-trade programs are particularly difficult to build around toxic air pollutants. Additionally, when regulating non-toxic emissions, such as greenhouse gases, a focus of the program can be the potential of a program to reduce existing emissions of pollutants that currently may contribute to hot spot formation. To the extent that hot spot formation is a concern, policy-makers may want to consider an anti-backsliding provision.

(4) CRITICISM: RECLAIM has proven slow in providing an incentive to invest in new technologies.

LESSONS LEARNED: Promoting investment in innovation and emission control technology is key. It seems very likely that this did not occur because RECLAIM failed to initially send the proper price signals due to its overgenerous initial allocation.

(5) CRITICISM: RECLAIM failed when the price spikes associated with the 2001 energy crisis hit.

LESSONS LEARNED: This criticism highlights the importance of building buffers to shocks to the cap-and-trade system. The most promising way to do this is though the allowance and promotion of banking, something RECLAIM failed to do. Adding additional flexibility into the program, for example through the inclusions of offsets, would also help.

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ENDNOTES

[1] John Carey, "Global Warming," Business Week (Aug. 16, 2004) (quoting Wayne Brunetti, CEO of Xcel Energy).

[2] Richard A, Kerr, "Acid Rain Control: Success on the Cheap," Science (Nov. 6, 1998); U.S. General Accounting Office, *Allowance Trading Offers an Opportunity to Reduce Emissions at Less Cost*, GAO/RECD-95-30, (Dec. 1994).

[3] U.S. Environmental Protection Agency, *Acid Rain Program 2003 Progress Report*, EPA 430-R-04-009 (Sept. 2004) (reporting that in 2003 only one unit out of 3,497 was out of compliance); U.S. Environmental Protection Agency, *Acid Rain Program 2004 Progress Report*, EPA 430-R-05-012 (Sept. 2004) (reporting that in 2004 only four units out of 3.391 were out of compliance).

[4] Environmental Defense, *From Obstacle to Opportunity: How Acid Raid Emissions Trading Is Delivering Cleaner Air* (Sept. 2000).

[5] U.S. Environmental Protection Agency, *Acid Rain Program 2004 Progress Report*, EPA 430-R-05-012 (Sept. 2004).

[6] California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks*: *1990 to 2002 Update*, Pub. CEC-600-2005-025, p.7 (June 2005).

[7] California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2002 Update* at 7 (2005).

[8] Federal Highway Administration, *Highway Statistics 2003*, table MV-1 (2004) available at **http://www.fhwa.dot.gov/policy/ohim/hs03/mv.htm**.

[9] The creation of such "offsets" is discussed below.

[10] California Energy Commission, *Inventory of California Greenhouse Gas Emissions and Sinks*: *1990 to 2002 Update* at 5 (2005).

[11] R.C. Hyman, *et al.*, "Modeling Non-CO2 Greenhouse Gas Abatement," 8(3) *Environmental Modeling and Assessment* 175-186 (Sept. 2003).

[12] Richard B. Stewart & Jonathan B. Wiener, *Reconstructing Climate Policy* (2003).

[13] *Ibid*. This issue is discussed in further detail in the "offset" section below.

[14] William L. Chameides & Michael Bergin, "Soot Takes Center Stage: Climate Change and Black Carbon," 297 Science, vol. 297 at 1 (Sept. 27, 2002).

[15] Makiko Sato, et al., "Global Atmospheric Black Carbon Inferred from AERONET," 100 *Proceedings of the National Academy of Sciences* 6319-6324 (May 13, 2003).

[16] *See* Jacobson, 2005a. Jacobson, M.Z., "Updates to 'Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming'", *Journal of Geophysical Research Atmospheres*, February 15, 2005; Jacobson, 2002. Jacobson, M.Z., "Control of fossil-fuel particulate black carbon and organic matter, possibly the most effective method of slowing global warming", *Journal of Geophysical Physical Research*, volume 107, No. D19, 4410, 2002.

[17] See Alexander E. Farrell1 and Lester B. Lave, "Emission Trading and Public Health," 25 Annual Rev. Public Health 119 (2004) ("When RECLAIM was first implemented in 1994, the cap was generous, allowing for an increase in emissions over historical levels for many sources; however, the caps declined steadily each year, aiming at an overall reduction of about 75% by 2003."); Richard Toshiyuki Drury, Michael E. Belliveau, J. Scott Kuhn, and Shipra Bansa, "Pollution Trading and Environmental Injustice: Los Angeles' Failed Experiment in Air Quality Policy, 9 Duke Env L & Pol'y F 231 (1999) ("By inflating the initial allocation of credits, pollution trading programs like RECLAIM tend to reward the worst polluters. Rather than allocate emissions credits based on current actual emissions levels, SCAQMD allocated its initial round of credits based on historic emissions levels. SCAQMD allowed polluters to base their credit allocation on the highest year of emissions out of the last five years, because industry successfully argued that emissions should not be capped at current levels due to an economic recession that affected California before the RECLAIM program's adoption.")

[18] A presentation on this issue for the IPER working group, noted that the Supreme Court has even referred to this jurisprudence as "cloudy waters," "tangled underbrush," a "quagmire," "hopelessly confused," and "virtually unworkable in application." Johnathan Blees, "Overview of Constitutional Limitations on Out-of-State Procurement Rules," presentation to IEPR Committee Workshop on Clean Coal Technology and Electricity Imports (Aug. 18, 2005) found at **http://www.energy.ca.gov/2005_energypolicy/documents/2005_index.html#0817+1805**.

[19] A second, and admittedly less substantial constitutional barrier, is found in the Constitution's Compact Clause. The Compact Clause, Article I, Section 10, prohibits a state from entering into agreements with another state or a foreign government without the consent of Congress. This doctrine would become a barrier in the case that California attempts to rely on binding agreements with other states to address leakage issues. For example, an agreement between states regarding how leakage issues should be addressed could not take effect without Congress's permission. While it is uncertain whether or not California would desire to use this tool to address leakage, it should be noted that at least certain members of Congress have already expressed hostility to idea of approving state compacts that are designed to address climate change.

[20] *Oregon Waste Systems, Inc., v. Dep't of Envtl. Q. of State of Oregon*, 511 U.S. 93, 99 (1994) (citations omitted). *See also, Hunt v. Washington State Apple Advertising Comm.*, 432 U.S. 333 (1997); *C&A Carbon, Inc. v. Clarkstown*, 511 U.S. 383 (1994); *Philadelphia v. New Jersey*, 437 U.S. 617 (1978); *Dean Milk Co. v. Madison*, 340 U.S. 349 (1951).

[21] The Nicholas Institute will likely provide further research and analysis of this question by this Spring.

[22] A. Denny Ellerman, Emissions Trading in the U.S.: Experience, Lessons, and Considerations for Greenhouse Gases (2003) at 27 ("The ability to bank allowances, a tool that was largely unavailable under RECLAIM, is one potentially important tool for managing price volatility.") available at **http://www.pewclimate.org/docUploads/emissions%5Ftrading%2Epdf**.

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