Allocating Emissions Allowances
Under California's Cap-and-Trade Program

Recommendations to the California Air Resources Board

From the California Economic and Allocation Advisory Committee

Draft November 16, 2009

1 Introduction

1.1 Climate Change, AB 32 and Cap and Trade

California's diverse population, geography, and economy will experience diverse impacts of climate change. These impacts include more, longer, and hotter heat waves, less water storage in snow pack and more-frequent droughts, increasing difficulty in achieving air pollution reductions, and increases in sea level and coastal erosion.

Spurred by the threats to the economy, public health, and environment, as well as opportunities that come from early efforts to address a global problem, California has made strong commitments to reduce the global warming pollution that is causing climate change. One milestone has been the enactment of the California Global Warming Solutions Act of 2006, also known as AB 32. The Act set a binding emissions target of 1990 levels by 2020. It also authorized the Air Resources Board (ARB) to determine what policies would be enacted to achieve that target, and to publish a Scoping Plan detailing those policies. ARB approved the Scoping Plan in December 2008, identifying 39 measures.

Among the policies in the Scoping Plan is a cap-and-trade program, a program that engages market forces to achieve desired emissions reductions. There are three key components of cap and trade.

First, the regulatory authority specifies the total quantity of allowances to be distributed in given periods to participants in the program. Each allowance entitles the holder to a certain quantity of emissions of a given pollutant. In the case of a climate policy cap-and-trade program, an allowance entitles the holder to a certain quantity (usually metric ton) of greenhouse gases in carbon dioxide equivalents[1] (CO_2e). The number of issued allowances can decline over time; in this case overall emissions decline through time as well. When implemented, California's cap-and-trade program would cover about 85% of the state's emissions.

Second, the regulatory authority needs to distribute (put into circulation) the emissions allowances. The allowances can be given out through free allocation, through an auction, or through some combination of the two.

[1] Some GHGs have a greater climate effect than carbon dioxide (CO_2); for example, methane is about 25 times as potent (Intergovernmental Panel on Climate Change Fourth Assessment Report, 2007, Working Group I Report, p. 212). To treat emissions uniformly, GHGs are referenced to their carbon dioxide equivalent, CO_2e.

The third key component is the provision for trading of allowances. The ability to trade allowances lies behind cap and trade's potential to achieve emissions reductions at low cost to the overall economy. Emitters will generally consider their costs of reducing emissions to the level required by their current holdings of allowances, and compare this with the market price of allowances. For emitters with especially high costs of emissions reductions, the market price will be less than this abatement cost. In this case, the emitter will benefit by purchasing additional allowances instead of than taking on additional abatement cost. For emitters with especially low abatement costs, the market price will be greater than this cost. In this case, emitter benefits by selling some of its allowances; although this obliges the emitter to reduce emissions even further, the proceeds from the sale will more than offset the additional abatement costs. The trading of allowances thus results in more of the emissions-reduction being undertaken by facilities that can do it most cheaply. Buyers and sellers both benefit, yet the trading leads to no change in overall emissions: the number of allowances in circulation hasn't changed.

The Scoping Plan calls for linkages between California's cap-and-trade program, and the cap-and-trade programs of other jurisdictions participating in the Western Climate Initiative (WCI). The WCI is a collaboration of seven US states (including California) and four Canadian provinces to reduce greenhouse gas emissions.[2] The Partner jurisdictions' design for a cap-and-trade program allows the jurisdictions that implement it to link, forming a regional program. Linkage means reciprocal agreements to accept allowances issued by another jurisdiction for compliance in one's own. Linkage can reduce the overall cost of meeting an emissions target by increasing the breadth of reduction opportunities available.

A cap-and-trade program complements the other measures, and a firm cap acts as a backstop to help the state meet its 2020 target. It is also a policy that could be extended to help the state meet its long-term goal of emissions 80% below 1990 levels by 2050.

1.2 Significance of Allowance Allocation

The more allowances that a given facility owns, the less it must reduce emissions to be in compliance with the program. Firms generally may be willing to pay a significant amount to lessen the extent to which they must reduce emissions,[3] particularly if the cap-and-trade program calls for significant overall reductions. Thus the market price of allowances can be significant, as well as the total allowance value (the market price times the quantity of allowances in circulation). As discussed later in this report, the total allowance value under California's cap-and-trade program is likely to be several billions of dollars in each year of the program.

The ARB must make critical decisions affecting the allocation of this value. As mentioned, it can initially distribute this value through free allocation, auctioning, or both. To the extent that it employs free allocation, then the number of allowances given freely to different parties constitutes the

[2] The WCI's U.S. member states are Arizona, California, Montana, New Mexico, Oregon, Utah and Washington. The participating Canadian provinces are British Columbia, Manitoba, Ontario, and Quebec.

[3] Note, however, that firms' purchases of emissions allowances do not alter the total amount of allowances in circulation (which is determined by the regulatory authority), and thus do not affect total emissions.

allocation of allowance value. It may be noted the provision of free allowances need not apply solely to the emitters covered under a cap-and-trade program. Other parties (for example, groups of consumers) could receive free allowances and then sell them to the emitters that must submit allowances. Thus, emitters are not the only parties that would benefit from the receipt of free allowances.

To the extent that the ARB introduces allowances through an auction, the allocation of allowance value will depend on how the proceeds from the auction are distributed. Auction revenue could be used for a variety of purposes: compensating various parties impacted by AB 32, offering "dividends" to consumers, financing various investments or other public expenditures, and financing reductions in California taxes.

Thus, the ARB's allocation of allowance value will reflect the relative reliance on free allocation and auctioning and the distribution of free allowances and auction proceeds to various parties.

1.3 Establishment and Role of the Economic and Allocation Advisory Committee

The Economic and Allocation Advisory Committee (EAAC) was established May 22, 2009 by the ARB and the California Environmental Protection Agency. As the Committee's name suggests, the EAAC has two main roles – providing input on the evaluation of economic impacts of AB 32, and offering recommendations regarding the allocation of allowance value. These two roles are in keeping with the ARB's resolution in its Scoping Plan, which committed the ARB to solicit "input from experts to advise ARB on its continuing evaluation of the economic effects of implementing AB 32, including identification of additional models or other ongoing analysis tools that could be used in the ongoing economic analysis," as well as to solicit "expert input on key questions related to the distribution or auction of allowances and the use of revenue."

1.4 This Report

This report documents the EAAC's work relating to its allocation role. It articulates the Committee's findings as to the nature of the various options for distributing allowance value. It also presents the potential attractions and limitations of each option, and offers the Committee's recommendations as to which set of options seems best for California.

In arriving at recommendations, the Committee employed four criteria for choosing among allocation options: fairness, cost-effectiveness, environmental effectiveness, and simplicity. These four criteria encapsulate requirements throughout AB 32 to, for example, "minimize costs and maximize the total benefits to California," "consider…localized impacts in communities already adversely impacted by air pollution," and "minimize the administrative burden of implementing and complying with these regulations."

Comment [LG1]: Let's expand this to show how various objectives stated in AB 32 relate to the four criteria.

2. Mechanisms for Allowance Distribution

2.1 The Main Alternatives: Free Allocation vs. Auctioning of Allowances

In designing a cap-and-trade system, policy makers need to make important decisions about how to distribute emissions allowances. Perhaps the most fundamental is whether to give allowances away for free or sell them via an auction. The two alternatives are not mutually exclusive. Some allowances can be freely allocated, and the rest auctioned. Also, the split between free allocation and auctioning can change over time.

Both free allocation and auctioning provide allowance value to various entities. Free allocation offers this value directly to the recipients. Auctioning is an alternative conduit for allowance value, as the proceeds from an allowance auction can be recycled to various industrial or commercial entities, to households, or to the public Treasury.

This section discusses free allocation and auctioning as mechanisms for allowance distribution. It describes basic rationales for each of the approaches, indicates specific forms that each of these approaches can take, and discusses some potential advantages and drawbacks of each approach.

2.1.1 Distribution Mechanisms and the Ultimate Receipt of Allowance Value

Free allocation is often viewed as a mechanism for distributing allowance value to regulated entities -- the parties required to submit allowances. However, free allocation also can be employed to provide allowance value to other parties; these parties can subsequently convert this allowance value into cash by selling the allowances to the regulated entities. For example, in a cap-and-trade system in which the regulated entities include electricity generators and refiners, allowance value could be offered to industrial users of electricity and refined fuels in the form of free allowances that subsequently can be sold.

In principle, nearly all entities that could obtain allowance value as proceeds from an allowance auction could also obtain such value by receiving free allowances. Under each of these distribution mechanisms, allowance value can be conferred to serve a number of purposes. These include providing compensation to firms, consumers, or workers for potential adverse impacts of AB 32, offering income or "dividends" on a per-capita basis to all consumers, financing reductions in existing state taxes, and funding various investments (including investments in new technologies, job training,

and environmental remediation). We examine these alternative potential uses of allowance value in chapters 4 and 5.

Thus, both free allocation and auctioning are mechanisms for distributing allowance value to almost any potential recipient. However, awarding allowance value to certain parties might be simpler, or face fewer institutional challenges, under one mechanism than under the other. Also, the choice between the two approaches can have implications for the overall economic cost of the cap-and-trade program, and in some circumstances can influence the extent to which the program achieves its environmental goals. In the sections below we examine these issues.

2.1.2 Some General Considerations

The choice of policy design is not simply the choice between a system with 100 percent auctioning or 100 percent free allocation. Hybrid approaches are also possible, with some portion of allowances being given for free and some auctioned, and that ratio may shift over time. For example, it may be desirable to use free allowances to ease the transition for regulated entities or consumers in the early years of the program (especially those facing international competition and leakage), but to shift to a larger portion auctioned over time as greater parity in requirements among competing firms develops. Such an approach would be similar to those outlined in recent federal cap-and-trade proposals.[4]

Among the many considerations we describe below, another is how the program would interact with a national program. The pending Waxman-Markey legislation (HR 2454) calls for the development of regulations that allow for the exchange of allowances issued before 2012 under a California program, valued at the average auction price for emissions allowances issued in the year it was issued. The logic for this exchange is to provide early reduction credits and also to protect entities that had purchased allowances in non-federal programs. However, if those allowances were received for free it seems less likely that the implementing regulations would allow for the exchange of value.

Comment [LG2]: Dallas B. comment: We need more on interaction with regional/federal programs in an appropriate location (not necessarily here) in the report. Issues include: CA offering as a precedent (along with RGGI) to influence other program designs. Would one make the same choice for a CA design as for a national design? Discuss provisions under federal proposals that (a) preempt state programs and also (b) allow states to require supplemental retirements of federal allowances (greater that 1:1) in their states.>

2.2 Rationales for Free Allocation and Auctioning

2.2.1 Rationales for Free Allocation

Many view free allocation as a particularly expedient way to provide compensation to regulated entities. The compensation comes in the form of (valuable) free allowances. In contrast, when all allowances are auctioned, providing compensation to regulated entities involves both an auction and a subsequent recycling of auction revenue to these entities. Because the process involves two steps, regulated entities might feel that obtaining allowance value through recycling of auction revenue carries greater risk than obtaining such value in one step through receipt of free allowances. For firms with limited cash reserves or with limited ability to borrow in order to finance the purchase of auctioned allowances, receiving allowances free will be much more attractive than receiving proceeds

[4] *See* "The American Clean Energy & Security Act" (H.R. 2454, or "ACES") (2009); and "Clean Energy Jobs and American Power Act" (S. 1733) (2009).

from an auction after having had to purchase allowances. However, while free allocation might be relatively expedient when used to confer allowance value to regulated entities, it may be more cumbersome when used to provide allowance value to other entities. For example, when free allocation is used to grant allowance value to non-compliance entities such as local governments, community based organizations or directly to individuals, there is an added transaction cost imposed on these parties (relative to the case where the parties receive auction proceeds) since have to sell the allowances back into the market.

Free allocation has another potential attraction as a device for offering compensation. The value of allowances given for free would adjust automatically when prices change, but an allocation of allowance value that is a fixed sum would not. If the purpose of allocation is to compensate impacted parties for their increased costs of compliance, a fluctuating allocation value might be an advantage because the level of compensation would automatically adjust to changes in the harm. However, changes in the value might be a disadvantage if the goal is to fund purposes not directly linked to the cost of compliance, such as investments in research and development because it would imply fluctuations in the level of funding for these efforts.

Another justification for free allocation is to address the competitiveness of industrial users of electricity and fuels and other businesses that could have their costs affected significantly. The chemical and cement industries are often cited as examples of sectors that would be potentially vulnerable to out-of-state competition due to increasing energy costs and the cost of meeting their own obligations for reducing GHG emissions from their manufacturing processes. Higher costs could lead such energy-intensive manufacturers to leave California -- potentially yielding even higher GHG emissions in other regions (i.e., "emissions leakage"), which would undermine the environmental integrity of the program. An allocation to energy intensive, trade exposed firms covering some portion of direct and indirect emissions under the cap-and-trade program is one means of alleviating these concerns. However, the way that this type of allocation is delivered to firms will determine whether the allocation has its desired effect, as discussed below.

Some special considerations arise in the electricity sector. Although some advocate allocating free allowances to electricity producers, producers in electricity markets will generally be able to pass along much of the compliance cost to their customers. One alternative suggestion (incorporated into proposed federal legislation[5]) is to provide free allowances to local distribution companies (LDCs)—entities that deliver electric power to end-users. In California, these entities are either utilities regulated by the California Public Utilities Commission (CPUC) [6] or by local municipalities, or are cooperatives that can be (expected to act as trusties on behalf of energy consumers.[7] The value of allowances directed to LDCs would be used to lower electricity rates, put towards cost-saving investments in energy efficiency or potentially returned as a fixed rebate to consumers. This approach requires determining the appropriate basis for apportioning the allocation among the LDCs in the state. Also, to the extent that the LDCs used the allowance value to lower electricity rates it would increase overall program costs by dampening the price signal to consumers. If allowances are distributed to

Comment [LG3]: This paragraph seems out of place – or at least we need to put this text in the context of advantages or rationales for free allocation.

Comment [I4]: **Dallas B. comment:** Vicki, I've done some research on this in the Cal. Public Utility Code but I don't think I have an authoritative handle on what entities constitute the universe of LDCs in California's gas and electricity LDC universe. I can keep researching this, but it may be easier to send a question to staff.

[5] Included in both the "The American Clean Energy & Security Act" (H.R. 2454, or "ACES") (2009); and "Clean Energy Jobs and American Power Act" (S. 1733) (2009).
[6] Cal. Pub. Util. Code § 701 (Deering 2009).
[7] Cal. Pub. Util. Code §§ 2776-77 (Deering 2009). An electricity cooperative is defined as a "private corporation or association organized for the purposes of transmitting or distributing electricity exclusively to its stockholders or members at cost."

LDCs, separating the payments to consumers from their energy bill would increase the likely success of the price signal while achieving the goal of providing funds generated by the program to consumers. Nonetheless, a variety of implementation issues complicate this as a strategy.

One claimed drawback of free allocation is that it reduces firms' incentives to reduce emissions. However, except in cases where firms can influence their receipt of allowances by producing or emitting more (cases which we discuss below), the number of allowances a firm receives is unlikely to reduce incentives to abate emissions or to invest in new, low-emissions technologies. Firms minimize their costs by reducing emissions up to the point where the incremental cost of further emissions abatement just equals the allowance price. This point is largely unaffected by the number of allowances the firm receives for free.[8]

Beyond the issue of whether to rely on free allocation, there is the question as to which entities the allowances should be freely allocated. In later sections we take up the issue of alternative recipients of allowance value (whether via free allowances or auction proceeds). However, one argument related to this issue is worth considering here. Some interested parties have suggested that free allowances should be provided mainly to regulated entities on the grounds that these entities will incur the bulk of the costs of regulation. However, the actual economic burden of a cap-and-trade program does not necessarily fall solely—or even primarily—on the regulated entity. The burden of regulation can be shifted from a regulated entity forward to a firm's industrial, commercial, or residential customers; and it can be shifted backward to the firm's suppliers.[9] While there may be reasons to use free allocation to reduce the cost-burden to regulated entities, it is not necessarily the case that these entities face the principal burden.[10]

[8] At the same time, the number of allowances a firm receives for free does directly affect a firm's profit. Suppose that the amount of emissions consistent with equating marginal abatement costs with the market allowance price is X. Then each additional free allowance that a firm receives reduces costs or adds to revenue either by (a) reducing the number of additional allowances the firm must purchase in order to have allowances sufficient to justify emissions of X, or (b) increasing the number of allowances the firm can sell in order to reduce its holdings of allowance to the amount just sufficient to justify X. Either way, additional allowances allow the firm to retain more revenue.)

[9] The ability of regulated entities to shift the burden of regulation forward is primarily determined by whether entities are legally permitted to raise prices (i.e., regulated entities), and by the elasticity of demand (sensitivity of demand to a change in price) in the affected markets (i.e., the less that consumer demand changes in response to price increases, the more that covered entities can shift the burden of compliance to customers). The ability of regulated entities to shift the burden of regulation backward to suppliers is primarily determined by the market power of covered entities as input purchasers.

[10] Studies of a potential U.S. cap-and-trade system suggest that regulated entities would absorb less than 20 percent of the burden of such policy. *See* Goulder, Lawrence H., Hafstead, Marc A. C. and Dworsky, Michael, "Impacts of Alternative Emissions Allowance Allocation Methods Under a Federal Cap-and-Trade Program" (August 18, 2009) available at SSRN: http://ssrn.com/abstract=1457155; Smith, Anne E., Ross, Martin T., Montgomery, David W., "Implications of Trading Implementation Design for Equity-Efficiency Trade-offs in Carbon Permit Allocations" (December 2002) available at http://www.crai.com.au/uploadedFiles/RELATING_MATERIALS/Publications/Consultant_publications/Smith,_A/files/carbon-permit-allocations.pdf; and for a detailed examination of the U.S. electricity sector see Burtraw and Palmer (2008), Compensation Rules for Compensation Rules for Climate Policy in the Electricity Sector, *Journal of Public Policy Analysis and Management,* 27(4): 819-847.

2.2.2 Rationales for Auctioning

One potential attraction of auctioning is that it converts allowance value directly into cash. This has the potential to offer greater flexibility and administrative ease in devoting allowance value to various purposes. While free allowances must be sold before they can be used for purposes other than validating emissions, the proceeds from an auction can be used immediately.

Another important attraction of auctioning is that it opens up opportunities to reduce the costs of the tax system. The government could use auction revenue to reduce existing taxes on productive resources like labor and capital that are widely believed to inhibit economic efficiency. Economists have indicated that using auction revenues to lower pre-existing taxes on desirable activities could reduce the overall cost of a cap-and-trade program substantially, compared to an approach that distributes allowances for free.[11]

An auction also eliminates the need to adjust the allocation scheme to deal with sources entering and exiting the market. New entrants would see the same cost as their competitors when entering the market and those exiting would simply stop purchasing allowances.

Most policy discussions see a role for at least some percentage of auctioning in ensuring the smooth functioning of the market, particularly when the market is in its infancy. As with the Acid Rain Program, even a small auction can help with price discovery (providing information on what allowance price the market will bear) and ensure that at least some allowances will be available to program participants.

Finally, a potential attraction of auctioning is that when auction proceeds are disbursed to various parties, the value of these disbursements is quite visible. In contrast, when allowance value is offered through free allowances, the value of this provision is not immediately as obvious.

Comment [LG5]: I'm not sure this argument has much strength. To determine the value of this provision one needs only to multiply the quantity of allowances offered by the (visible) allowance price. Perhaps we should drop this point.

Three additional arguments in favor of auctioning are often made. These arguments deserve careful qualification. One is that auctioning makes use of the impersonal market to allocate allowance value. It thus avoids some of the contentiousness that arises under free allocation, where the regulator must decide directly which entities will receive allowances. However, it is worth noting that the use of an auction introduces a similar problem once the proceeds of the auction have been received: the government needs at that point to decide to which parties the proceeds will be allocated. This is politically contentious as well.

A second argument is that auctioning is preferable to free allocation because free allocation may reward firms that have already reduced their emissions through investment in cleaner fuels or lower carbon technologies, since they will have to purchase relatively fewer allowances compared to firms that have not made these investments. This is in fact an argument against a particular form of free allocation: namely, freely allocating allowances simply according to historical emissions levels. Allowances need not be freely allocated on this basis. As discussed below, many existing cap-and-trade

[11] See, for example, Parry, Ian W.H. and Wallace E. Oates, 2000. "Policy Analysis in the Presence of Distorting Taxes." *Journal of Policy Analysis and Management* 19(4):603-14, and Sanstad, Alan H and Wolff, Gary H., *Tax Shifting and the Likelihood of Double Dividends: Theoretical and Computational Issues*, (January 2000).

programs with free allocation are designed so as to avoid rewarding firms that have failed to make earlier investments in cleaner production methods.

A third argument is that auctioning provides a better signal of firms' costs of abatement than does free allocation. When allowances are introduced through a competitive auction, the market price of allowances indicates the costs that firms bear, at the margin, to reduce emissions.<explain in footnote> The same applies in a system where allowances are introduced through certain forms of free allocation. However, as discussed below, under certain forms of free allocation involving updating of allowances, this may not be the case.

2.3 Specific Forms of Free Allocation

Although free allocation may suggest a single approach to distributing allowances, in fact many approaches are possible. Each of these variants has attractions and drawbacks relative to others. We examine these specific forms of free allocations in this subsection.

A key distinction can be made between *fixed* allocation approaches, e.g., approaches that are not adjusted in response to current or future behavior, and *contingent* or *updated* approaches, e.g., approaches that adjust over time in response to behavior and market conditions.

2.2.1 Fixed allocation

Fixed allocation establishes the distribution of allowances in ways that are independent of the actions of consumers or firms regulated within the cap and trade program. The *grandfathering* approach is a specific case of fixed allocation. Under grandfathering, the allocation is based upon a metric such as the emissions or activity levels of firms or sectors during a previous baseline period. To be truly fixed, the baseline period must be before the cap-and-trade program, as well as the allocation, were anticipated by those eligible to receive them.

A main attraction of fixed allocation is that it is not expected to have an impact the abatement decisions of firms. If firms' allotments of free allowances are believed to be fixed, they will have no reason to alter their behavior as an attempt to influence this allotment. Attempts by firms to influence future allocations by changing their behavior often lead to additional costs for the program overall and various unintended consequences. As a result, a fixed allocation scheme has traditionally been viewed as the most efficient form of free allocation, at least with regards to the costs of complying with the emissions cap.

Comment [LG6]: Would be good to provide in a footnote an example of an additional cost or unintended consequence.

Fixed allocation has its critics, however. One criticism stems from the perception that it is unfair. Under a strictly fixed allocation scheme such as that used for the U.S. sulfur dioxide emissions trading program, firms continue to receive allowances even if they close their facilities. Also, the particular case of grandfathered allowances is sometimes viewed as inequitable on the grounds that it "rewards" the largest emitters with the largest allocations.

Fixed allocation is sometimes criticized as being unnecessarily rigid. Fixed allocation can tie the hands of regulators, who would be unable to respond to unexpected outcomes in the market by

revising an allocation approach.[12] In the face of these criticisms, many existing allowance-trading programs employ some form of updating of the rules used for the allocation of emissions allowances.

2.2.2 Updated allocation

Comment [LG7]: The discussion here remains good, but I think it becomes a difficult read for the non-specialist. I've tried to make it clearer and simpler in various places. But I think we should continue to simplify by trimming this subsubsection and putting much of the specifics in footnotes or the appendix.

In the broadest sense, "updated allocation" refers to any system of free allocation that gives regulators the ability to revise the allocations in response to economic or allowance market conditions. In practice, allowance updating has followed particular rules that are declared by the regulators and understood in advance by the market participants. A key decision of the regulator is the specification of such rules, that is, of the basis for changing the allocations.

The entry and exit of facilities is sometimes treated as the basis for updating. For example, the closure of a plant could be a basis for forfeiting future allocations, while the construction of a new plant could trigger a new allocation.[13]

More generally, some allocations systems have based allocations in a future period upon the production of a plant in the current period. This approach is usually called *output-based updating.* An alternative approach would base future allocation on the current emissions of a facility. This is usually called *emissions-based updating.* A similar approach is *input-based updating,* which would base future allocation on the current input of energy at a facility. It is similar to emissions-based updating because in the absence of post-combustion controls to remove CO_2 from the emissions of a facility, the energy input and fuel type will determine its emissions. In multi-industry settings, such as allowance trading for CO_2, a hybrid approach is often discussed that would allocate allowances to facilities in a given industry based upon the output of that facility and a benchmark emissions rate for all facilities in that industry. We will refer to this approach as *benchmarking*.

Before discussing the important differences between particular updating approaches, it is important to emphasize a fundamental difference between updating and fixed allocation. Under any form of updating, allocations are tied to ongoing behavior. As a result, updating can influence firms' decisions about methods and levels of production in ways that exogenous allocation does not.

Output-based and Emissions-based Updating

Under output-based updating, each firm receives an allocation of allowances proportional to its total production of goods or services. In the electricity context, for example, this means each firm receives an allocation proportional to the MWh it generates. The effects of output-based updating have been a subject of much research.[14] The main insight is that output-based updating is in effect a form of a production subsidy: firms are rewarded, in the form of valuable allowances, for each additional unit of output. This production subsidy induces firms to increase output relative to the level

[12] This issue was one of the ones identified by the DC Circuit Court when it vacated and subsequently remanded to the EPA the Clean Air Interstate Rule because the rule would affect the allocation of SO2 emissions allowances that had been set in statute using an fixed "grandfathering" approach (North Carolina v. EPA, 531 F.3d 896 (D.C. Cir. 2008)).

[13] Åhman et al. (2007) show that removing allocations to sources that close or granting allocations to new sources can alter investment incentives in a way that increases the profitability of relatively less efficient (dirtier) sources.

[14] See Jensen and Rasmussen (2000), Fischer (2003), and Fischer and Fox (2007)

that they would choose under fixed allocation or allocation via an auction. The subsidy also helps keep product prices of these firms from rising as much as they would under other forms of allocation.

Introducing an environmental regulation in one jurisdiction can raise production costs and prices in that jurisdiction relative to other jurisdictions that do not introduce comparable regulations. This can cause a shift in demand away from goods produced in the first jurisdiction and toward goods produced elsewhere. As a result, the reduction in production and emissions in the first jurisdiction is offset by increased production and emissions elsewhere. The offsetting increase in emissions is called emissions leakage. Output-based allocation has the potential to mitigate such leakage by helping keep domestic prices low and helping domestic firms maintain a share of the larger market.

These two effects of output-based updating --- mitigating leakage and lowering product price increases --- form the basis of its appeal as well as the main concerns with it. The American Clean Energy and Security Act (HR 2454) includes "rebates" for ``energy-intensive, trade-exposed" industries. In effect, this is updating in the form of output-based allocation. Updating mitigates leakage because the allowances are *not* awarded to imports, and because the subsidy is related to the level of overall production. The production subsidy in the form of the allowance value partially offsets the incremental impact of CO_2 prices on domestic firms, thereby leveling the playing field with imports that were not subject to the regulation. However, if the production subsidy affects only a portion of the regulated industries covered by the emissions cap, the subsidy will lead to relatively more emissions from this sector of the economy, causing there to be a need for more emissions reductions at higher costs from other sectors. Output-based allocation also mitigates the increase in prices for products such as electricity and therefore mitigates the impacts of GHG regulation on consumers. However, these lower prices, relative to a fixed allocation scheme, can lead to inefficient over-consumption because it removes the price incentive for consumers to implement energy efficiency measures.[15]

There is a concern that output-based updating, if applied symmetrically to all producers, would exacerbate equity concerns with respect to the distribution of costs within the regulated industry. For example, there is a fear that low-carbon producers will experience a ``windfall'' under output-based allocation, while high-carbon producers will suffer most of the cost impacts of GHG regulations. This is because output-based allocation favors cleaner producers, which are rewarded for production, and penalized for emissions. Further, it is not straightforward to compare units of ``output'' (e.g., a ton of cement or a MWh of electricity) across industries.[16] Some proposals call for "value added" as an alternative to units of output.

An alternative approach to updating, and one that addresses these concerns, is *emissions-based updating.* Under this approach, updating is based on the level of emissions. For example, a plant may be allocated 1 ton in allowances for each 2 tons of emissions it produces. In this way facilities are all awarded allowances in equal proportion to their direct costs of the GHG regulation. The obvious criticism of emissions based allocation is that it rewards firms for producing the very thing that the regulation is trying to reduce.

Under both output-based and emissions-based updating, there is a fundamental tension between sustaining production levels and market share of polluting facilities and reducing overall

[15] See Burtraw, Palmer, and Kahn (2005).

[16] If the allocation is first apportioned across industries then marginal costs of emissions reductions are likely to vary, raising the overall costs of the program.

emissions from those facilities. The aggregate impact on the environment can be mitigated by not allowing the cap to adjust, and awarding "shares" of the available allowances according to output or emissions-based updating.[17] This combination of simultaneously rewarding and punishing similar behaviors can result in inflating the allowance prices.[18] If the updating allocation is awarded to just a portion of the regulated firms, then the firms that do not receive an allocation will face higher allowance prices and greater compliance costs. Also, because updating can lower product prices below efficient levels, the "over-consumption" of products such as electricity can increase the overall cost of abating emissions to stay below the cap relative to an fixed allocation scheme.

In practice, the obvious conflicts inherent in emissions-based updating reduce its appeal, and the practical considerations make purely output-based updating rare. Instead, it is more common for output-based allocations to be based upon some kind of emissions benchmark.

Benchmarking

Benchmarking aims to apply updating based on criteria for best practice. Under this approach, the regulator establishes a baseline emissions rate for an industry (e.g., cement) or process (e.g. coal generation) and awards allowances to all facilities in that industry according to the "benchmark" GHG content of their output. Benchmarking combines attributes of both output-based and emissions-based updating.[19] Although firms are explicitly rewarded for output rather than emissions, this only makes a difference if there are practical low-carbon methods for making those products. To the extent that the carbon intensity of output for a firm or industry cannot be changed, output-based updating closely resembles emissions-based updating. The only way to reduce emissions is to reduce output.

It is important to emphasize that emissions-based and output-based allocations can produce very different implications for the markets to which they are applied. Theory would predict that emissions-based allocation would put more inflationary pressure on allowance prices, and it does not appear to be as effective as output-based at mitigating leakage. To the extent a benchmarking approach takes on emissions-based characteristics, it can therefore undermine some of the important benefits of updating.[20]

Both the Federal ACES Act and the proposals of the Western-Climate Initiative (WCI) feature fuel-differentiated benchmarking approaches to updating.[21] The WCI proposal would apply updating

[17] If the output-based allocation were not combined with a strict aggregate cap, the result would be very similar to an intensity standard, such as the Low Carbon Fuel Standard. Firms would have an incentive to produce their products in a low-carbon fashion, but less incentive to limit overall production levels. Holland, Hughes and Knittel (2009) suggests that the added costs of an intensity standard, compared to cap and trade, when applied to the liquid fuels market can be substantial.

[18] Bohringer and Lange (2005) study a "closed" cap-and-trade system where all firms receive allocations equivalent to a portion of their emissions. The results are identical to an fixed allocation scheme except that allowance prices rise proportionally to the "rebate" implied by the allocation.

[19] One difference is that the benchmarking approach often resembles an intensity (performance) standard whereby changes in aggregate emissions vary with the level of economic activity. The benchmark emissions rate can be adjusted over time to achieve the aggregate emissions target, or else other regulated sectors not subject to a benchmarking allocation would be required to achieve emissions reductions at a level that balances with the cap.

[20] See Bushnell and Chen (2009).

[21] <We need to clarify what is in the WCI proposal vs. the recommendation of the joint agencies for California.>

only to the electricity sector, but generation from different fuel sources would receive allowances according their carbon intensity (e.g., coal plants would receive more allowances per MWh than gas plants). Among other implications, this makes compliance by switching from coal to gas less attractive, as it would result in a lower allocation.[22]

Complicating matters for California and the WCI is the interaction of allocation policy, the "first-deliver" point of compliance, and legal constraints such as the Interstate Commerce clause of the constitution. One way to interpret the legal constraints is that suppliers from outside California must be treated no worse than in-state suppliers, so import purchases need to be eligible for updated allocations in order to maintain the symmetric treatment of domestic and imported production. This was the conclusion of the CPUC and CEC when they formulated a recommendation to apply fuel-based updating to both sources within California and first-deliverers receiving power from outside the state. Unfortunately, this legal constraint may compromise one of the key benefits of updating, its ability to limit leakage, because there can be less of an allowance-based advantage to maintain production inside the state. The actual effect at limiting leakage will depend on the emissions rates of in-state electricity and the way emissions rates are calculated for imported electricity. Since imports have a higher emission rate on average than in-state generation, there could remain some advantage to in-state generation from updating. Hence, in a first-deliver system, "fuel-based" or "emissions-based" updating could limit leakage of emissions to electricity generators out of state, but its overall effects would depend on the estimation of emissions associated with imported power.

2.3 Alternative Auction Designs

Auctions are becoming increasingly popular as a way to deliver resources and other goods to markets. One reason for this is their ability to direct goods to their highest valued use in an efficient manner. There are many types of auctions in use today; they can be tailored to match the circumstances of specific goods or the needs of sellers and buyers. An important lesson from the economic literature on auctions is that one size does not fit all, but rather auctions should be designed for specific situations (Binmore and Klemperer, 200X).[23]

Auctioning has been employed as a method of allowance value in several cap-and-trade systems. The sulfur dioxide trading program established under the 1990 U.S. Clean Air Act amendments distributed the value of emissions allowances to incumbent emitters -- that is, it employed grandfathering. But the program also employed an auction and continues to do so. The auction is held annually. Initial bilateral trades (between two parties) revealed a wide distribution of prices for emissions allowances, reflecting uncertainty about the cost of emissions reductions among compliance entities and about the functioning and liquidity of the emerging market. The first auction in <April 1994 check> cleared at a price that was well below most of the previous trades, and the second auction a year later did so again. While some observers doubted the performance of the auctions at the time, within weeks of the second auction the price for trades in the market fell to the level

[22] Åhman and Holmgren (2006) show that fuel-based benchmarking for new sources in the EU ETS can change the order of investments, leading to a substitution toward higher-emitting technology.

[23] There is an expansive economic literature applying analytical, empirical and experimental methods that can inform the design of an auction. In addition to collective experience with auctions generally, over the last couple decades there has been experience with auctions for emissions allowances in particular that provides the basis for designing a potential auction in California.

observed in the auction and since then the auction has tracked the market, and vice versa, very closely. Unlike a bilateral trade that brings forward the information available to two parties, the auction process brings into play the collective information of all the participants in the market and it organizes that information to reveal the marginal cost of emissions reductions for the market as a whole.

Generally, auctions are cited for their transparency and administrative simplicity relative to other mechanisms for distributing government-created licenses and property. Perhaps unfairly, administrative decisions about the distribution of such valuable assets inevitably convey a sense of special dealing. Even when explicit criteria are offered for determining the distribution of such assets, the outcome is determined by subjective evaluation of how parties conform to the criteria. The value that is assigned through such a process can be substantial and is likely not to be known in the decision making process because it occurs prior to the maturation of the market where the value of the asset is determined. Consequently the administrative allocation can overshoot or undershoot the goals embodied in its criteria. In the largest emissions allowance in existence, the CO2 emissions trading program in the EU, several formal ex post investigations determined that the value of the emissions allowances that were distributed for free far exceeded the cost that was incurred by the regulated entities that received the allowances, leading to billions of dollars in windfall profits. This revelation led the European Commission to overhaul the allocation approach initiating a transition to a full auction by 2020.

2.3.1 The alternatives

There are many types of goods and services distributed through auctions. Depending on the type of good or service involved, one form of auction may be more effective than another. Thus, many types of auctions have been conceived and implemented.

An allowance auction would distribute multiple, identical goods, e.g. each emissions allowance with a common vintage is of equal value. This simplifies the potential design of an auction compared to one where each good has a different but correlated value.

There are two main choices that fundamentally determine the design of the auction to be used for emissions allowances. One choice is whether the outcome of the auction will stem from one round of bidding or from several. *Sealed-bid* auctions bring about a one-round result. In auctions in which participants can revise their bids, the process involves several rounds. These auctions are called *multi-round* auctions. They are sometimes called *clock* auctions because the bid price moves up or down like the hands on a clock until supply equals demand.

The second choice is whether bidders pay the amount they individually bid, called a "discriminating price" auction, or if all bidders pay the same "uniform price."

One can find examples of each type of auction in practice. A uniform price, sealed bid auction is used in the Regional Greenhouse Gas CO_2 program, where nearly 90 percent of the emissions allowances are distributed through an auction. A discriminating price, sealed bid auction is used for the SO2 program. A uniform price multi-round auction was used by the State of Virginia to auction its emissions allowances in the NOx budget program. A discriminatory price multi-round auction is used by the Federal Communications Commission to distribute licenses for broadcast rights.

After the two main choices are made to determine the design of an auction, there are a number of other features that should be considered, including:

- Frequency of the auction (e.g., quarterly)
- Allowance vintages to be auctions (e.g. current year and/or future year vintages)
- Use of a reserve price (a minimum price in the auction)
- Auction platform (how the auction will occur)
- Market monitoring (to ensure against manipulation of the auction)
- Eligibility rules and financial prequalification
- Information from the auction to be revealed to the public

2.3.2 Criteria for choosing among auction designs

The choice among auction designs can be helped by criteria that may be important to state agencies, the regulated entities and the public. These include the administrative costs for the state and transaction costs for the bidders. Also, various designs may be perceived as more fair or understandable to participants and the public. The academic literature can inform how well each design performs in assigning the allowances to those who value them most. A concern of many parties may be the assurance that the auction is robust against potential attempts to manipulate the price, although there is no empirical evidence for this in previous allowance auctions. Also, the design of the auction may help minimize price volatility in the auction and the secondary market. Raising reasonable revenues from the sale of the valuable emissions allowances is likely to be a concern. In addition, entities will want to ensure the auction design is compatible with existing electricity and energy markets.

The characteristics of allowances do argue for certain auction designs. First, as described above, the values are common to all who purchase them. Anyone who buys an allowance could resell it at the market price in a secondary market. Second, there is initial uncertainty as to what the value of an allowance will eventually be, which is the precondition for what is known as the "winner's curse," where the highest bidders are usually the ones with the most extreme estimates of future allowance values. However, an active secondary market causes the uncertainty and the risk of the winner's curse to nearly vanish. Some authors have asserted that a multi-round auction where bidders can adjust their estimates of allowance values in response to the actions of other bidders is an appropriate design in the presence of uncertainty,[24] but no empirical literature that finds that a multi-round auction actually does better than a sealed bid auction in avoiding the winner's curse but may raise the possibility for collusion in the auction.[25]

Ultimately, an important set of criteria for the design of an auction will be its transparency and how well its operation can be understood by participants. Sophisticated or large firms have the ability

[24] The intuition behind this assertion is that when bidders are allowed to adjust their estimates of allowance values in response to the bidding behavior of others, they have less fear of the winner's curse and are less likely to "shave" their bids downward, and also that the auction price more closely resembles the true market value. (Milgrom, "Auctions and Bidding: A primer" *Journal of Economic Perspectives*. 1989 vol. 3 (3) pp. 3-22).

[25] The intuition is that a multi-round platform gives participants a better chance to coordinate bids. Burtraw, Goeree, Holt, Myers, Palmer and Shobe (2009), Collusion in Auctions for Emissions Permits: An Experimental Analysis, *Journal of Policy Analysis and Management*, 28(4): 672–691.

to understand and participate in complicated auction environments, but many compliance entities may not have the ability to do that. Since the auction would be used to distribute the ability to access a public good (emit into the atmosphere), the operation of the auction will be of interest to a broad class of parties. Many feel the simplest and most transparent design is a sealed-bid, uniform price auction, which makes it a strong candidate for the auction design unless other criteria emerge to affect the choice.

There is ample experience to draw on in determining the auction design. In addition, various authors have recommend the use of laboratory experiments to "stress test" the auction design examine its performance according to criteria that are identified as important, and to make sure that it is robust when faced with various types of potentially unpredictable behavior and market circumstances.

3. Total Allowance Value

3.1 General Issues

3.1.1 Why is the allowance value important?

The value of allowances under the cap-and-trade program represents a new intangible asset that will be distributed through free allocation and/or through the assignment of revenues from an auction to entities in the California economy. The total allowance value is substantial. As this report discusses, allowance value can be directed to a variety of possible purposes.

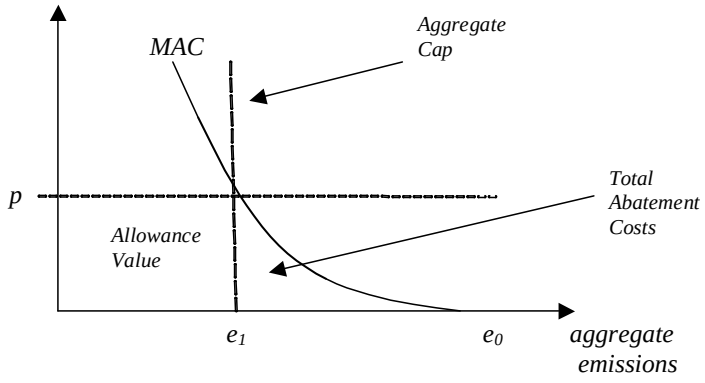
Having a sense of total allowance value is important, since it influences how this value might be used. Some uses will have higher priority than others, and depending on total allowance value certain lower-priority uses may or may not be advisable.

It is also helpful to understand the variability of allowance value over time, because some potential uses of the funds may be more vulnerable to fluctuations in the availability of funds. If this is the case, the state might identify these potential uses as having first claim, but perhaps a limited claim, on allowance value. Even if allowance value fluctuates, the potential uses with a primary claim would have relative assurance that funding would be stable. Secondary claims on allowance value might be identified that could benefit if allowance value is available and that have greater resilience to variability in the allowance value that is received.

Comment [LG8]: I removed the text claiming that the allowance value exceeds the resource cost. I believe it's better first to provide the graph and then state that allowance value can (but does not necessarily) exceed total abatement costs. Otherwise many readers are likely to have trouble interpreting the statement.

3.1.2 What determines allowance value?

The figure below offers a stylized representation of California's marginal costs of reducing emissions. This is a marginal abatement cost curve, labeled "MAC." It represents the change in abatement costs associated with each additional unit reduction in emissions. Marginal abatement costs increase as emissions are reduced. The vertical line (e_1) is the aggregate emissions cap. The aggregate value of allowances is determined by the quantity of emissions that are enabled (e_1) and the price of allowances (p), where the latter depends on the marginal costs of abatement at the emissions quantity e_1.



Total allowance value may rise or fall with greater stringency of the cap, depending on the slope of the MAC curve. As discussed below, for the first couple decades of a program in California the value of emissions allowances can be expected to increase in real terms as the overall cap becomes more stringent.

The above figure helps identify the information needed to estimate the allowance value that would become available by introducing a price on CO_2. In particular, we would need to have estimates of the marginal costs of abatement associated with the cap-and-trade system's cap for particular years. This would give us the price of allowances in each year. We would then apply this price to the level of "residual" emissions (e_1) expected each year to obtain total allowance value.

As indicated in the figure, allowance value is the product of two factors, the quantity of emissions allowances that are introduced in the system and their price. The allowance quantity is a policy choice representing the state's commitment to achieving emissions targets over a specific time schedule.

The figure shows that the allowance price depends on the emissions target and the cost (at the margin) of reducing emissions from their business-as-usual level to achieve that target. Abatement costs, in turn, are influenced by a range of factors, including the design of the emissions market. The next section describes factors that influence the marginal cost of achieving emissions reductions in the short run and in the long run. The discussion includes attention to policy variables that have a strong bearing on the cost of emissions reductions. We use this information to report a range of probable allowance values, based on information available to the committee, and an estimate of the value of allowances that would be available for the state to direct to various purposes.

3.2 Factors Determining Abatement Costs

3.2.1 Technological and Behavioral Factors

Total allowance value in a given year is the product of the quantity and price of allowances. While the former is set by policy makers, the latter reflects regulated entities' marginal costs of reducing (or abating) emissions. This latter cost depends on technological, behavioral, and policy-related factors.

Here we concentrate on the technological and behavioral factors that influence marginal abatement costs. The marginal abatement costs depend on the ease with which regulated entities can utilize various channels for abatement. The channels vary in terms of the length in which the behavioral changes from either firms or consumers will take place; some of the channels will operate immediately, others will take a number of years to occur.

Reduced Output

One important channel is a reduction in output of the good that is being produced. Pricing greenhouse gases will increase the prices consumers pay for greenhouse-gas-intensive products. These higher prices will elicit a reduction in the quantity demand for these products, leading to a reduction in greenhouse gas emissions.

The extent to which output is reduced may vary with time. The "short-run demand elasticity" is the key parameter that expresses how far demand (and output) will fall in the short run in response to an increase in prices. For electricity consumers, these reductions represent changes in consumer behavior such as increasing thermostat settings during the summer or switching to compact fluorescent lighting. Reductions in natural gas demand may come from reducing thermostat settings in the winter or adjusting hot water heater temperatures. Behavioral changes that reduce gasoline demand include reductions in VMT through carpooling, trip collection, and better engine maintenance.

A variety of studies have estimated the short-run demand elasticity for greenhouse gases intensive products. Dahl (200X) summarizes the short-run elasticities for a variety of energy-intensive products, reflecting the percentage reduction in demand for a one percent increase in price. She finds that the elasticity for electricity and natural gas is roughly 0.20, while the elasticity for gasoline is 0.26. If greenhouse gas reductions only came from demand reductions, allowance prices would be high. For example, allowance prices would have to be roughly $115 per ton of CO_2e to reduce electricity consumption, and thus greenhouse gas emissions from the electricity sector, by 15% . Even higher allowance prices would be required to reduce gasoline and natural gas consumption by 15%.

Over the longer term, there are likely to be larger reductions in output in response to increased prices. This reflects the increases ability of consumers to identify and use substitutes with the passage of time. Consumers' adjustments might include replacing inefficient air conditioners, hot water heaters or automobiles. These changes take place in the "medium term" of 2-10 years.

Comment [LG9]: Need to make sure we connect this information on price elasticities with the estimates below on total allowance value.

Fuel-Substitution and Opportunities for Process Change

Firms can also reduce emissions by lowering the amount of emissions per unit of produced output. They can do this either by substituting low-GHG fuels for other fuels, or by undertaking other changes in the methods of production. Opportunities for fuel-substitution and process-change may be relatively limited in the very near term, but can be considerable over the longer term. Consider in particular the incentives for fuel substitution by electric power generators. While at a zero greenhouse

gas price and existing natural gas and coal prices, coal plants have lower marginal costs than natural gas plants of the same heat rate, as the price for greenhouse gases increase, coal marginal costs increase faster than natural gas marginal costs. Switching from coal to natural gas generation can have large effects on greenhouse gas emissions. Coal fired power plants produce roughly twice the greenhouse emissions than a comparable natural gas plant.

Table XX below illustrates the "flipping point" (the point at which fuel-substitution would be economic) for a variety of coal and natural gas prices (expressed in terms of $ per mmBTUs) for plants operating at a heat rates of 11.1 and 11.3 for coal and natural gas plants, respectively. [26] For example, natural gas is currently trading at roughly $5 per 10,000 million British thermal units (mmBtu); coal, on the other hand, sells for roughly $2.25 per mmBTU.[27] At these prices, a permit price of $57 would equate the marginal cost of coal and natural gas, for a power plant with a heat rate of 10. Simple back-of-the-envelope calculations allowing for both reductions in consumption within the electricity, natural gas and transportation fuels sectors and fuel switching, suggest an allowance price of roughly $70 is required to achieve a 15% reduction in greenhouse gases.

Comment [LG10]: Should we add "in medium and long run?"

Developing New Technologies

Pricing greenhouse also incentivizes firms to invest more in research and development in greenhouse gas reducing technologies. Absent a price on greenhouse gases, advances in greenhouse gas reducing technologies must rely on "piggy backing" off of cost reducing advances that also reduce greenhouse gases. For example, automobile firms have an incentive to invest in energy efficiency because consumers value fuel efficiency. These advances also reduce greenhouse gas emissions, but without pricing greenhouse gases, firms and consumers have too little of an incentive to invest in energy efficiency. This suggests that rates of technological progress are likely to increase under a cap and trade system.

Comment [LG11]: it would be good to cite relevant empirical studies (confirming or disputing this claim). Some people question whether cap-and-trade would stimulate technological progress.

		Natural Gas Price ($/mmBTUs)																	
		$ 2.00	$ 2.50	$ 3.00	$ 3.50	$ 4.00	$ 4.50	$ 5.00	$ 5.50	$ 6.00	$ 6.50	$ 7.00
Coal Price ($/mmBTU)	$ 1.50	$ 9	$ 18	$ 27	$ 36	$ 45	$ 54	$ 63	$ 72	$ 81	$ 90	$ 99
	$ 1.75	$ 4	$ 13	$ 22	$ 31	$ 40	$ 49	$ 58	$ 67	$ 76	$ 85	$ 94
	$ 2.00	$ -	$ 9	$ 18	$ 27	$ 36	$ 45	$ 54	$ 63	$ 72	$ 81	$ 90
	$ 2.25	$ (4)	$ 4	$ 13	$ 22	$ 31	$ 40	$ 49	$ 58	$ 67	$ 76	$ 85
	$ 2.50	$ (9)	$ -	$ 9	$ 18	$ 27	$ 36	$ 45	$ 54	$ 63	$ 72	$ 81
	$ 2.75	$ (13)	$ (4)	$ 4	$ 13	$ 22	$ 31	$ 40	$ 49	$ 58	$ 67	$ 76
	$ 3.00	$ (18)	$ (9)	$ -	$ 9	$ 18	$ 27	$ 36	$ 45	$ 54	$ 63	$ 72

3.2.2

3.3 Policy Factors That Influence Allowance Prices

Comment [LG12]: The latest drafts have suggested that price was fully determined by the emissions cap and the MAC curve. Price was simply to marginal abatement costs ath the oint of intersection of the MAC curve and the cap.

This wasn't compatible with the discussion that starts here. The expanded analysis seemd to justify a new subsection. It also seemed important to reconcile this expanded analysis with what went before – hence the new introductory paragraph.

The simple diagram in the previous subsection indicated that the allowance price is determined by the marginal abatement costs at the level of the aggregate emissions cap. While the diagram helps focus on central determinants, several policy factors can influence the allowance price as well, either

[26] These represent the average heat rates for coal and natural gas plants within the WECC.
[27] http://www.eia.doe.gov/cneaf**/electricity/epm/epm_sum.html.**

by altering firms' production incentives or by establishing links in abatement costs across regions or across time. We discuss these factors here.

Free Allocation with Output-Based Updating

As discussed in Section 2, the way that emissions allowances are initially distributed is a key policy variable that can have an important effect on the price of allowances. In particular, updating approaches that award allowances in response to production or emissions will tend to increase the allowance price compared to fixed allocation or an auctioning. Such updating implicitly subsidizes output and thereby leads to a higher demand for allowances. This tends to yield higher allowance prices.

Linkage with Larger CO_2 Markets

It is reasonable to expect that a level of reciprocity with other established GHG allowance markets will be allowed. Given that California GHG emissions would constitute only a fraction of total emissions in all these markets, a high degree of linkage with other markets would imply that CA allowance prices will be tied to those in other regions.[28]

If California's system is linked with other systems, then the price of allowances reflects marginal abatement costs not only in California but in the entire system. Linking various systems introduces more opportunities to exploit especially low-cost abatement opportunities through trades in allowances across regions. <need express more clearly>

Futures prices in these markets give some signal of future prices in CA. The current EU ETS price for a 2012 delivery futures contract is 17.42??update?? euro/ton on the European Climate Exchange.

Availability (and price) of CO_2 Offsets

In many CO2 markets, firms have the option to comply with the cap through the purchase of carbon "offsets" from industries or regions beyond the scope of the cap-and-trade system. Usually this involves paying firms to take actions that reduce carbon emissions from their activities, or sequester CO2 from the atmosphere. The exact cost and availability of offsets will largely depend upon the criteria that are established for California's allowance trading system. The stringency of the certification process for offsets, their ultimate availability and their price will determine the extent to which they can influence the overall price of allowances.

To the extent that sufficient offsets are available and allowed by the rules for compliance, their price can form an upper bound on the price. If the cost of direct mitigation rises above the cost of offsets, firms will utilize the offsets as their compliance strategy. If the amount of offsets allowed for compliance is limited, and this limit is binding, then offset prices would no longer establish an upper bound on allowance prices. The WCI guidelines propose up to 49% of total allowance requirements could be procured through offsets, but many California stakeholders view this limit as too high.

[28] California's capped sectors would amount to about 1/10th of that in 2012.

Banking and Borrowing Provisions

Comment [LG13]: To link this with the earlier discussion, I think it would be good to indicate that with banking and borrowing, today's allowance prices still depend on marginal abatement costs – but not simply on the current marginal abatement costs. They now depend on on future abatement costs as well.

Rules on the inter-temporal usage of allowances play an important role in determining the volatility of prices. These rules include the degree to which firms can use a current-year allowance for compliance in latter years through "banking" emissions reductions, and the extent to which a firm can use a future-year allowance for compliance in the current year through "borrowing." In general borrowing is more controversial as it implies a delay in overall abatement. Also, there are concerns about the credibility of enforcement in the face of large-scale borrowing. In other words, borrowing constitutes a promise to reduce emissions disproportionately in future years, and its effectiveness depends upon holding firms to that promise.

The WCI guidelines implicitly allow for borrowing only within a 3 year compliance window. They allow for unlimited banking. If this framework is extended to California, this means that prices in near-term years should be influenced by prices in latter years if, as expected, the cost of abatement is higher in those later years due to more stringent caps in those years. Under those conditions, with unlimited banking the price in 2012 should equal the price in 2020, discounted for expected interest earnings.

However, some important considerations could limit the use of banking. A firm that chooses to bank a California allowance will have to consider the possibility that a California program may not exist in 2020, or may look very different. In particular, the prospect of federal legislation pre-empting California's emissions market at some point over the next decade could limit the expected future value of California allowances.[29]

Impacts of Other Directed Policies

Under AB32, allowance trading is only one element of a broad set of policies aimed at reducing CO_2 emissions. In the projections of the scoping plan, directed policies are expected to account for about 80% of overall required abatement and XX% of abatement from sectors covered under allowance trading.

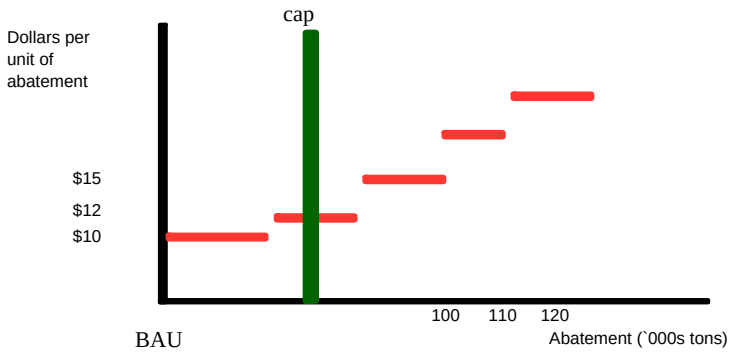


Figure 1: Supply and Demand for Abatement

[29] Although there are provisions in the currently proposed federal bills that would compensate firms for the value of banked state allowances, these provisions are ambiguous.

If one considers all mitigation options as forming a "supply curve" of CO2 reductions, then the cap can be thought of as setting the "demand" for reduction. The directed policies will have the effect of specifying some of the compliance options firms must undertake. The reductions accounted for under the directed programs in effect reduce the "demand" for reductions under the cap. They also remove those directed options from the supply curve of remaining mitigation options. To the extent these mandated options would have been chosen under allowance trading system even without the mandate, this will not impact the allowance price, as illustrated in Figure 1. However, if some of these options can be thought of as coming from higher up in the mitigation cost curve, they can actually reduce the equilibrium allowance price, even though they may raise the overall cost of the regulatory effort. Thus the "marginal" cost of abatement – the cost of the "last" ton of abatement – may not necessarily be the highest-cost option, as illustrated in Figure 2. It is the marginal cost – the cost of the last unit of abatement – that will determine the price of allowances, however.

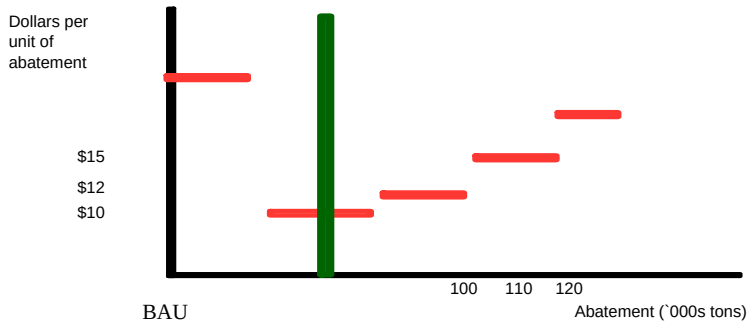


Figure 2: A High Cost Option is Mandated

Leakage and/or Reshuffling

Another important factor to consider in predicting an allowance price is the extent to which "compliance" will be obtained through leakage of production – or of demand for production – to other regions outside the cap. To the extent that it is cheaper to produce a product in a region where it is not covered by the cap and import it into California than it would be to either abate CO2 emissions or purchase an allowance *inside* California, there will be a migration of production to other regions. Another possible outcome is reshuffling, which represents selling more of a low-carbon variety of a product (e.g., cellulosic ethanol) in California and more of the high carbon variety outside of California without changing overall greenhouse gas emissions. If these events were to occur, emissions inside California will be reduced and the demand for actual abatement inside California will go down, as will allowance prices. However, emission leakage would undermine the environmental integrity of the program and total regional emissions will not be reduced by as much as the observed emissions reduction in the state. A similar, but less direct form of leakage could arise if firms who consume CO2 intensive products, such as electricity, themselves move to uncapped regions. Again consumption of CO2 inside California would decrease, but regional emissions probably would not.

In this way, the extent of leakage from California to uncapped regions could play a significant role in determining allowance prices. The electricity sector has been identified as particularly

vulnerable to leakage, and special provisions to combat leakage through a "first deliverer" design have been developed to mitigate it. However, some leakage from electricity is a strong possibility and there are no specific policies yet in place to combat leakage in other sectors. Some forms of updating allocation may reduce leakage but they also bring other considerations, as suggested elsewhere in this report.

Summary

Policy variables exert impacts on allowance prices in various ways.

Free allocation with an updating approach provides a subsidy to production or consumption of a good, leading to more of the activity and an associated higher demand for emissions allowances, which raise their cost. Even grandfathering may increase allowance price if it occurs in a sector subject to cost of service regulation because allowances received by firms would be treated at original (zero) cost by the regulator and therefore lead to smaller retail prices than under an auction, and that would constitute a subsidy to consumption relative to an auction.

Linking provides a way to reduce costs across different regulatory programs, but the program with relatively lower marginal cost will be pulled into making additional emissions reductions, and that will raise the allowance price for that program while lowering the allowance price in the other program.

Banking and borrowing provides an opportunity to find least cost ways to reduce emissions across time periods. That will lower the cost of the program. However, this flexibility over time causes there to be a relation across the allowance prices in different periods. Borrowing will lower the allowance price in the near term (compared to the absence of borrowing). On the other hand, banking will raise the allowance price in the near term because firms will capture early reduction opportunities in order to bank allowances for use in the future.

The presence of the other policy variables would lead to a lower allowance price, but an increase in overall costs. Offsets and other directed policies reduce the need for emissions reductions in the regulated sector. Leakage of emission indicates supply of a product outside the regulated region that relieves the demand to incur costs within the region.

In summary, the design of the program is likely to have as great or greater of an effect on the allowance price as does the level of the emissions cap. Program various choices for the design could cause allowance prices to vary by multiple times.

Comment [LG14]: I'm not sure we have a strong basis for this claim. Suggest we soften it.

3.4 Range of Allowance Prices

Several studies have reported an estimated allowance price for compliance with a cap-and-trade program under various scenarios that vary assumptions about coverage of the cap, underlying technological progress, emissions trajectory beyond 2020, banking of allowances, availability of offsets, and methods of allocation. This brief summary includes studies performed by the Air Resources Board,

Western Climate Initiative, Charles River Associates, David Roland-Holst, and researchers at Resources for the Future.

The Air Resource Board's Scoping Plan provides a comprehensive approach for reducing state GHG emissions to the target level defined in AB 32. The Plan proposes a cap-and-trade program, coordinated with the WCI program, along with a broad set of complementary policies, such as a 33% RPS, designed to reduce emissions from specific sources. Using the E-DRAM model, ARB estimated the economic impacts of the Scoping Plan as a whole. This model does not include allowance banking or offsets. For the cap-and-trade program, the modeling results reflect a 2020 allowance price of $10 (2007$) per metric ton. Despite this low allowance price, some of the complementary policies are expected to cost much more than this in order to achieve their emission reductions. In fact, the 33% RPS is estimated to have a cost of $133 (2007 dollars) per metric ton. This analysis did not incorporate a link to the WCI partner jurisdictions.

The WCI analysis was performed using the ENERGY2020 model and covered eight of the 11 WCI Partner jurisdictions. All of the cases examined include allowance banking and some complementary policies, but they also include different scopes of coverage, treatments of offsets, and energy prices. In these different cases, the allowance price in 2020 varies from $18 to $71 (2007 dollars) per metric ton. The narrower scope of coverage significantly increases the allowance price, as does prohibiting the use of offsets. The WCI analysis is currently being updated to incorporate all 11 partner jurisdictions and updated assumptions regarding economic growth, complementary policies, and other factors.

Charles River Associates used its MRN-NEEM model to analyze several different policies and targets for emission reductions, none of which allowed for banking of allowances or the use of offsets. All of these policies achieved the target of reducing emissions to 1990 levels by 2020, but the reduction path following this date varies from no additional reductions to 80% below the 1990 level by 2050. Under these different scenarios, the allowance price in 2020 ranged from approximately $60 to $100 (2007 dollars) per metric ton. Another scenario also included a safety valve that allowed additional emissions if allowance prices reached a certain level. This scenario also resulted in an allowance price of about $60 (2007 dollars) per metric ton, but it did not achieve the same emission reductions. The documentation for this study does not specify if the model included complementary policies or if a link to the larger WCI region was considered.

David Roland-Holst's analysis used the BEAR model to examine a wide range of policies to achieve the necessary emission reductions by 2020. All of the cases modeled prohibit banking of allowances and the use of offsets, but they do include all of the complementary policies proposed by CARB. The cases differ based on the effectiveness of these complementary policies, the sectors covered by the cap-and-trade policy, and the level of technological innovation to reduce the cost of energy efficiency. This wide range of cases results in an allowance price in 2020 varying from $8 to $213 (2007 dollars) per metric ton. A more narrow scope of coverage and less effective complementary policies both increase the allowance price, while efficiency innovation reduces the price. The documentation for this study does not specify if the model included a link to the larger WCI region.

Researchers at Resources for the Future used the Haiku electricity model to analyze how different cap-and-trade policies would affect the electricity sector and what the resulting allowance price would be. To do this, they estimated the expected contribution from the electricity sector within an economy-wide cap-and-trade policy, which is an emission reduction of 30% from the baseline in 2020. They modeled policies for both California and the larger WCI, and they allocated allowances

through both an auction and electricity local distribution companies. This model assumed no allowance banking or offsets, but it did include a 20% RPS in California and first-deliverer compliance for imported electricity. These different scenarios yielded an allowance price of $21 to $127 (2007 dollars) per metric ton in 2020.

The table below summarizes these studies and the scenarios they modeled, including information on different model assumptions and the allowance prices in 2020. These studies indicate that allowance values in 2020 could extend over a wide range, depending on critical features of the program design.

Author **Region**	**Scenario**	**Additional Policies**	**Allowance Price in 2020[1]**
CARB (EDRAM)			
California	g Plan	Vehicle standards, 20% RPS, etc.	$10
WCI (Energy 2020)		Limited amount of offsets, banking allowed, current RPSs	
WCI	Stationary Sources		$71
WCI	Economy-wide		$24
WCI	Economy-wide - High Energy Prices		$18
WCI	Economy-wide - Low Energy Prices		$56
WCI	Economy-wide - High Natural Gas Prices		$20
WCI	Economy-wide - No Offsets	No offsets	$63
Charles River Associates, EPRI (MRN-NEEM)		No offsets, no banking	
California	Binding Reductions[2]		$60 - $100[3]
California	Safety Valve	Safety valve[4]	$60
Roland-Holst (BEAR)		No banking, no offsets, all CARB policies	
California	Economy-wide[5]		$23 - $214
California	20% Cap-and –Trade[6]		$23 - $179
California	20% with Efficiency Innovation[6]		$8 - $161
Palmer et al. (Haiku - electricity sector only)[7]		20% RPS, no offsets, no banking, first-deliverer compliance	
California	Auction		$58
California	LDC Allocation		$127
WCI	Auction		$21
WCI	LDC Allocation		$26

Notes:

[1] All prices are in 2007$/metric ton CO2e. CARB and CRA do not specify year for dollars, so we assume their dollars are for the year preceding the year in which the study was released - 2007$ for CARB and 2006$ for CRA.

[2] Multiple scenarios that meet the goal of 1990-level emissions in 2020 but vary for 2020-2050 (no reduction from 1990 emissions to 80% reduction from 1990 emissions by 2050).

[3] Values approximate because estimated from a figure.

[4] Safety valve allows additional emissions and breaks the cap.

[5] Economy-wide scenarios that vary in the effectiveness of complementary policies.

[6] Sectors covered by the cap-and-trade policy vary.

[7] Emissions targets for the electricity sector derived from the assumed contribution of the electricity sector within an economy-wide policy, assuming a linear emission path to 2020, where emissions are 30% below the 2020 baseline (64 million short tons in 2020).

In a memo to the EAAC, the Cal/EPA and ARB EAAC Policy Team summarized the assumptions and allowance prices of several studies by saying:

> "All the studies examined here include numerous assumptions about program design, fuel prices, economic growth, complementary policies, technologies, and other factors. . . Nevertheless, despite the differences in approaches and assumptions used in the studies, the review of allowance price estimates shows that allowance prices are most often estimated to be in the range of roughly $20 to $60 per metric ton of emissions in 2020."

Although the studies examined here have a larger range of prices, $8 to $214 (2007 dollars) per metric ton, due to some sensitivity analyses, the general conclusion is the same – allowance price is highly dependent on the specific parameters of the policy. Based on the studies summarized here, it appears allowance prices on the lower end of the range are due to the use of complementary policies to assist a cap-and-trade program in reducing emissions, the use of emission offsets, and the inclusion of California in a larger WCI-wide policy. The presence of allowance banking and the method of allowance allocation also have an impact on the allowance price.

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Palmer, K., D. Burtraw, and A. Paul. 2009. Allowance Allocation in a CO2 Emissions Cap-and-Trade Program for the Electricity Sector in California. <http://www.rff.org/RFF/Documents/RFF-DP-09-41.pdf>

Roland-Holst, D. 2007. Cap and Trade Scenarios for California. <http://are.berkeley.edu/~dwrh/CERES_Web/Docs/C&T_ReportDRH0711112.pdf>

Western Climate Initiative (WCI). 2008. Design Recommendations for the WCI Regional Cap-and-Trade Program. <http://www.westernclimateinitiative.org/component/remository/general/design-recommendations/Design-Recommendations-for-the-WCI-Regional-Cap-and-Trade-Program/> >

3.5 Range of Allowance Values

As mentioned, the allowance value created under the cap-and-trade program hinges on two numbers, the quantity of emissions allowances introduced under the cap and the price of allowances. The table below provides an example of plausible allowance values based on a combination of an example emission budget and expected allowance prices.

The emission budget is calculated using a constant rate of emission decline for each of the two program phases – 2012-2014 and 2015-2020. The sources covered in phase one start at their projected emission level in 2012 and follow a linear emission trajectory so as to meet their expected contribution to the emission target in 2020. Beginning in 2015, when more sources are covered for the first time, a

new rate of emission decline is assumed in order for all of the covered sources to reach the reduction target in 2020.

The expected range of allowance prices is based on the analysis of the Cal/EPA and ARB EAAC Policy Team that finds a plausible range of allowance prices of $20 to $60 (2007 dollars) per metric ton in 2020. The allowance price in earlier years is calculated using a 6% discount rate from the 2020 price, which is the kind of price path the allowance price is expected follow if banking of allowances is allowed.[30] As an example, when the example budget is combined with an assumed allowance price of $35 (2007 dollars) per metric ton in 2020, this yields a total allowance value of $4.4 billion in 2012, $11.0 billion in 2016, and $12.8 billion 2020 (all in 2007 dollars).

As stated previously, the allowance price will be highly dependent on several design parameters of the cap-and-trade policy, so the allowance value will also be dependent on these factors. The studies we reviewed previously indicate that inclusion of complementary policies, offsets, allowance banking, and a link to the WCI, as well as allocating allowances through an auction rather than to local distribution companies, all appear to yield lower allowance prices. Consequently, these factors will lead to allowance values closer to the lower end of the range shown in the table below.

	Example	Illustrative 2020 Allowance Prices and Total Value of Allowances							
		$20.00		$35.00		$45.00		$60.00	
Year	Budget ($MMTCO_2e$)	Price ($/ton)	Value (mill. $)	Price ($/ton)	Value (mill. $)	Price ($/ton)	Value (mill. $)	Price ($/ton)	Value (mill. $)
2012	200	$12.54	$2,508	$21.96	$4,392	$28.23	$5,646	$37.65	$7,530
2013	195	$13.29	$2,592	$23.28	$4,540	$29.92	$5,834	$39.91	$7,782
2014	190	$14.09	$2,677	$24.68	$4,689	$31.72	$6,027	$42.30	$8,037
2015	405	$14.94	$6,051	$26.16	$10,595	$33.62	$13,616	$44.84	$18,160
2016	397	$15.84	$6,288	$27.73	$11,009	$35.64	$14,149	$47.53	$18,869
2017	389	$16.79	$6,531	$29.39	$11,433	$37.78	$14,696	$50.38	$19,598
2018	381	$17.80	$6,782	$31.15	$11,868	$40.05	$15,259	$53.40	$20,345
2019	373	$18.87	$7,039	$33.02	$12,316	$42.45	$15,834	$56.60	$21,112
2020	365	$20.00	$7,300	$35.00	$12,775	$45.00	$16,425	$60.00	$21,900

Budget: Illustrative California cap-and-trade program emission allowance budget in millions of metric tons of carbon dioxide equivalent ($MMTCO_2e$).

Price: Illustrative emission allowance price in each year in dollars per metric ton. The price trajectory is computed assuming a 6% annual price increase, resulting in the 2020 price noted in the table.

Value: Illustrative allowance value in millions of dollars, equal to the allowance price times the allowance budget.

Table prepared by Cal/EPA and ARB EAAC Policy Team (October 20, 2009). Values are 2007 dollars.

[30] If markets are competitive and banking is allowed, then the value of an emissions allowance is expected to increase at the same rate over time as the opportunity cost of capital to the private sector. If it were to differ from that rate, for example if allowance prices grew faster than this rate, then investors would take money out of other investments and buy allowances causing the price of allowances to adjust accordingly.

4. Making Use of Allowance Value – General Considerations

4.1 The Alternatives

Section 2 contrasted the two main mechanisms for distributing allowance value – free allocation and auctioning. This section and the one following it concentrate on alternative uses of allowance value – alternative potential recipients of this value. Below we distinguish four general ways that allowance value can be used.

4.1.1 Compensation

Allowance value can be employed to provide compensation to parties adversely affected by AB 32.[31] Among such parties are owners of firms whose profits are adversely affected by California's climate policy. Climate policy can also place burdens on consumers: such policy can be expected to raise prices of fuels, and these price increases will be reflected in higher prices of consumer goods. These higher prices can be especially burdensome to low-income households, for which purchases of energy-intensive goods and services represent an especially large share of the household budget. In addition, climate policy prompts changes in employment. While it yields new types of jobs and new opportunities for employment, it causes distress by displacing some workers. Allowance value could be employed to compensate displaced workers, that is, to provide income relief while such search for and obtain other employment. AB 32 is likely to change the geographical pattern of emissions greenhouse gases and of local pollutants. Some have suggested that the initiative could in fact lead to an increase in emissions in certain areas. To the extent that this in fact happens, allowance value could be used to compensate communities where such increases occur.

Fairness considerations offer support for devoting allowance value to compensation. It may seem only fair to compensate parties that, in the absence of compensation, would endure disproportionate burdens from AB 32.

4.1.2 Dividends to the Public

Another potential use of allowance value is to provide the general public a "dividend" related to the public's having granted firms the right to make use of the waste-disposal services of the atmosphere through their emissions. If the general public is viewed as having ownership of these climate-regulating services, then it might seem appropriate to devote allowance value to the general public – in effect, this corresponds to having emitters of greenhouse gases pay the general public for

Comment [MRB15]: Matt B. comment: I support a different frame of reference: transition, not compensation, to (i) non-priced externality to priced externality and (ii) a CA only system to a national or international system

Comment [LG16]: I believe the notions of compensation and transition assistance are conceptually distinct. It may be that there's stronger basis for providing allowance value to one than the other, but nevertheless it seems appropriate to discuss both.

I suggest we include transition assistance as a separate item within the list of government expenditure options.

[31] This report focuses on methods for distributing and employing allowance value from a cap-and-trade system. However, in considering compensation, it takes account of impacts that derive not only from the cap-and-trade component of AB 32 but from the overall AB 32 effort.

the right to have access to, or to disrupt, these services. This use of allowance value resembles using allowance value to compensate households for adverse impacts of climate policy. However, the basis for supplying allowance value as a dividend is different: in this case it is a payment for a service rendered rather than compensation for an adverse impact (such as higher consumer good prices).

Support for this use of allowance value stems from the idea that the general public has a right to ownership of environmental services of the atmosphere. Requiring emitters to pay for the use (or alteration) of these services is a way of upholding this right.

4.1.3 Tax Reduction

Finally, allowance value can be used to finance reductions in taxes. To the extent that California's treasury receives revenue from auctioning emissions allowances, the state will not need to rely as much on other taxes (such as income and sales taxes) to meet given expenditure needs. Revenue from an allowance auction can finance cuts in current taxes.

Using allowance value to cut tax rates also has attractions in terms of economic efficiency. This reduces the government's reliance on ordinary taxes – taxes that lead to inefficiencies by discouraging work effort, saving, and investment. Studies indicate that by lowering the rates of existing taxes, California would enjoy an efficiency gain: the increase in income to the private sector would exceed the avoided tax payments.

4.1.4 Financing Investments and Other Government Expenditures

Allowance value can be used to finance government expenditures of various kinds. It can be used to help industry make adjustments to adopt cleaner production processes, or to support private efforts to invent new technologies that involve lower emissions. It can also be used to finance other types of investment, including investments in education or in job-training, or in various community development projects. It can be used to finance expenditures dedicated to environmental remediation. In addition, it can be used to finance adaptation projects, that is, projects to plan for and adapt to climate change.[32]

Comment [LG17]: An example would be good.

Considerations of fairness or justice can support these uses of allowance value. The support of new, cleaner technologies may be viewed as a matter of equity, since it helps avoid climate-related or other environmental assaults that current production activities might otherwise impose on current or future generations. For similar reasons, justice considerations also support the use of allowance value to finance adaptation projects, or to remediate environmental problems in disadvantaged communities. Cost-effectiveness considerations may apply as well. Allowance value can be used to promote public efforts to overcome market barriers to the development of cost-effective new technologies.

[32] Climate change poses both immediate and long-term threats to California communities, natural resources, and economic sectors. These changes can already be seen in the increased magnitude and frequency of events including heat waves, droughts and floods, increases in coastal sea-levels and land erosion, declines in drinking and irrigation water supply and quality, increases in the severity and frequency of wildfires, loss of biodiversity, and impacts to other state natural resources.

We now proceed to discuss in more detail the implications of using allowance value in each of these alternative ways. This will help guide the recommendations in Section 6 as to how to allocate allowance value across the alternative uses.

5 Making Use of Allowance Value – Examining the Alternatives

5.1 Compensation

5.1.1 Prevention of Adverse Impacts on Industry

Some firms are likely to experience a reduction in profits as a result of AB 32. This burden depends on the extent to which cost rise and the extent to which firms can pass these cost-increases forward to consumers. The increase in cost will be positively related to the energy-intensity of production, as well as the ease with which firms can switch to production processes involving lower energy intensity.

The ability to pass forward the cost-increases depends on supply and demand. The less responsive is demand to a change in price, the greater will be the ability of industry to pass changes in costs on to consumers. This would occur because consumers will bear the burden of a higher price and not change their purchase decisions significantly. The greater is the responsiveness of supply, the smaller is the profit loss to the firm. The elasticity of supply is closely related to the mobility of physical capital. An industry with mobile capital can avoid the costs of the program by transferring its capital to other uses. Both these characteristics would imply that firms would suffer relatively less harm from the program. In addition, a firm with many options for abatement would incur lower costs implying less cost for both consumers and producers.

The primary way that previous trading programs have compensated firms has been through free allocation based on a historic measure of performance such as emissions, known as "grandfathering." However, theoretical and empirical analyses, as well as recent experience in the European Union's Emissions Trading Scheme, indicate that grandfathering can lead to windfall profits: the value of the allowances given to firms exceeds the profit losses that the firms would otherwise suffer.

The intent to compensate the owners of a firm for the loss in the firm's value with grandfathering runs up against other potential program objectives, for example the desire to lessen the impact on residents of California, and to help the state prepare for the emerging global economy. The grandfathering approach would deliver free allowances "with no strings attached" meaning that the firms would have no obligation to redirect the allowance value toward investment in the state. According to the U.S. Treasury, over 10 percent of securities in U.S. firms are foreign held, meaning that compensation to the owners of the firms would go overseas. It follows that U.S. citizens living outside

Comment [LG18]: The material in this subsubsection is very good, but it probably could be tightened up. Some of the material repeats ideas from Section 2.

Also, to parallel the empirical information supplied elsewhere in Section 5, I'd recommend we include some estimates of the potential profit impacts of AB 32 on various industries in the absence of compensation.

Comment [LG19]: This does not include info from Nancy Sidhu's notes on impacts on small business.

California own a substantial majority of securities of firms doing business in California. Consequently, directing allowance value to compensate owners of firms is not linked to new investment in California.

Another challenge in compensating the owners of firms is the difficulty of matching the recipient and the person originally harmed. The harm to shareholders occurs when the market recognizes the new cost of a regulation and anticipates the change in profits that are likely to result, a process that is likely to have begun with the passage of AB32 in 2006 in California, if not long before. In the intervening period, shares in the firm change hands. The owners today are not the same persons who owned the firm in the past. Unless the market in 2006 anticipated free allocation, owners suffered a loss then that would not be directly compensated by the decision to direct free allocation to these firms today.

Nonetheless there can be substantial impacts on industry from regulation and those impacts can ripple through California causing lost employment opportunities and other disruptions to communities. The problem can be so severe as to undermine the environmental integrity of the cap and trade program, because if economic activity leaves the state and locates in regions that do not regulate emissions then global emissions could actually increase. This outcome is labeled "leakage" meaning that emissions reductions in the state leak out of the program and occur elsewhere.

Comment [LG20]: Again – let's give some numbers.

To avoid or lessen leakage as well as the impacts on industrial activity and employment, California could adopt output-based allocation, which involves updating. (This form of allocation was described in Section 2.) In contrast to grandfathering, which simply tries to compensate for the lost value but does nothing to mitigate the impact, output based updating makes free allowances conditional on the level of economic activity measured as value added, which corresponds closely to employment. Under this approach, firms would have a compliance obligation to surrender emissions allowances for their emissions, but they might be eligible for a rebate of their allowance burden including the change in costs for electricity associated with the program. Rebates could be benchmarked to "best practice" in the industry so that firms have an incentive to reduce their emissions.

Two criteria would define the eligibility of a firm for a rebate. One is whether it is energy intensive, meaning that its operating costs are affected in an important way. The second is whether it is trade exposed, meaning that it operates in a market with import competition from out of state or that it exports to other markets. The two leading federal proposals <WM and KB – get titles> both include allocations for energy intensive trade exposed industries. Eligibility is conditional on the finding of an agency according to specific criteria, and the finding would be reviewed on a regular, perhaps annual basis. In California such a finding could be managed practically by the ARB. This process allows for automatic adjustments in the program under various scenarios such as the expansion of cap and trade to other states or the nation. In that case, the measure of trade exposure would change, and the qualification for rebates would also adjust.

There are disadvantages to output based updating allocation, or rebates. The rebates reduce the change in price of the final product, just as rebates on other products do (although in this case the rebate is received by the producer not the consumer). The reduced price erodes the price signal that is intended by the cap and trade program, and consequently consumers do not receive the proper incentive to substitute away from energy intensive goods that have high CO2 emissions. Greater activity in this industry implies that greater emissions reductions have to be achieved in other ways and at higher costs in order to achieve the emissions cap, implying higher costs overall. However, the trade

off is that leakage can be reduced and the impact on employment in the energy intensive trade exposed industries is also reduced.

The other alternative often mentioned at the federal level is border tax adjustments. Because of California's status as a state, the commerce clause of the U.S. constitution precludes it from implementing this approach.

5.1.2 Compensation to Displaced Workers

Owners of California businesses are not the only ones concerned about possible impacts of the AB 32. Employees also worry that their firms will shrink or close down their California operations to reduce or avoid these impacts. Fairness considerations suggest that compensating the workers most severely impacted by AB 32 is another justifiable use of allowance value. Such value could be used to fund worker transition assistance (WTA) for California firms' employees who lose their jobs [or their full-time status] due to the AB 32 greenhouse gas reduction program. The assistance would be designed to give these displaced workers the time and resources to carry out a job search and, if necessary, the training to find a new job in another industry.

A model for this type of program already exists. The federal Trade Adjustment Assistance (TAA) program provides such assistance to workers who lose their jobs or their full-time status, either because the firm's customers switched to foreign suppliers or because the firm relocated the production facility to a foreign location. The federal process appears to be simple, though in practice it can take a good deal of time. A brief review of the TAA process follows:

- First, a two-page petition must be filed--by a group of affected workers, a union official, a representative of the local One Stop Career Center, or an officer of the company. The petition will be administered by the Department of Labor in Washington and a local TAA coordinator (the local Workforce Investment Board or One Stop Career Center).
- The company will be asked to provide pertinent information about its business and its customers. The firm's customers also may be asked to provide information. Important note: the whole process moves faster if this information is supplied promptly. The DoL will not certify the petition until after it has received satisfactory responses to its requests for information.
- TAA benefits can include cash transition payments, job search assistance, relocation allowances, and trade training.

5.1.3 Compensation to Disproportionately Affected Consumers

California households will have face higher prices directly for electricity, natural gas, and gasoline, and indirectly as businesses pass costs for GHG reduction on to consumers. [ADD: reference to estimates of likely price increases from Economic Analysis chapter?]

Comment [LG21]: Yes, good idea. Also would be good to show the impact on real household income absent compensation. Perhaps we can draw from Dan Kammen's work for this.

These higher prices can be expected to a regressive impact: as a percentage of their incomes, they will hit low-income households harder than upper-income households. This is because a larger fraction of the budget of low-income households is spent on relatively carbon-intensive goods (such as household fuels), whereas upper-income households generally spend a larger fraction on other goods and services.[33]

Comment [LG22]: let's supply some numbers.

Compensating Consumers via Direct Provision of Allowance Value

From a fairness standpoint, there is a case for compensating low-income consumers for the impact of higher energy prices on their real incomes. From an efficiency standpoint, however, it would be costly to blunt or negate the impact of the newly introduced price signals by subsidizing energy use. Cash transfers could provide compensation without reducing incentives for to conserve energy.

Comment [LG23]: **Matt B comment** – need to understand how PUC policy impacts low income customrers – if PUC doesn't pas on the increased cost, there is no case for compensation

From an administrative standpoint, allocating allowance value to compensation for low-income consumers would require the development of criteria and procedures for "means testing" to determine eligibility.

A precedent for such compensation is the American Clean Energy and Security Act (Waxman-Markey bill), passed by the U.S. House of Representatives in June 2009, which allocates 15% of allowance value to relief for low-income households. Under this bill, eligible households (with incomes at or below 150 percent of the official poverty line) would receive a monthly refund via the Electronic Benefit Transfer (EBT) cards that states already use to deliver food stamps and other benefits, or via an increase in the Earned Income Tax Credit.

Compensating Consumers via Lower Electricity Prices

Another way consumers may be disproportionately affected is through changes in electricity prices which depend on the source of electricity supply, which varies geographically across the state. In some service territories consumers rely to a relatively greater extent on high-emitting out-of-state generation sources due to previous investments or long-term power purchase agreements that lock in the purchase of this power for years into the future. Historically, these agreements have delivered relatively low cost power to these customers and in so doing it has reduced their incentive to invest in efficiency. In other regions, customers have invested aggressively in energy efficiency. Consequently, the introduction of a price for CO2 could cause changes in electricity prices that vary geographically across the state and affect households in different ways, especially in the near term before new sources of supply are identified and brought on line and additional investments in energy efficiency are realized.

The regional disparities in price changes might be mitigated through compensation that takes the form of allocation of allowance value to electricity local distribution companies (LDCs) which are regulated by the CPUC or are public utilities. In either case they can be expected to act as trustees on behalf of consumers with respect to the disposition of free allowances or allowance value they receive. This approach is embodied in the CPUC/CEC staff recommendation. The same approach could be extended to natural gas consumers who receive supplies from an LDC.

[33] See also the Appendix to this Report on "Dividends."

There are potential disadvantages to this approach. First, it is crucially important that the program provide strong price signals to encourage the rapid replacement of inefficient capital. To preserve the incentive to rapidly transition to more efficient capital the CPUC/CEC recommended a four-year phase out of this allocation approach.

Second, as initially indicated in Chapter 2 <check to avoid repeating them>, the natural way for LDCs to pass on allowance value to their consumers is to reduce electricity prices, but this reduces the information that consumers receive about the need to change habits. An alternative would be to apply the allowance value to reduce the fixed portion of customers' electricity or natural gas bill that deals with the distribution network; however, bills are not organized in a way that separates the fixed portion from the energy use portion. Some have suggested lump-sum payments back to customers in a separate envelope, but that could invite a proliferation of customer accounts to receive additional payments and it is not obvious how to address multi-unit buildings. These disadvantages need to be balanced against the advantages of free allocation to LDCs.

Third, customers in regions that already have reduced their energy use should not be penalized for their efforts. Moreover, most households in regions that are expected to experience relatively greater changes in electricity prices reside in regions with relatively lower demand for home heating and they will face lower changes in those costs. Hence, the net effect on households should be taken into account, rather the effect with respect to one particular type of energy use.

If there were to be an allocation of allowance value to LDCs, an important question is how that allowance value would be apportioned among LDCs. Three ways are possible: on the basis of population, consumption or emissions embodied in energy use. The leading federal climate proposals (H.R.2454 and S.1733) propose apportionment among electricity LDCs according to a formula that provides 50 percent weight on emissions in a historic base period and 50 percent weight on consumption updated each year. This formula has won widespread support from diverse interests in the electricity industry nationally, but it has the disadvantage that it rewards consumption at the expense of investments in energy efficiency. An improvement might be to include avoided energy consumption achieved through energy efficiency ("nega-watt hours") to the consumption basis of the calculation.

Other Ways to Compensate Consumers

There are also other existing programs to assist low-income consumers, such as low-income energy efficiency programs, transit passes, rate assistance, and commuter checks that could be used as vehicles for compensating disproportionately impacted consumers.

It may be noted that the allocation of allowance value to dividends (see section 5.2) would reduce or eliminate the need for compensation to low-income consumers, as they stand to receive the largest net benefits (dividends minus costs from higher fuel prices) from a cap-and-dividend policy.

5.1.4 Environmental Compensation

A final candidate for compensation may be communities – if any -- that experience adverse environmental impacts as a result of AB 32 implementation.

Section 38570(b) of AB 32 mandates that "to the extent feasible" ARB shall consider "localized impacts in communities that are already adversely impacted by air pollution" and "design any market-based compliance mechanism to prevent any increase in the emissions of toxic air contaminants or criteria air pollutants." For the state as a whole, AB 32 will reduce not only GHG emissions but also various "co-pollutants" -- pollutants that result from the same processes that are involved in generating GHG emissions. Co-pollutants include reactive organic gases, carbon monoxide, nitrogen oxides, sulfur oxides and particulate matter. Even so, it is conceivable that as GHG emissions are reduced statewide, some localities will experience increased emissions of GHGs and the associated co-pollutants. Such increases would be of particular concern if they happen in disadvantaged communities that are already overburdened by disproportionate exposure.

It is not possible for the ARB or EAAC to ascertain in advance whether or to what extent AB 32 implementation will be accompanied by the emergence of "hot spots" where co-pollutant damages do, in fact, increase. Should this occur, however, such communities could have a claim for compensation. Such environmental compensation would be distinct from and additional to the provision of allowance value for investment in disadvantaged communities, discussed in section [x] below.

We cannot know in advance the extent to which AB 32 implementation will result in the emergence of "hot spots" where co-pollutant emissions increase, even as overall emissions decline statewide. Quantitative information on this issue is expected to be obtained during AB 32 implementation. As the Scoping Plan states:

> *ARB already conducts robust environmental and environmental justice assessments of our regulatory actions. Many of the requirements in AB 32 overlap with ARB's traditional evaluations. In adopting regulations to implement the measures recommended in the Scoping Plan, or including in the regulations the use of market-based compliance mechanisms to comply with the regulations, ARB will ensure that the measures have undergone the aforementioned screenings and meet the requirements established in HSC sec 38562(b)(1-9) and sec 38750(b)(1-3).*[34]

The referenced HSC (Health and Safety Code) sections include AB 32's provisions that ARB shall "ensure that activities undertaken to comply with the regulations do not disproportionately impact low-income communities" and "consider the potential for direct, indirect, and cumulative emission impacts …, including localized impacts in communities that are already adversely impacted by air pollution."

In implementing the cap-and-trade element of AB 32, ARB must collect information to ensure that GHG emissions by regulated entities are within the limits set by the number of permits they hold. This will assist in identifying any localities where GHG emissions (and hence co-pollutants) actually increase.

If the ARB finds increased co-pollutant burdens in some communities, a share of allowance value could be allocated for compensation to these communities (with commensurate reductions in the

[34] ARB, *Climate Change Scoping Plan: A Framework for Change.* Pursuant to AB 32, The California Global Warming Solutions Act of 2006, December 2008, p. 106. Online at http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf.

share of allowance value allocated to other uses). Since the extent of such claims cannot be known in advance, this can be regarded as a contingent use of allowance value.

5.2 Dividends to the Public[35]

The return of carbon permit auction revenues to the public in the form of equal per capita dividends – sometimes called a "cap-and-dividend" policy – transfers allowance value to households, leaving decisions on the final use of the money to the public. The rationales advanced for this policy include:

1. *The principle of common ownership of nature's wealth:* Cap-and-dividend is founded on the premise that rights to the limited carbon storage capacity of the atmosphere – and hence to share in the "rent" (permit revenue) obtained from its use – belong equally to all.

2. *Protection of household real incomes:* Dividends help to shield household real incomes from the impact of higher fossil fuel prices that result from an emissions cap. The net effect (dividends minus price impacts) on any individual household varies – those with the smallest "carbon footprints" see the biggest gain – but all households receive a tangible payment that reminds them of the benefits of the policy, while at the same time having a clear price incentive to reduce their consumption of fossil fuels,.

There are several precedents for this approach. One is the allocation of revenues to this use is the Alaska Permanent Fund, which recycles oil-extraction royalties to Alaska residents as equal per-person dividends. The Alaska fund affirms the principle of common ownership of nature's wealth, and demonstrates that it is feasible for state government to administer a dividend policy. A second is the American Clean Energy and Security Act (or Waxman-Markey bill), passed by the U.S. House of Representatives in June 2009, which would establish a Climate Change Consumer Refund Account that would provide *tax refunds on an equal per capita basis to each household in the United States.*[36] *If the Act becomes law, disbursements under this account are expected to amount to roughly 50% of allowance value from 2030 onwards.*

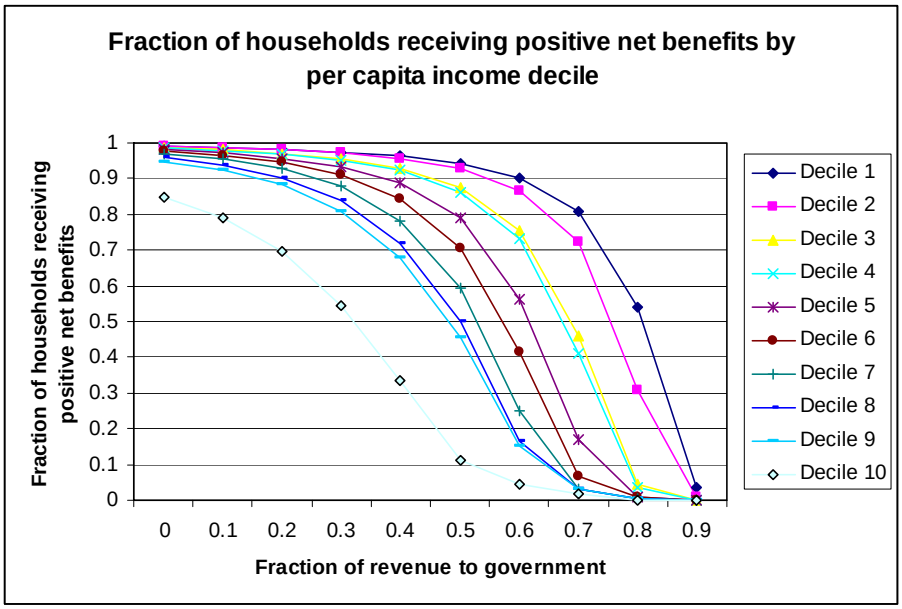
In terms of environmental considerations, dividends forego possible gains from using auction revenue to achieve deeper GHG emission reductions in locations with high co-pollutant burdens. From an efficiency standpoint, dividends also forego possible additional gains (above and beyond those resulting from carbon pricing alone) via use of revenue for tax shifting (see below). From a fairness standpoint, dividends have two main attractions: first, they offer universal coverage based on the principle of common ownership of nature's wealth; and second, they reduce income inequality since all residents receive the same dollar amount regardless of their income level.

Comment [LG24]: Matt B comments:

Alternatively, instead of either /or, dividends could be thought of as the fall back use either (i) temporally after an initial transition period or (ii) in any year in which compensation and investment uses are exhausted but additional money is still available.

We have talked about the importance of temporal concerns, and I think there is an important one here: the federal law does not dividend much until 2030, because we need time to transition, and allowance value is an important resource for aiding that transition. Similarly, in California, we should consider that dividends might be a more attractive option in the medium or longer term , while uses that aid transition (ie: investments in low-carbon options) are more important in the short term.

[35] See also the Appendix to this Report on "Dividends."
[36] H.R. 2454 as passed by the U.S. House of Representatives, 26 June 2009, Section 789(a).



In terms of simplicity, dividends are an exceptionally transparent use of allowance value. The federal American Clean Energy and Security Act proposes to disburse them via tax refunds to all U.S. nationals and legal residents. Alternatively – and more visibly – they could be disbursed by means of ATM cards, similar to those used today to access Social Security payments: at the ATM, individuals could view the auction revenue deposits into their accounts, withdrawing available funds at their convenience.

Comment [LG25]: We should refer in the text to the graph above, and identify the study from which it emerges. Also, need to make clear whether these results pertain to California or the U.S. as a whole.

If dividends are taxable, a fraction of the allowance value distributed through this route ultimately returns to government. This revenue stream becomes available other uses, including tax shifting or defraying the impact of higher fuel prices on government purchasing power. On fairness grounds, larger taxable dividends may be considered preferable to the alternative of withholding an equivalent amount of auction revenue for government and returning smaller non-taxable dividends to the public, since the latter would be equivalent to a "head tax" in that it takes an equal dollar amount from each person regardless of income. At a carbon price of \$30/tCO_2, the following table shows the estimated state government revenue in 2020 from taxing dividends given to adults in CA. This table assumes an average income tax rate of 5.6%.[37]

[37] Franchise Tax Board, http://www.ftb.ca.gov/aboutFTB/Tax_Statistics/Reports/Personal_Income_Tax/AGIC_Tables/2006/PDF/2007_Comparison_By_Tax_Years.pdf

Fraction of auction revenue returned as dividends	1	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
State tax revenue (million $)	$440	$400	$350	$310	$260	$220	$180	$130	$88	$44

5.3 Tax Rate Reduction

Another potential use of proceeds from an allowance auction is to finance cuts in existing California tax rates – in particular the rates of income or sales taxes. This effectively substitutes auction revenue for other taxes as a way of meeting the state's spending needs.

Like the cap-and-dividend option described in the previous subsection, this is a way to provide allowance value to households. However, while cap and dividend offers allowance value as a lump-sum or rebate, this approach offers such value through cuts in marginal tax rates.

A principal attraction from using auction revenue to cut marginal rates is the ability to lower the costs of a cap-and-trade program. Income and sales taxes lead to reduced production and incomes by reducing work incentives as well as incentives to save and invest. In economics lingo, these are "distortionary" taxes – taxes that cause the overall economy to shrink (even after recycling the tax revenue or devoting the revenue toward public spending). The magnitude of the distortion increases with the tax rate. The "marginal excess burden" from these taxes has been estimated to fall in the range of $.20 to $1.00 – which means that, for every extra dollar collected from these taxes, the loss of value created by the private sector (before returning the tax revenue) is between $1.20 and $2.00.[38] Using auction revenue to finance cuts in the marginal rates of these existing taxes enables the state to avoid this excess burden. In effect, by using auction revenue to finance tax cuts, California relies on a non-distortionary source of revenue – the proceeds from allowance auction – as a substitute for distortionary taxes such as income and sales taxes. One can think of as akin to green tax reform. [39]

[38] See, for example, Stuart (1984), Browning (1987), and Jorgenson and Yun (1991). (References cited: Browning, Edgar, K., 1987. "On the Marginal Welfare Cost of Taxation." American Economic Review 77: 11-23. Jorgenson, Dale and Kun-Young Yun, 1991. "The Excess Burden of the US Tax System." Journal of Accounting, Auditing, and Finance 6: 487-509. Stuart, Charles, 1984. "Welfare Costs per Dollar of Additional Tax Revenue in the United States." American Economic Review 74: 352-62.)

[39] Another option, applicable In other settings, is to use auction proceeds to finance reductions in the deficit. Reducing the budget deficit implies lower future taxes because it leads to lower debt and lower interest payments that must be financed through future taxes. It therefore yields cost-savings much like cuts in current tax rates do. However, since California law requires the state to balance its budget, the deficit-reduction issue does not apply here.

The cost-savings under California's cap-and-trade system could be substantial. This total saving is equal to the avoided excess burden, which is net reduction in collections from existing taxes times the marginal excess burden of those taxes. Table <xx> in Section 3 offered estimates of total allowance value from AB 32. For the year 2015, the estimates ranged from $6 to $18 billion. Suppose that the auctioning of emissions allowances were bring in net revenue of $10 billion. [40] Based on the estimates for marginal excess burden immediately above, devoting this net revenue to cuts in income tax rates would save between 2 and 10 billion dollars in that year -- a very large share of the allowance value. These would be real savings in income to Californians.

Using allowance value to finance tax-reductions mainly serves cost-effectiveness objectives. On its own, or in its simplest form, it would not serve some other important goals. In particular, if allowance value is used to cut the rates of income taxes, then households that are already exempt from income taxes (perhaps because of very low incomes) would not benefit from the rate cuts. This raises equity concerns. However, not all allowance value needs to be devoted to tax rate cuts. This approach does not preclude other uses of allowance value, including the targeting of some allowance value to compensate low-income households, as discussed in subsection 5.1. A hybrid program in which allowance value is used both for tax-rate reduction and targeted compensation is an attractive way both to achieve considerable cost-savings while accomplishing fairness goals in a targeted way. While the cap-and-dividend approach has several attractions, it cannot bring about these cost savings and need not have any advantage in terms of income distribution relative to the hybrid. [41]

However, some further potential limitations of financing tax-rate reductions deserve recognition. First, it may be administratively difficult to guarantee that the proceeds from an allowance auction will indeed be accompanied by tax rate cuts. In addition, the benefit to households from this approach is likely to be less visible than under some other options such as cap and dividend.

Comment [LG26]: Should indicate here who would have administrative authority, and any legal challenges.

[40] We refer to *net* revenue because the relevant value is gross auction revenue minus the change in tax revenue associated with changes in the tax base. To the extent that AB 32 reduces (increases) state income, the income tax base will fall (rise), and revenues from other taxes will fall (rise) as well.

[41] Another way to serve fairness objectives is to use allowance value to finance cuts especially large cuts in marginal tax rates for households with lower incomes that are in the lower tax brackets. This helps avoid or reduce potential regressivity, but unlike the hybrid approach it does not help low-income households that already pay no income taxes.

5.4 Public Financing of Investments and Other Public Expenditure

Some portion of allowance value can be used to finance investments or other expenditures that would reduce the overall cost to California of meeting AB 32's emissions limits, as well as help achieve AB 32's other goals. Investments could be put towards a number of different areas, such as existing greenhouse gas (GHG) emission reduction programs; efforts to adapt to future climate change; research, development and deployment (RD&D) of new clean technologies; capital investments, including new infrastructure; job training; and programs or projects centered on disadvantaged communities. Additionally, public expenditures could be used to help fund the efforts of state and local agencies to meet their legislated GHG mandates. This section first offers general rationales for devoting auction revenues toward investments or other public expenditure, and then examines several categories of investment in more detail. It concludes with a brief discussion of how to compare investment options.

5.4.1 Rationales for investments

Investment in GHG reductions could save money for California. It could do this in three ways:

- *Helping to overcome other market failures*. Many low-cost opportunities to reduce GHG emissions exist today but are not being implemented because of barriers impeding their adoption in the marketplace. Investment can help mitigate the under-provision of GHG-reducing programs and technologies.

- *Providing valuable "learning by doing" experience*. Facilitating greater experience with GHG-related programs and technologies can help reduce the cost and increase the efficiency of their installation and operation.

- *Reducing emissions in the near term*. Investment in GHG reduction now can help avoid the greater cost of more dramatic reductions later.

As ARB's Scoping Plan[42] and McKinsey's report[43] on GHG reductions illustrate, there are many negative-cost opportunities to reduce GHG emissions. (See Figures 1 and 2). The fact that these cost-saving opportunities already exist and remain untapped, however, suggests that they face non-price market barriers.[44] Thus, even though the creation of a cap-and-trade program will help put a price on

[42] California Air Resource Board Scoping Plan (December 2008), available at: http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm

[43] McKinsey & Company, "Reducing Greenhouse Gas Emissions: How Much at What Cost?" (2007), available at: http://www.mckinsey.com/clientservice/ccsi/pdf/US_ghg_final_report.pdf

[44] Much has been written about the pervasive market barriers to adoption of GHG reduction strategies. See, e.g., Marilyn Brown et al., *Carbon Lock-in: Barriers to Deploying Climate Mitigation Technologies*, Oak Ridge National Laboratory, sponsored by U.S. Climate Technologies program, revised January 2008; Golove, W.H. and J.H. Eto, "Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency," Lawrence Berkeley National Laboratory, LBL-38059, March 1996, available at:

carbon that spurs beneficial actions in the marketplace, the price signal alone might not be enough to enable California to capture the lowest-cost reduction opportunities.

California can pursue cost-effectiveness by capturing all of the low-cost reduction opportunities on the low end of the cost curves shown in Figures 1 and 2, and only going as high up the marginal abatement cost curves as is necessary to meet the emissions limits. If the state cannot overcome all the non-price market barriers to capture the lowest-cost opportunities and instead skips (or under-utilizes) these and implements higher cost measures instead, AB 32 will cost the state more.

Figure 1: Scoping Plan Marginal Abatement Cost Estimates[45]

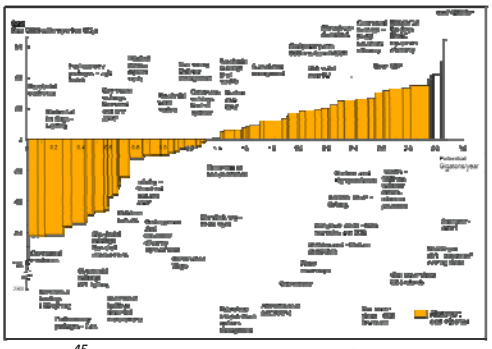


Figure 2: McKinsey's "Mid-Range Case" U.S. Cost Curve [46]

5.4.2 Investment options

Allowance value could be used to invest in low-cost reduction opportunities that face market barriers. Achieving low-cost reductions that would not be achieved through the market alone will lower the overall cost of California's emission reduction program.

Investment in Energy Efficiency[47]

http://eetd.lbl.gov/EA/emp/reports/38059.pdf.; ETAAC Advanced Technology Draft Report for Public Review (Sept. 18, 2009); available at: http://www.arb.ca.gov/cc/etaac/meetings/102909pubmeet/mtgmaterials102909/public_review_draft_ETAAC_advance_tech_update_9-18-09.pdf

[45] Jim Sweeney, Presentation to Economic Modeling Subcommittee, August 13, 2009, available at: http://www.climatechange.ca.gov/eaac/meetings/2009-08-13/presentations/Economic_Modeling_Subcommittee.pdf

[46] McKinsey & Company, "Reducing Greenhouse Gas Emissions: How Much at What Cost?" (2007), available at: http://www.mckinsey.com/clientservice/ccsi/pdf/US_ghg_final_report.pdf

[47] The Scoping Plan estimates California will save 4.3 MMTCO2 by 2020 from commercial and residential energy efficiency (measure CR1; see Table 8), with savings of $109 per MTCO2. Note: this measure consists of natural gas reduction programs (800 million therms saved) utility energy efficiency programs, building and appliance standards, and additional efficiency and conservation; none of the measures deal specifically with residential EE. The Scoping Plan does not include mandatory provisions for industrial energy efficiency, so this is potentially ripe for investment.

Market Barriers. Energy efficiency is a low-cost emission reduction opportunity that faces numerous non-price market barriers, including.[48]

- **Split incentives**: The potential purchaser/owner of the energy efficient product often is not the consumer/user of the energy (e.g., landlords are in a position to buy more efficient air conditioning systems, but it is the tenants that pay the energy bill each month).[49]
- **High upfront costs**: Purchasers of energy efficient products can be dissuaded by their high upfront costs, coupled with a lack of access to capital and the "payback gap" (where potential buyers of efficiency demand a much shorter payback period than do potential builders of new fossil-fuel power plants).[50]
- **Informational barriers:** Potential purchasers of energy efficient products often lack of knowledge about what energy efficiency options are available to them[51], how their life-cycle costs compare to less efficient options,[52] and how the different technologies are expected to perform. Moreover, there are transactions costs associated with obtaining and processing this information.

Estimates indicate that these sorts of market barriers cause consumers nationally to use at least 20-40% more electricity than they would in a well-functioning, cost-minimizing market.[53]

Using Allowance Value to Overcome Market Barriers. California's efficiency codes and standards for new buildings and appliances and utility energy efficiency programs have a long history of overcoming market barriers and achieving cost-effective energy efficiency. While the state's desire is to capture all cost-effective energy opportunities, utilities and agencies need to continue to expand their energy efficiency efforts to reach that goal.[54] Auction revenue could be used to supplement existing funding sources to expand efficiency efforts. [55]

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[48] See Appendix for additional market barriers facing energy efficiency measures.

[49] The ACEEE, for instance, found that split incentives (also referred to as the 'principal-agent problem') affects 40-90% of commercial leased office space energy use. See "Quantifying the Effects of Market Failures in the End-Use of Energy" (2007); available at: http://www.aceee.org/Energy/IEAmarketbarriers.pdf.

[50] See, e.g., ETAAC Advanced Technology Draft Report for Public Review (Sept. 18, 2009); available at: http://www.arb.ca.gov/cc/etaac/meetings/102909pubmeet/mtgmaterials102909/public_review_draft_ETAAC_advance_tech_update_9-18-09.pdf

[51] For example, small businesses generally have fewer resources with which to monitor government policy so are less aware of subsidies, financing schemes, and other policies aimed at implementing clean energy technologies. Id (citing UK study).

[52] See id.

53 Cavanagh, R., "Energy Efficiency in Buildings and Equipment: Remedies for Pervasive Market Failures," National Commission on Energy Policy, Technical Appendix, Chapter 3: Improving Energy Efficiency; December 1, 2004, http://bipartisanpolicy.org/sites/default/files/TA_C3.pdf (pp.1-5).

[54] See, for example, the California Energy Commission's Draft "2009 Integrated Energy Policy Report" discussing some additional steps needed to reach the state's goal of capturing all cost-effective efficiency (pp. 3-5, available at http://www.energy.ca.gov/2009publications/CEC-100-2009-003/CEC-100-2009-003-CTD.PDF), and the CEC's December 2008 staff report "Achieving Cost-Effective Energy Efficiency for California: An AB 2021 Progress Report" noting that the publicly-owned utilities must continue to significantly expand their programs to achieve their energy saving targets (available at http://www.energy.ca.gov/2008publications/CEC-200-2008-007/CEC-200-2008-007.PDF).

[55] See Appendix

Investment in New Technologies

Allowance value could also be used to invest in research, development and deployment (RD&D) of clean energy technologies. Recent studies show a pervasive decline in private sector investment in energy RD&D, which underscores both the effect of market barriers and the need to combat them with public investment.[56]

Market Barriers. Private companies systematically under-invest in RD&D for new low- and zero-carbon technologies for a number of reasons.[57] Several studies suggest that obtaining funding is particularly difficult for projects in the development and demonstration phase. This is the "Valley of Death," seen in Figure 3. This presents a formidable challenge for private companies to develop and deploy low carbon technologies.[58]

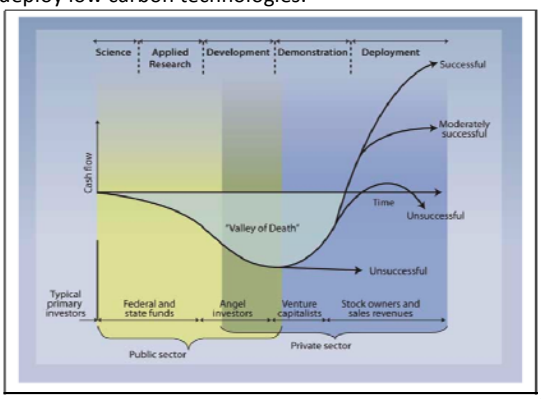

Figure 3: From Innovation to Market: the Valley of Death[59]

Using Allowance Value to Overcome Market Barriers. Allowance value should be channeled into programs and policies targeted at overcoming the market barriers impeding private investment in RD&D.[60] In particular, allowance value could be deployed during the technology demonstration/pre-commercialization phase in a product's life cycle, which ETAAC has identified as the critical stage for public financing.[61] As Figure 3 above depicts, private investors are less willing to invest in technologies

Comment [LG27]: Economists often refer to knowledge spillovers as a main source of under-investment in R&D or innovation – that is, entrepreneurs underinvest because they cannot appropriate all of the social return from their efforts – some of the knowledge they generate spills over to and benefits other parties. I think we should refer to this in this subsubsection..

Comment [LG28]: **Matt Barger comment:**

I personally am skeptical the "Valley of Death" exists for Clean Tech Ventures- there is a plethora of VC money dedicated to this area.

[56] See, e.g., Gregory F. Nemet & Daniel M. Kammen, "U.S. Energy Research and Development: Declining Investment, Increasing Need, and the Feasibility of Expansion" (2007) (finding that private investment in energy R&D, which previously contributed about half of the nation's total investment in energy R&D during the 1980s and 1990s, now accounts for 24%; investments in energy R&D by U.S. companies fell by 50% between 1991 and 2003; and, overall, the U.S. invests about $1 billion less in energy R&D today than it did a decade ago).

[57] See Appendix

[58] See, e.g., Marilyn Brown et al., "Carbon Lock-in: Barriers to Deploying Climate Mitigation Technologies," Oak Ridge National Laboratory, sponsored by U.S. Climate Technologies program (revised January 2008).

[59] Marilyn Brown et al., "Carbon Lock-in: Barriers to Deploying Climate Mitigation Technologies," Oak Ridge National Laboratory, sponsored by U.S. Climate Technologies program (revised January 2008).

[60] See Appendix for list of existing institutions currently working on clean-tech RD&D

[61]] ETAAC Draft Final Report: "Technologies and Policies to Consider for Reducing Greenhouse Gas Emissions in California," available at:

as they advance from invention to commercialization because of the difficulty of managing market, regulatory, and other risks.[62] At this point, when return on investment cannot be readily projected, additional funding is necessary to see if the technology has commercial promise.[63]

Targeted Investment Tax Credit

An investment tax credit (ITC) granted to firms that invest in new equipment that reduces greenhouse gas emissions can be justified as an "investment" use proposed for the allowance value created by California's cap and trade program.

- By reducing the net after-tax capital costs incurred, the ITC would help all California businesses that utilize the credit to finance their investment in new technologies.
- This would be especially helpful in situations where there are split incentives to make such investments. For example, the ITC would encourage owners of residential, commercial and industrial space to make their buildings more energy efficient even though their tenants stand to benefit through reduced energy bills.
- Also, making an ITC available in the early years of the AB 32 regulatory regime would incentivize businesses to adopt the new technologies sooner than might otherwise be the case.

This proposal would target for relief California businesses investing in mandated or optional equipment and structure improvements that reduce greenhouse gas emissions by granting a special investment tax credit (ITC) against the cost of such purchases.

Except for the state's energy utilities, little information is publicly available as to the estimated gross initial capital expenditures California businesses will be required to make under the AB32 implementation plan. However, there is great concern among businesses throughout the state, especially small businesses, that these costs will be very large and burdensome. A significant targeted investment tax credit would help to reduce initial capital costs and relieve some of these concerns.

As part of their demand management programs, several of the state's energy utilities offer discounts and rebates to their commercial and industrial customers against the purchase of specified energy-saving equipment or building improvements. Because they reduce the net cost of acquiring such equipment, these programs are the functional equivalent of targeted tax credits. However, they are typically special-purpose offerings and not available to all businesses in all industries for all types of emission-reducing equipment or structural building improvements.

Investments in Job Training

Job training can be justified as another type of investment financed by allowance value. Such an investment would help ensure the state has an adequate supply of trained workers to staff the new jobs opening up in the green economy.

Comment [LG29]: The ideas and info expressed here are great. But it now occurs to me that this ITC is an instrument for achieiving investment, whereas the other items in this subsection are types of investment. My feeling is it would be better to refer to the ITC (and offer much of the information here) within the discussion of investments in energy efficiency and the discussion of funding R&D – that is, we use allowance value to fund an ITC for these two purposes.

We could indicate, for example, that allowance value could be used to support investment in new technologies through a targeted investment tax credit.

Perhaps we should distinguish offering a credit for purchases of equipment from a credit for expenditures on R&D.

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http://www.arb.ca.gov/cc/etaac/meetings/021108pubmeet/meeting_handouts_and_materials/etaac_final_draft_2-11-08-sc.pdf.

[62] Marilyn Brown et al., "Carbon Lock-in: Barriers to Deploying Climate Mitigation Technologies," Oak Ridge National Laboratory, sponsored by U.S. Climate Technologies program (revised January 2008).

[63] [section in progress] Id.

More than 100,000 California workers were employed in the "green economy"[64] in 2007, and the number of green jobs is expected to grow rapidly, boosted by federal stimulus spending and the new opportunities created by AB32 related programs and regulations. It's important that the state's workforce be prepared to take on the new green jobs when the openings arise; such timeliness will hasten reductions in the state's greenhouse gas emissions.

Investment in Disadvantaged Communities

AB 32 specifically directs the ARB to consider the needs of disadvantaged communities.[65] These communities also frequently bear disproportionate air pollution impacts, and AB 32 specifically directs CARB to maximize co-benefits of GHG emission reduction and complement state efforts to improve air quality.[66] Allowance value could be used to reduce emissions of GHGs and co-pollutants while simultaneously achieving California's goals of assisting disadvantaged communities. Some opportunities to do this are encompassed in the categories above of low-income energy efficiency programs, public transit, and land use planning. More could be done by directing targeting a portion of allowance value specifically to these communities.

Allowance value could be channeled into Community Benefit Funds (CBFs) that support reductions in emissions of GHGs and co-pollutants, investment in adaptations to climate change, and other environmental improvements in disadvantaged communities. The identification of eligible communities can build upon CARB's work to develop measures of cumulative environmental impacts and community vulnerability. An additional source of revenue for CBFs could be created by introducing a co-pollutant surcharge on GHG emissions in communities heavily burdened by air pollution, a step that would also strengthen incentives for emission reductions in these locations.[67]

Public Transit and Land Use Planning

Expanding both the extent of public transit systems and the frequency and reliability of public transit are beneficial for meeting California's climate goals. Public transit, like all aspects of our transportation system, does not rely entirely, or even significantly, on the private market.[68] Recent State budget cuts and sharp declines in sales and property taxes have taken a severe toll on California's

Comment [LG30]: Steve Levy recommends we devote more text to this investment option, to consider specific options more.

Comment [LG31]: Steve Levy had some comments on this that I haven't yet had time to address.

[64] According to research carried out by Collaborative Economics for Next 10 and the California Economic Strategy Panel, the Green Economy consists of fifteen segments ranging from energy generation, storage, and infrastructure to energy efficiency to specialized manufacturing, advanced materials, green building, and finance and investment.

[65] For instance, AB32 requires CARB, to the extent feasible, to "direct public and private investment toward the most disadvantaged communities in California," Cal. Health and Safety Code §38565; "ensure that activities undertaken to comply with the regulations do not disproportionately impact low-income communities," Cal. Health and Safety Code §38562(b)(2); and consider "direct, indirect, and cumulative impacts from these mechanisms, including localized impacts in communities that are already adversely impacted by air pollution;" Cal. Health and Safety Code § 38750(b)(1).

[66] AB 32 requires CARB to design GHG reduction measures in a manner that "maximizes additional environmental and economic co-benefits for California, and complements the state's efforts to improve air quality." Cal. Health and Safety Code §38501(h).

[67] See Appendix to this Report on "Investment in Disadvantaged Communities."

[68] The overwhelming majority of transit operating funding comes from local sales and parcel taxes (roughly 60%) and fare box revenues (roughly 20%). Federal grants make up some of the difference. The Legislature recently completely eliminated the State Transit Assistance program, which also contributed to operations

transit agencies.[69] Despite increasing ridership, transit agencies are forced to cut service and raise fares, both of which dissuade transit riders and limit transit's potential to address climate change. Similarly, investing in land use planning and implementation of CARB-approved SB 375 Sustainable Communities Strategies (SCS) could allow local governments to structure communities more efficiently; for example, by better integrating residential and commercial zoning to reduce the amount of driving necessary to access daily needs. Outdated and unwieldy local plans often block the market demand for higher density, which would in turn lead to reduced greenhouse gas emissions and a variety of other benefits. Using allowance revenue to allow regions to create SCS plans and local governments to update their general plans and zoning to implement the SCS plans can remove these barriers and ensure that developers can create communities that reduce per capita transportation related greenhouse gas emissions.

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Financing Agencies To Ensure That They Can Fully Implement AB 32

Another way in which allowance value could be used to quickly capture low-cost reduction opportunities is to ensure that state, regional, and local agencies have the staff resources they need to effectively implement all of the reduction strategies described in the Scoping Plan. The Scoping Plan recognizes that there are many cost-effective opportunities to reduce GHG emissions, and lays out various regulatory strategies for capturing them. However, some of the agencies tasked with implementing these strategies might be understaffed, and auction revenue could ensure that they have the resources they need.

First, CARB could use additional laboratory/technical support to implement its heavy-duty diesel equipment rules.[70] The agency might also benefit from having a Chief Economist (parallel to its Chief Counsel), to reflect the significance of economic criteria in meeting its AB 32 responsibilities.

Second, a substantial portion of the carbon reductions that are included in the AB 32 Scoping Plan is within the CPUC's jurisdiction.[71]Yet the CPUC has been unable to increase AB 32 staff support

[69] Transportation for America, et al, "Stranded at the Station, The Impact of the Financial Crisis in Public Transportation, August 2009, http://t4america.org/resources/stranded/. California Transit Association, STA Program Aftermath, http://tiny.cc/xBwzW.

[70] Cleaner diesels trucks, locomotives, and construction equipment produce substantially less CO2 than gasoline and clean diesel cars are an increasing share of the market and a plausible bridge to hybrid and fuel cell vehicles. CARB certifies new engines but knows very little about in-use emissions performance. The lab could also support an increasing CARB focus on black carbon, which is a large fraction of the soot in diesel exhaust and a short-lived but very potent GHG.

positions over the last three state budget cycles. This leaves the California PUC today with fewer staff dedicated to clean energy initiatives (35) than the New York Public Service Commission (40), even though California's initiatives are more than double the size of New York's as measured in dollars and megawatt-hours (and the CPUC total staff of about 1000 is two and a half times New York's 400).

Third, California has a strong statewide building code that sets minimum efficiency levels for new construction. However, the code is enforced by local agencies that often do not have sufficient capacity. Ensuring that these agencies are fully staffed and that the state is simply meeting the codes that are already in place could result in significant cost-effective savings.

Finally, according to a League of California Cities survey of likely SB 375 implementation costs, regions will need $20 to $60 million over the first 2-3 years of implementation to improve models, run alternative development scenarios, fund public participation and other activities.[72]

Investment in Adaptation

Many in the state's public and private sectors are or will be affected by climate change over the coming decades. For example, the state is the world's 5th largest supplier of food and agricultural commodities, representing over $36 billion in revenues (2007) for the state.[73] Other key affected sectors include: construction, coastal and land management, education, public health, emergency management and public safety services, energy, engineering services, forestry, fisheries, parks and recreation, insurance, healthcare and health related services, real estate, textiles, tourism, transportation, telecommunications, utilities, water management, and more.

The California Resources Agency and eight other state departments spent almost a year compiling what is now the California Climate Adaptation Strategy Discussion Draft;[74] providing the best available science and recommendations for state agencies to address climate change impacts to seven of the state's sectors (agriculture, biodiversity, forestry, oceans and coastal, public health, water, and transportation and energy infrastructure). The report promoted planning to adapt to changes anticipated from climate change. For example, assuming a 55-inch rise in sea levels, the report identified nearly half a million people, $100 billion in property, and $46 billion in the coastal-dependent economy would be at risk.[75] However, the relevant agencies lack the necessary funding to actually implement the report's recommendations. Additionally, adaptive actions are needed from entities other than state departments or agencies, including local governments and communities, the private

[71] These include energy efficiency, renewables (including the solar initiative), and combined heat and power policy. Together this represents about 40% of the reductions in the Scoping Plan. Cap-and-trade, which will be dominated in the early years at least by the electric and gas sectors, accounts for an additional 20%. This leaves the CPUC with significant oversight and implementation responsibilities for more than half of the anticipated reductions in California's greenhouse gas emissions.

[72] The California Council of Governments estimates the costs to regions at $10 million annually after this start up period. The League of California Cities' survey estimated the cost of bringing all California general plans up to date and consistent with the SCS at $500 million, with an additional $50 million required annually for ongoing updates.

[73] California Department of Food and Agriculture, Agricultural Statistical Review for 2007, http://www.cdfa.ca.gov/statistics/files/CDFA_Sec2.pdf

[74] California Natural Resources Agency, California Climate Adaptation Strategy Discussion Draft ("California Adaptation Strategy"), posted August 3, 2009, http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-D.PDF.

[75] California Adaptation Strategy, p.64.

sector, and individuals. In addition, solutions and support for adaptation efforts across the state will not come exclusively from the state government, but from academia, other states and countries, the private sector and other public and non-profit entities. Resources are needed to provide more localized science and modeling tools on impacts, sector-specific and cross-sector applied research, technology and innovations for solutions to mitigate impacts, tools for adaptation planning and on-going learning, and the expertise required to analyze, develop, implement and/or monitor adaptive options. There is also a need to coordinate activities across the state's agencies as well as across sectors and regions within the state.

In addition to adaptation to the effects of climate change, allowance value could be invested in the provision of ecological services including biological carbon sequestration. This would provide a way to support agricultural, forestry and soil conservation practices that reduce net GHG emissions by removing carbon dioxide from the atmosphere, without necessarily relying on offsets to fund these investments.

5.4.3 Comparing the Investment Options

Investment options should be compared and prioritized based on how well they meet the objectives of AB 32. EAAC has identified four criteria for evaluating the use of allowance value that are rooted in the language of AB 32 as follows:

- **Cost-effectiveness:**
  - "shall . . . achieve the maximum technologically feasible and cost-effective greenhouse gas emission reductions" (§38562(a))
  - "encourage early action to reduce greenhouse gas emissions" (§38562(b)(1))
- **Fairness:**
  - "equitable" (§38562(b)(1))
  - "do not disproportionately impact low-income communities" (§38562(b)(2))
  - "direct public and private investment toward the most disadvantaged communities in California and provide an opportunity for small businesses, schools, affordable housing associations, and other community institutions to participate in and benefit from statewide efforts to reduce greenhouse gas emissions." (§38565)
- **Environmental effectiveness:**
  - "complement the state's efforts to improve air quality" (§38501(h)) and "reduce toxic air contaminant emissions" (§38562(b)(4); see also §38570 (b)(2))
  - "minimize costs and maximize the total benefits to California" (§38562(b)(1); see also §38501(h))
  - "maximize additional environmental and economic co-benefits for California" (§38501(h) and 38570 (b)(3))
- **Simplicity:**
  -

Figure 4 below uses the EAAC criteria and the language of AB 32 to rate and compare the above investment options. The table makes clear that many of these investment options meet all four criteria.

Evaluating Investment Options	Cost-Effectiveness		Fairness		Environmental Effectiveness		Simplicity	
	Non-price Market barriers ?	**Spurs early action ?**	**Equitable ?**	**Lessens impact on low-income ?**	**Improves local air quality?**	**Other envt'l and economic co-benefits ?**	**Agency has existing program?**	**Able to use more funds ?**
Public Transit	**high**	**high**	**high**	**high**	**high**	**high**	City and county	**high**
Implementation of Regional Plans	**high**	**high**	**high**	**high**	**high**	**high**	City and county	**high**
Disadvantaged Communities	**high**	**high**	**high**	**high**	**high**	**high**	Local jurisdictions	**high**
Low-Income EE	**high**	**high**	**high**	**high**	med	med	CPUC / CEC / POUs	med
Industrial EE	med	med	low	low	**high**	med	*CARB (voluntary) / CPUC*	med
Green Jobs Training	low	med	**high**	**high**	low	**high**	Comm'ty Colleges	**high**
RD&D	**high**	low	low	low	low	**high**	PIER / University Centers	low